FCC/ISED RF TEST REPORT

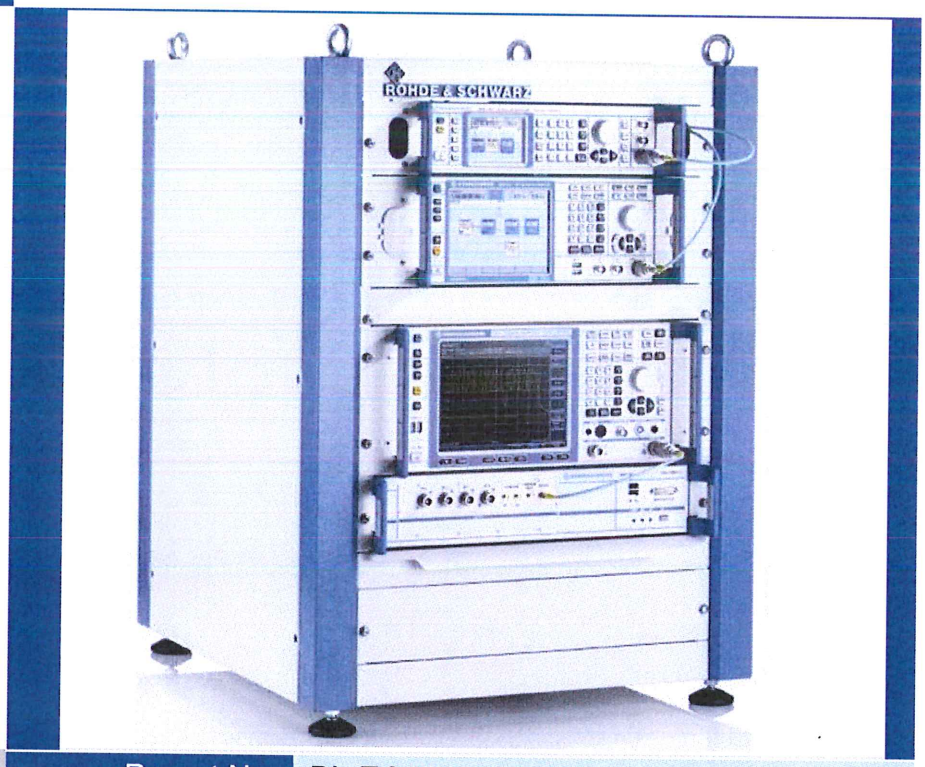
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Personal Ground Station

ISSUED TO
Yuneec Technology Co., Limited

Unit 2301, 23/F, 9 Chong Yip Street, Kwun Tong, Kowloon, Hong Kong.



Report No.:	BL-EC2060327-603
EUT Name:	Personal Ground Station
Model Name:	ST16E
Brand Name:	YUNEECS
Test Standard:	47 CFR Part 15 Subpart E RSS-Gen (Issue 5, March 2019) RSS-247 (Issue 2, February 2017)
FCC ID:	2ACS5-ST16E
ISED Number:	11554B-ST16E
Test Conclusion:	Pass
Test Date:	Jun. 28, 2020 ~ Jul. 16, 2020
Date of Issue:	Jul. 17, 2020

Prepared by: Ye Hongji
Ye Hongji
Date Jul. 17 2020

Approved by: Liao Jianming
(Technical Director)
Date Jul. 17, 2020

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Jul. 14, 2020	Initial Issue
Rev. 02	Jul. 17, 2020	Added test data on Annex A

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory is a testing organization accredited by American Association for Laboratory Accreditation(A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20℃ to 25℃
Ambient Relative Humidity	45% to 55%
Ambient Pressure	100 kPa to 102 kPa

1.4 Announce

(1) The test report reference to the report template version v4.4.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

(7) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2 PRODUCT INFORMATION

2.1 Applicant

Applicant	Yuneec Technology Co., Limited
Address	Unit 2301, 23/F, 9 Chong Yip Street, Kwun Tong, Kowloon, Hong Kong.

2.2 Manufacturer

Manufacturer	Yuneec International (China) Co., Ltd.
Address	No.388 East Zhengwei Road, Jinxi Town, Kunshan, Jiangsu 215324, China

2.3 Factory

Factory	Yuneec International (China) Co., Ltd.
Address	No.388 East Zhengwei Road, Jinxi Town, Kunshan, Jiangsu 215324, China

2.4 General Description for Equipment under Test (EUT)

EUT Name	Personal Ground Station
Model Name Under Test	ST16E
Series Model Name	N/A
Description of Model name differentiation	N/A
Serial Number	CAFBB22A09805012
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Technical Information

Network and Wireless connectivity	2.4G WIFI 802.11b, 802.11g, 802.11n 5G WIFI 802.11a 2.4G ISM Band (OFDM modulation), GPS

The requirement for the following technical information of the EUT was tested in this report:

Frequency Range	Band IV: 5725 MHz to 5850 MHz
Product Type	☐ Mobile ☒ Portable ☐ Fix Location
Modulation technology	OFDM
Modulation Type	64QAM, 16QAM, BPSK, QPSK
Transfer Rate (Mbps)	802.11a: 54/ 48/ 36 / 24 / 18/12 / 9/ 6 Mbps
Channel Bandwidth	802.11a: 20 MHz
Maximum Output Power	17.50 dBm
Antenna Type	Omni-directional Antenna
Antenna Gain	-3.48 dBi
About the Product	The equipment is Personal Ground Station, intended for used with information technology equipment.
Note: This value of antenna gain is provided by the applicant.	

2.6 Additional Instructions

EUT Software Settings:

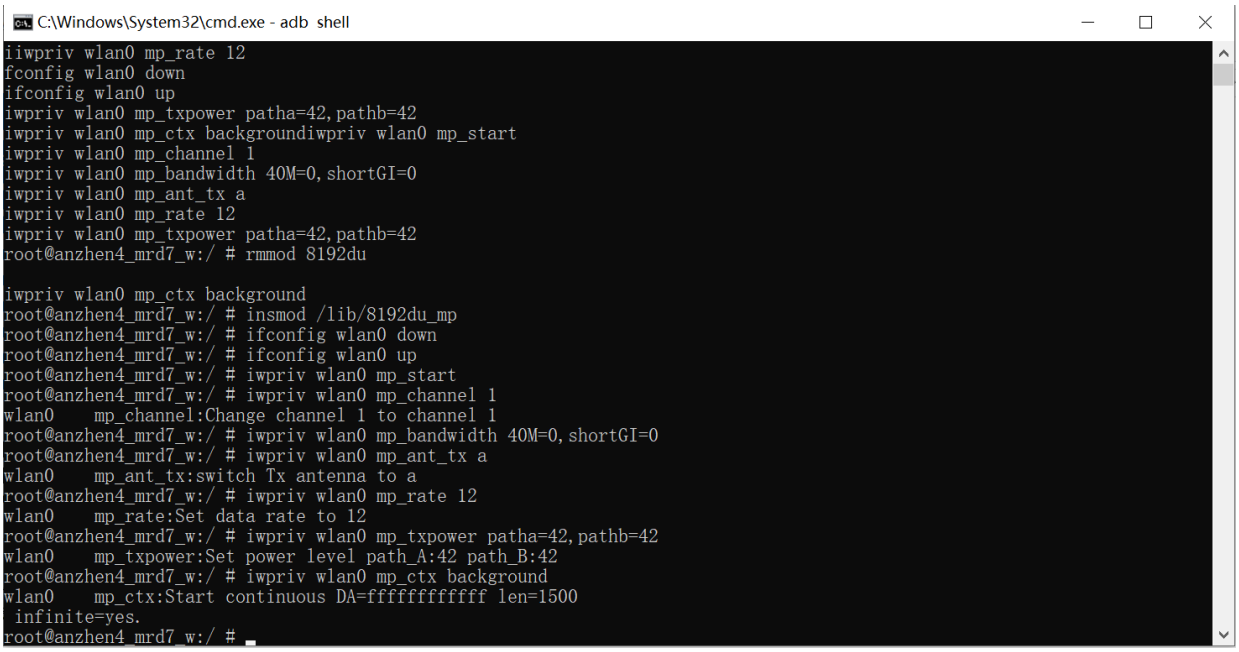
Mode	☒ Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test Software Version	ADB		
Support Units (Software installation media)	Description	Manufacturer	Model
	Notebook	Lenovo	K43c-80

Band IV (5725 - 5850 MHz) Power level setup in software			
Mode	Channel	Frequency (MHz)	Soft Set
11a	CH149	5745	27
11a	CH157	5785	27
11a	CH165	5825	27

Run Software



2.7 Channel List

20 MHz	
Channel Number	Frequency (MHz)
149	**5745**
153	5765
157	**5785**
161	5805
165	**5825**

The Lowest frequency, the middle frequency and the highest frequency of channel were selected to perform the test, and the selected channel see below:

For 802.11a

Band IV (5725 - 5850 MHz)		
Channel Number	Channel	Frequency (MHz)
149	Low	5745
157	Mid	5785
165	High	5825

Note: Preliminary tests were performed in different data rate in above table 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	Modulation Type	Band IV Channel
RF Output Power	11a	6	BPSK	165/157/149
Emission Bandwidth & 99% Occupied Bandwidth	11a	6	BPSK	165/157/149
6 dB bandwidth	11a	6	BPSK	165/157/149
Power Spectral Density	11a	6	BPSK	165/157/149
Radiated Spurious Emissions	11a	6	BPSK	165/157/149
Band Edge (Restricted-band)	11a	6	BPSK	165/157/149

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15 Subpart E (10-1-16 Edition)	Unlicensed National Information Infrastructure Devices
2	KDB Publication 789033 D02v02r01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
4	RSS-Gen (Issue 5, Mar. 2019)	General Requirements for Compliance of Radio Apparatus
5	RSS-247 (Issue 2, February 2017)	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices
6	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	RSS Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	RSS-247, 6.2	--	Pass
2	RF Output Power	15.407(a)	RSS-247, 6.2	ANNEX A.1	Pass
3	Emission Bandwidth & 99% Occupied Bandwidth	15.407(a)	RSS-247, 6.2	ANNEX A.2	Pass
4	6 dB bandwidth	15.407(e)	RSS-247, 6.2	ANNEX A.3	Pass
5	Power Spectral Density	15.407(a)	RSS-247, 6.2	ANNEX A.4	Pass
6	Conducted Emission	15.207	RSS-GEN, 8.8	ANNEX A.5	Pass
7	Radiated Spurious Emissions and Band Edge (Restricted-band)	15.407(b)	RSS-247, 6.2	ANNEX A.6	Pass
8	Receiver Spurious Emissions	--	RSS-Gen, 7.1.2	--	N/A[Note3]

Note [1]: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note [2]: Only radio communication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, so this test is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

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

Relative Humidity	45% to 55%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+22℃ to +25℃
Working Voltage of the EUT	NV (Normal Voltage)	3.6 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2020.06.08	2021.06.07
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2020.06.08	2021.06.07
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2020.06.09	2021.06.08
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2020.06.09	2021.06.08
LISN	SCHWARZBECK	NSLK 8127	8127-687	2020.06.09	2021.06.08
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2020.06.08	2021.06.07
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2020.06.08	2021.06.07
Power Splitter	KMW	DCPD-LDC	1305003215	--	--
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2020.06.08	2021.06.07
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	--	--
Temperature Chamber	AHK	SP20	1412	2020.06.10	2021.06.09
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2017.11.09	2020.11.08
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2018.08.22	2020.08.21
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2019.07.22	2021.07.21
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	2019.01.06	2021.01.05
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2017.02.21	2022.02.20
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	N/A	2018.08.08	2021.08.07
Shielded Enclosure	ChangNing	CN-130701	130703	--	--
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2020.06.08	2021.06.07
Power Amplifier	OPHIR RF	5225F	1037	2020.02.19	2021.02.18
Power Amplifier	OPHIR RF	5273F	1016	2020.02.19	2021.02.18
Directional Coupler	Werlantone	C5982-10	109275	N/A	N/A
Directional Coupler	Werlantone	CHP-273E	S00801z-01	N/A	N/A
Sound Level Meter	B&K	NL-20	00844023	2019.11.12	2020.11.11
Ear Simulator	B&K	4185	2409449	2019.11.12	2020.11.11
Ear Simulator	B&K	4195	2418189	2019.11.12	2020.11.11
Audio analyzer	B&K	UPL 16	100129	2019.11.12	2020.11.11

4.3 Measurement Uncertainty

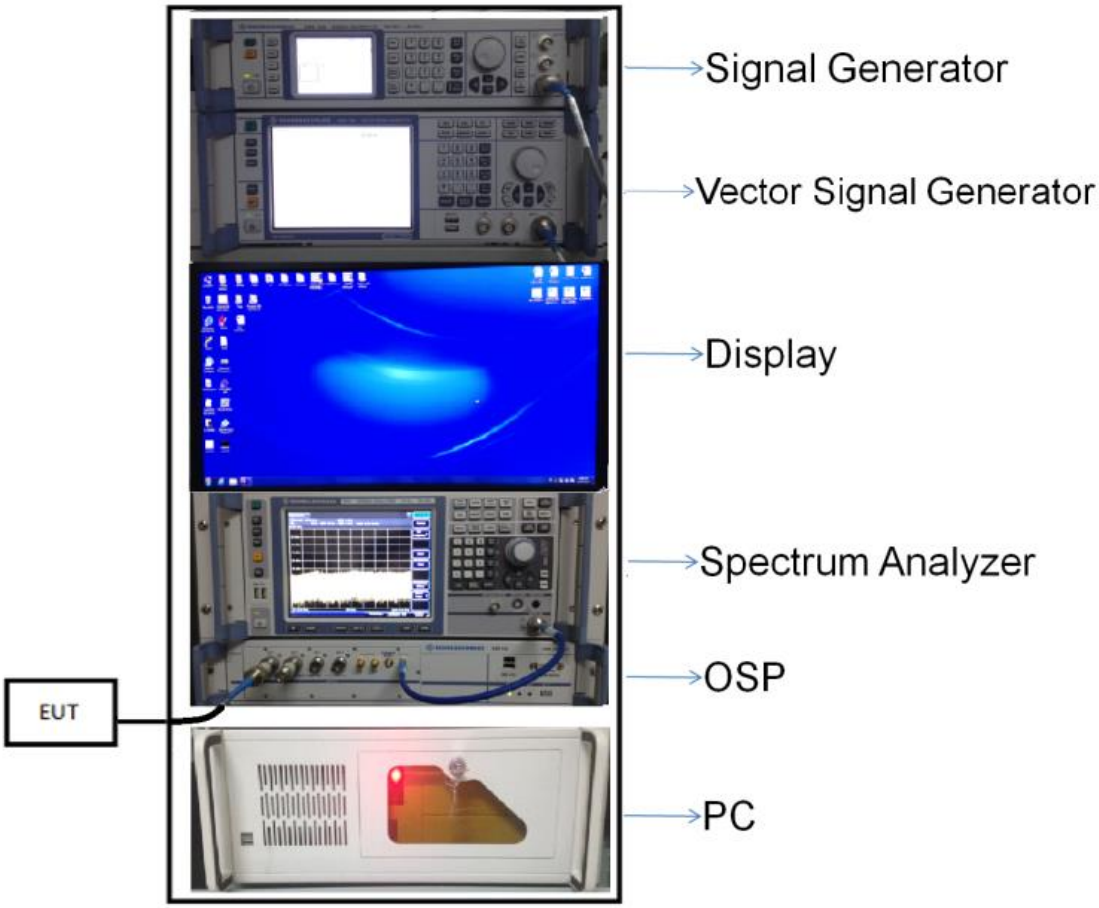
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

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

Measurement	Value
Occupied Channel Bandwidth	±4%
RF output power, conducted	±1.4 dB
Power Spectral Density, conducted	±2.5 dB
Unwanted Emissions, conducted	±2.8 dB
All emissions, radiated	±5.4 dB
Temperature	±1°C
Humidity	±4%

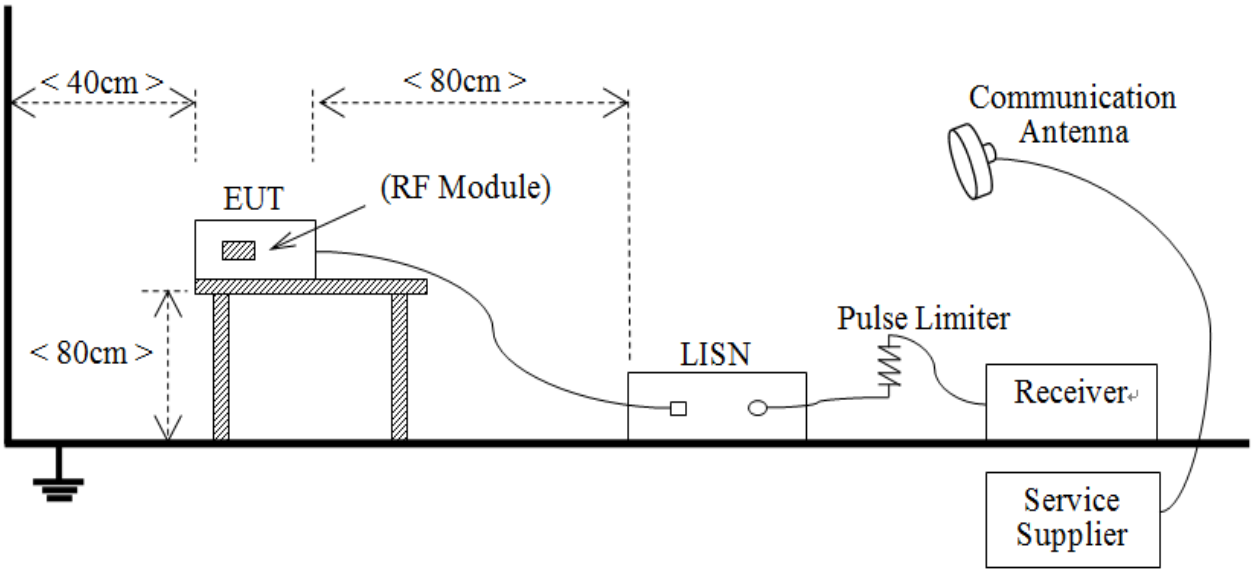
4.4 Description of Test Setup

4.4.1 For Antenna Port Test



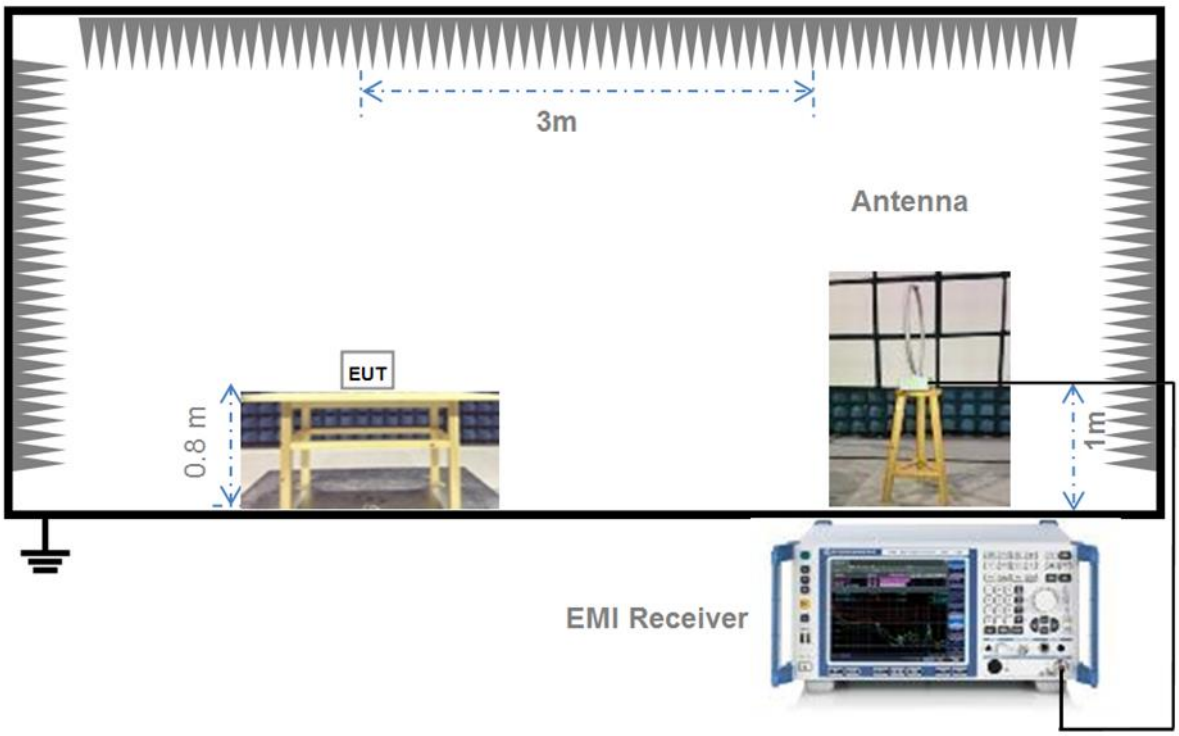
(Diagram 1)

4.4.2 For AC Power Supply Port Test



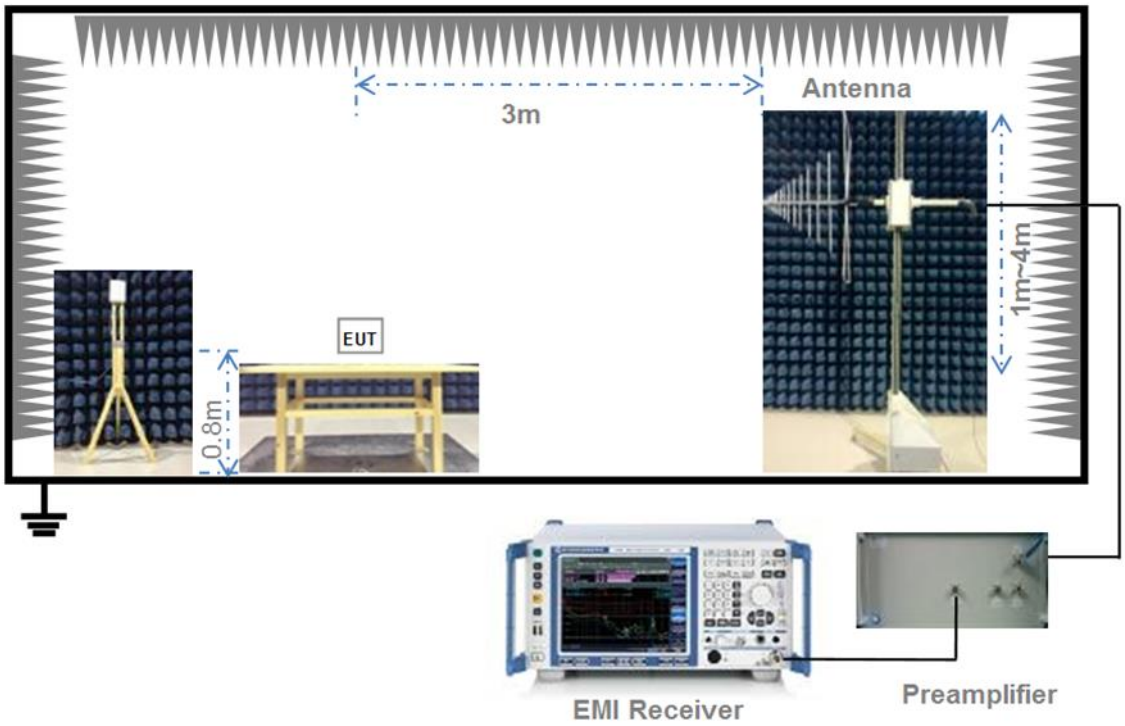
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



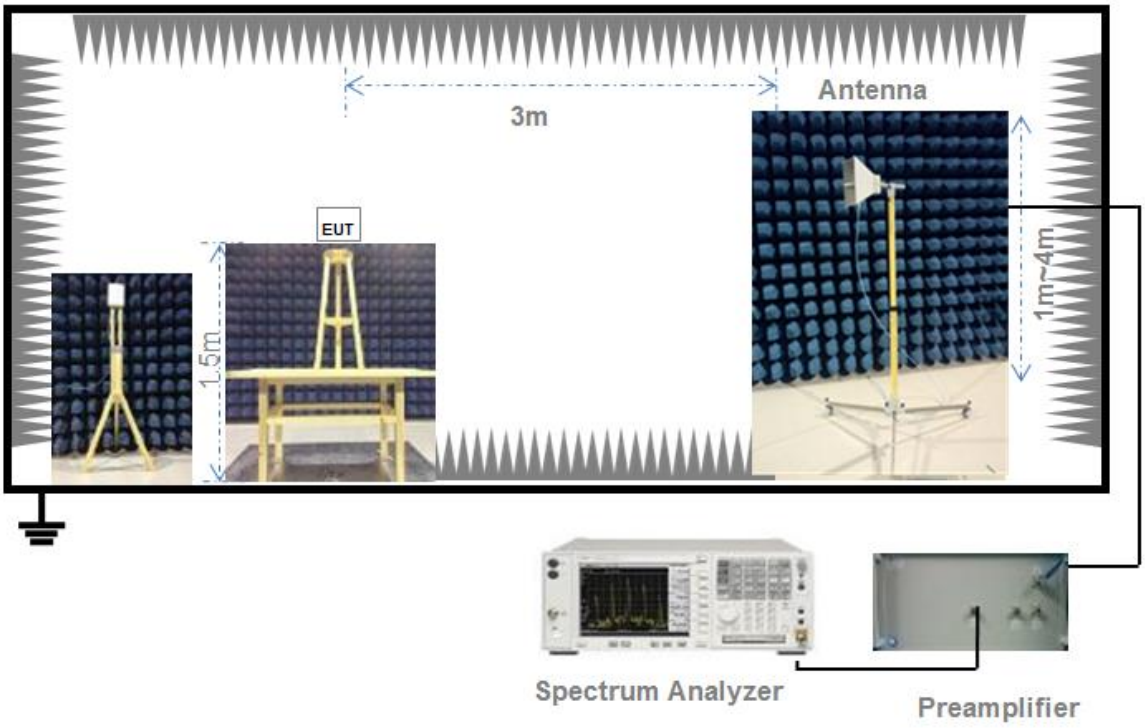
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

5 TEST ITEMS

5.1 RF Output Power

5.1.1 Test Limit

FCC §15.407(a)

The maximum conducted output power should not exceed:

Frequency Band (MHz)	Limit
5150-5250	250 mW
5250-5350	250 mW or 11 dBm + 10log B, whichever is less.
5470-5725	250 mW or 11 dBm + 10log B, whichever is less.
5725-5850	1 W
Note: Where “B” is the 26 dB emissions bandwidth in MHz.	

RSS-247, 6.2

The maximum conducted output power shall not exceed:

Frequency Band (MHz)	Limit
5150-5250	N/A
5250-5350	250 mW or 11 dBm + 10log B, whichever is less.
5470-5725	250 mW or 11 dBm + 10log B, whichever is less.
5725-5850	1 W
Note: Where “B” is the 99% emissions bandwidth in MHz.	

The maximum e.i.r.p. shall not exceed:

Frequency Band (MHz)	Limit
5150-5250	200 mW or 10 dBm + 10log B, whichever is less.
5250-5350	1W or 17 dBm + 10log B, whichever is less.
5470-5725	1W or 17 dBm + 10log B, whichever is less.
5725-5850	N/A
Note: Where “B” is the 99% emissions bandwidth in MHz.	

5.1.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.3 Test Procedure

The maximum peak conducted output power may be measured using a broadband Average RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the emission bandwidth and utilize a fast-responding diode detector.

The E.I.R.P used radiated test method. At a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment.

5.1.4 Test Result

Please refer to ANNEX A.1.

5.2 Emission Bandwidth and 6 dB Bandwidth

5.2.1 Limit

FCC §15.407(a), RSS-247, 6.2

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

5.2.2 Test Setup

The test setup photo please refer to 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

Emission bandwidth

1. Set RBW = approximately 1% of the emission bandwidth.

2. Set VBW ≥ 3*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.

Occupied Bandwidth

1. Set Span = 1.5 times to 5.0 times the OBW

2. Set RBW = 1% to 5% of the OBW.

3. Set VBW ≥ 3*RBW, Detector = Peak.

4. Trace mode = Max hold.

5. Use the 99% power bandwidth function of the instrument.

6 dB bandwidth

1. Set RBW = 100 kHz, VBW = 300 kHz.

2. Detector = Peak.

3. Trace mode = Max hold.

4. Allow the trace to stabilize.

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.

5.2.4 Test Result

Please refer to ANNEX A.2 and ANNEX A.3.

5.3 Power Spectral density (PSD)

5.3.1 Limit

FCC §15.407(a)

The maximum power spectral density should not exceed:

Frequency Band (MHz)	Limit
5150-5250	11 dBm/MHz
5250-5350	11 dBm/MHz
5470-5725	11 dBm/MHz
5725-5850	30 dBm/500kHz

RSS-247, 6.2

The maximum power spectral density should not exceed:

Frequency Band (MHz)	Limit
5150-5250	N/A
5250-5350	11 dBm/MHz
5470-5725	11 dBm/MHz
5725-5850	30 dBm/500kHz

The e.i.r.p. spectral density should not exceed:

Frequency Band (MHz)	Limit
5150-5250	10 dBm/MHz
5250-5350	N/A
5470-5725	N/A
5725-5850	N/A

5.3.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth.

1. Set RBW = 510 kHz/1 MHz, VBW ≥ 3*RBW, Sweep time = Auto, Detector = RMS.
2. Allow the sweeps to continue until the trace stabilizes.
3. Use the peak marker function to determine the maximum amplitude level.
4. The E.I.R.P spectral density used radiated test method. At a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment.

5.3.4 Test Result

Please refer to ANNEX A.4.

5.4 Conducted Emission

5.4.1 Limit

FCC §15.207, RSS-GEN, 8.8

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 150 kHz to 30 MHz 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
0.50 - 30	60	50

5.4.2 Test Setup

The section 4.4.2 (Diagram 2) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

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.

5.4.4 Test Result

Please refer to ANNEX A.5.

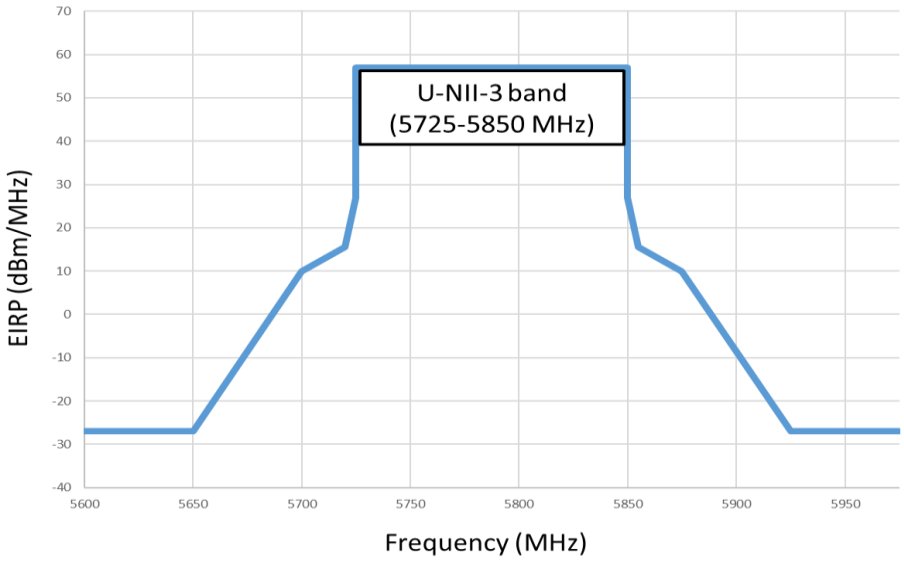
5.5 Radiated Spurious Emissions and Band Edge (Restricted-band)

5.5.1 Limit

FCC §15.209 & 15.407(b), RSS-247, 6.2

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 [1]: The Limit for radiated test was performed according to FCC Part 15C
Note [2]: The tighter limit applies at the band edge.

Un-restricted band emissions	
Out Operating Band (MHz）	Limit
5150 - 5250	e.i.r.p. -27 dBm (68.2 dBuV/m@3m)
5250 - 5350	e.i.r.p. -27 dBm (68.2 dBuV/m@3m)
5470 - 5725	e.i.r.p. -27 dBm (68.2 dBuV/m@3m)
5725 - 5850	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. 

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

5.5.2 Test Setup

The section 4.4.3-4.4.5 (Diagram 3 - Diagram 5) test setup description was used for this test. The photo of test

setup please refer to ANNEX B.

5.5.3 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$E = EIRP – 20\log D + 104.8$

where:

E = electric field strength in dBμV/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

f) Compare the resultant electric field strength level to the applicable limit.

g) Perform radiated spurious emission test.

Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 1.

b) VBW ≥ 3 x RBW.

c) Detector = Peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer for low duty cycle applications).

Table 1—RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.

c) RBW = 1 MHz (unless otherwise specified).

d) VBW ≥ 3 x RBW.

e) Detector = RMS, if span/(# of points in sweep) ≤ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

f) Averaging type = power (i.e., RMS).

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is 20 log(1/x), where

x is the duty cycle.

3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30 MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto

Detector function = peak
Trace = max hold

5.5.4 Test Result

Please refer to ANNEX A.6.

ANNEX A TEST RESULT

A.1 RF Output Power

Note [1]: For FCC standard, if transmitting antennas of directional gain greater than 6 dBi are used, all band maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
Note [2]: For IC standard, the band IV (5725 - 5850 MHz) maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Data
Conducted Power

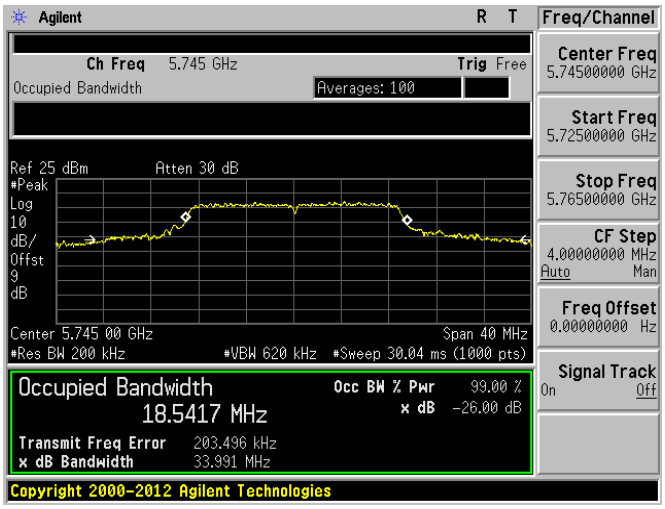
Band IV (5725 - 5850 MHz)						
Mode	Channel	Frequency (MHz)	Conducted Power (dBm)	Conducted Power (mW)	FCC/IC Limit (W)	Verdict
11a	CH149	5745	17.50	56.23	1.0	Pass
11a	CH157	5785	17.12	51.52	1.0	Pass
11a	CH165	5825	17.31	53.83	1.0	Pass

A.2 Emission Bandwidth & 99% Bandwidth

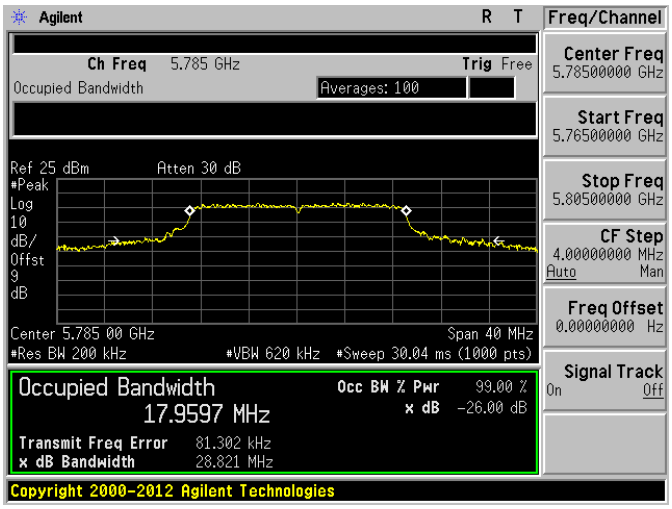
Band IV (5725 - 5850 MHz)				
Mode	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH149	5745	33.99	18.38
11a	CH157	5785	28.82	17.94
11a	CH165	5825	27.77	17.84

Test plots (26dB Bandwidth)

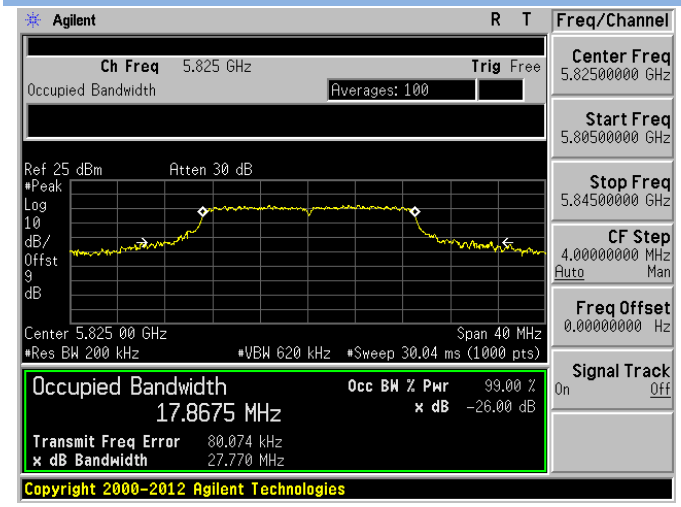
802.11a Band IV LOW CHANNEL



802.11a Band IV MIDDLE CHANNEL

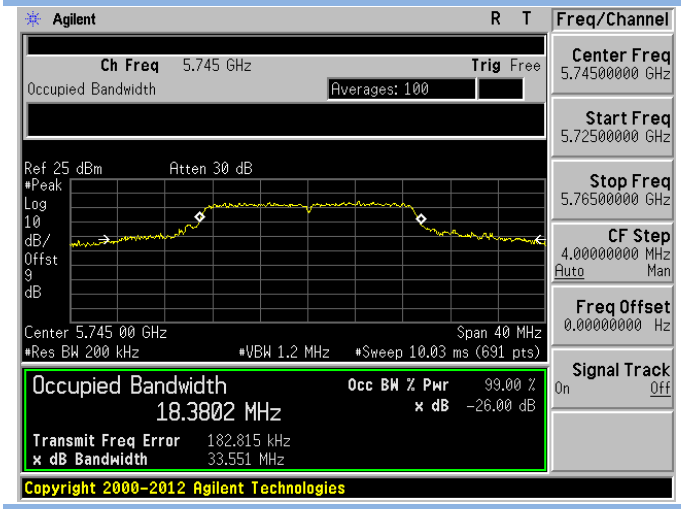


802.11a Band IV HIGH CHANNEL

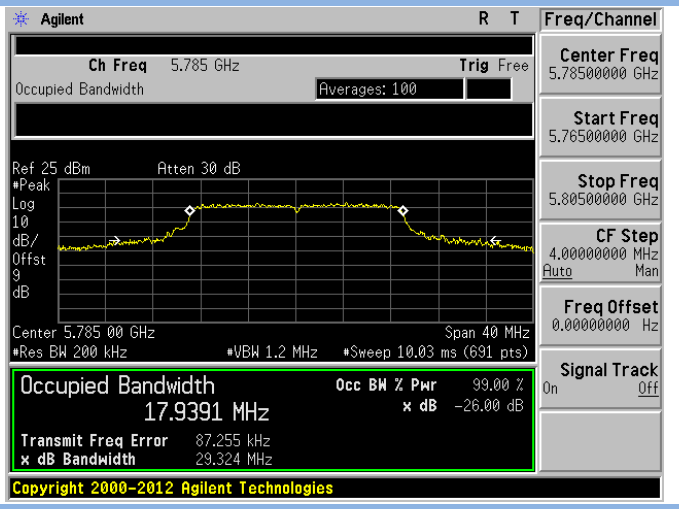


Test plots (99% Bandwidth)

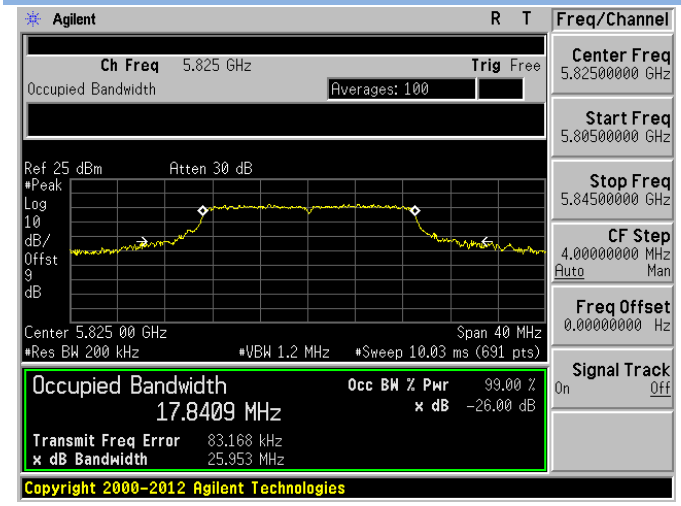
802.11a Band IV LOW CHANNEL



802.11a Band IV MIDDLE CHANNEL



802.11a Band IV HIGH CHANNEL



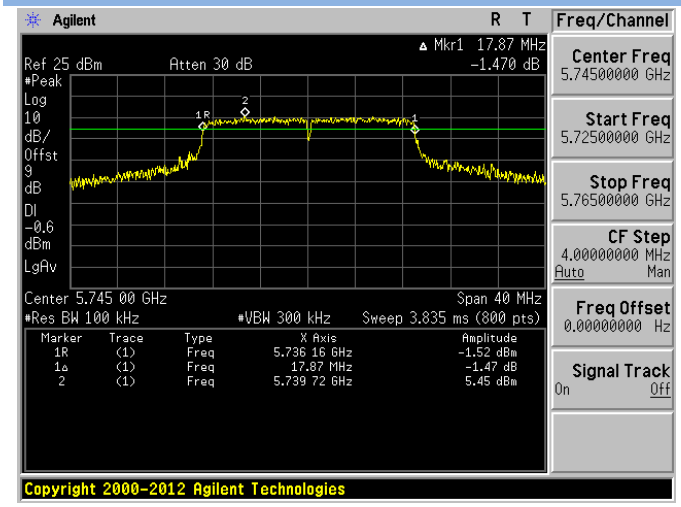
A.3 6 dB Bandwidth

Test Data

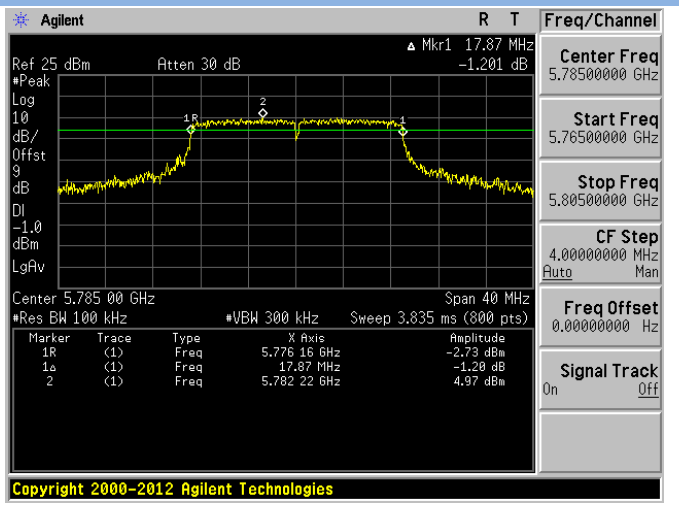
Band IV (5725 - 5850 MHz)					
Mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (kHz)	Verdict
11a	CH149	5745	17.87	500	Pass
11a	CH157	5785	17.87	500	Pass
11a	CH165	5825	17.77	500	Pass

Test plots

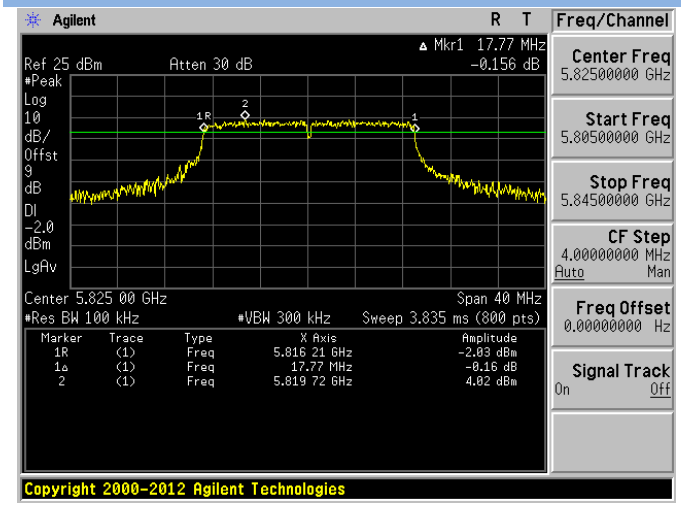
802.11a Band IV LOW CHANNEL



802.11a Band IV MIDDLE CHANNEL



802.11a Band IV HIGH CHANNEL



A.4 Power Spectral Density

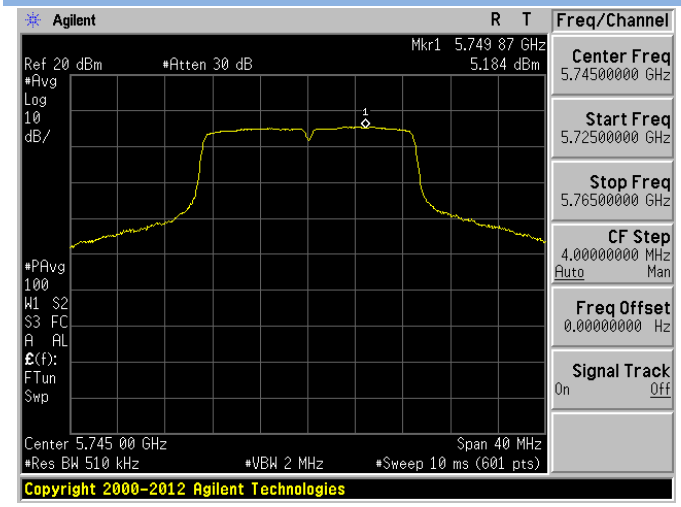
Test Data

Band IV (5725 - 5850 MHz)					
Mode	Channel	Frequency (MHz)	PSD (dBm/MHz)	FCC/IC Limit (dBm/500kHz)	Verdict
11a	CH149	5745	5.18	30	Pass
11a	CH157	5785	4.68	30	Pass
11a	CH165	5825	3.40	30	Pass

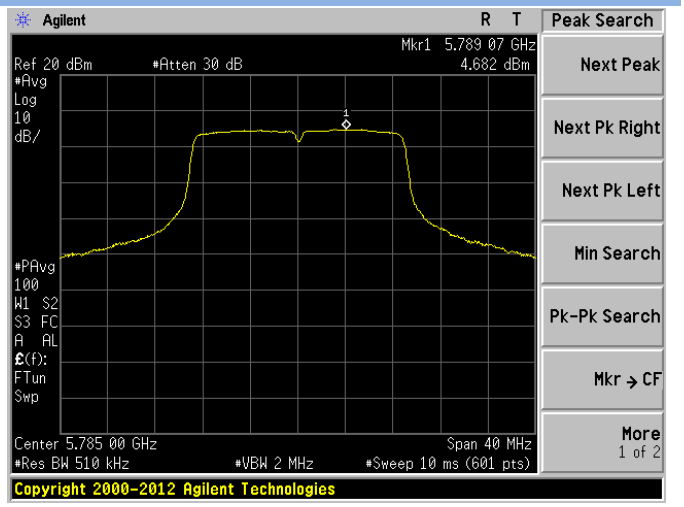
Note: The RBW used in Band IV is 510 kHz, and the PSD factor is: 10*log (500 kHz/RBW) = -0.09 dBm.

Test plots

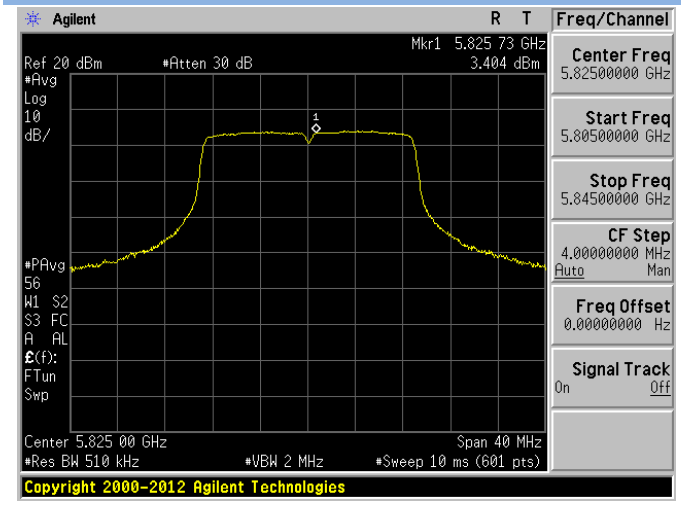
802.11a Band IV LOW CHANNEL



802.11a Band IV MIDDLE CHANNEL

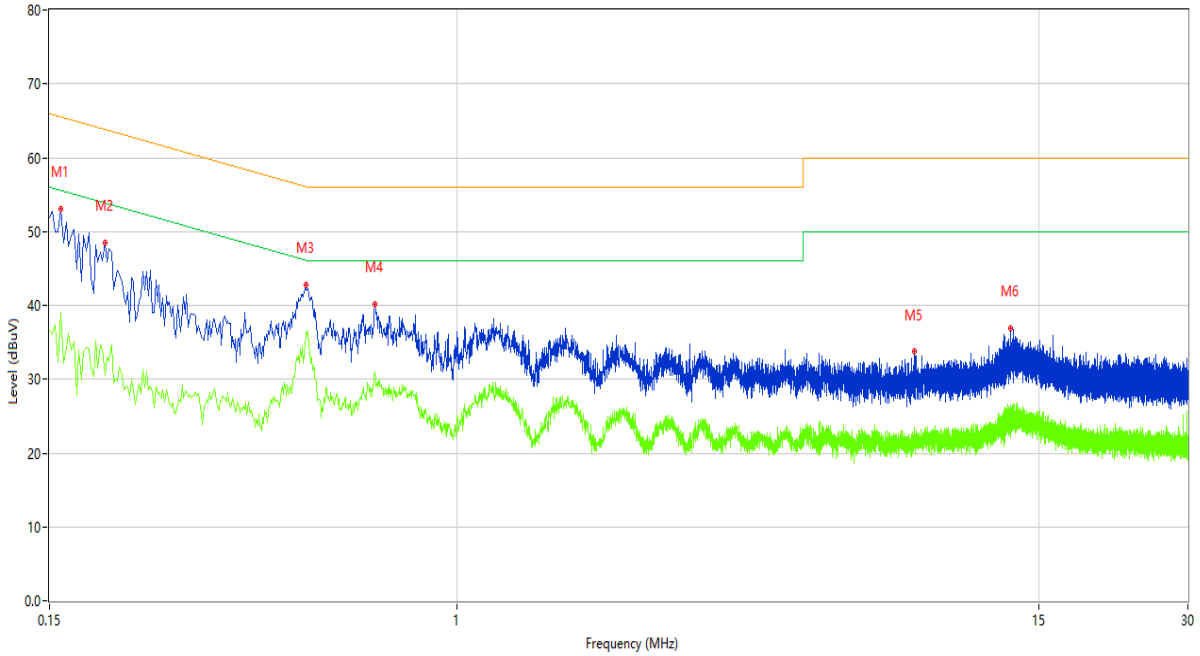


802.11a Band IV LOW CHANNEL



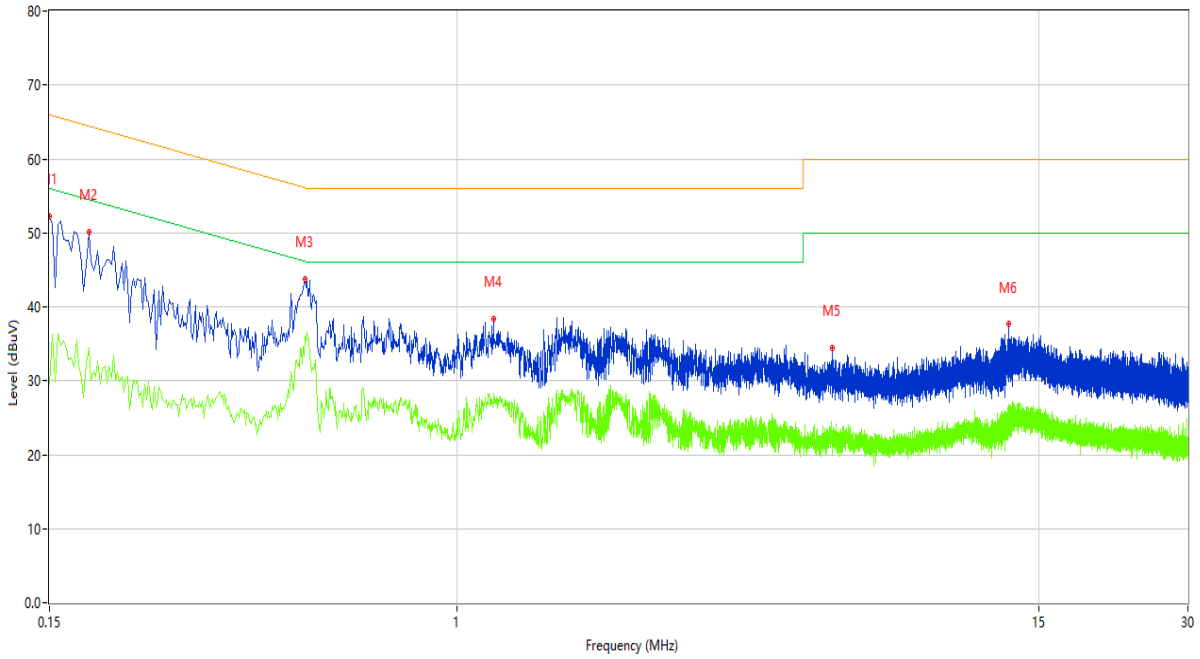
A.5 Conducted Emissions

L Line



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1*	0.158	50.49	11.12	65.57	-15.08	Peak	L	Pass
1**	0.158	39.04	11.12	55.57	-16.53	AV	L	Pass
2*	0.194	45.38	11.21	63.86	-18.48	Peak	L	Pass
2**	0.194	30.54	11.21	53.86	-23.32	AV	L	Pass
3*	0.494	40.32	11.11	56.10	-15.78	Peak	L	Pass
3**	0.494	35.80	11.11	46.10	-10.30	AV	L	Pass
4*	0.682	35.04	11.20	56.00	-20.96	Peak	L	Pass
4**	0.682	30.98	11.20	46.00	-15.02	AV	L	Pass
5*	8.400	24.32	11.06	60.00	-35.68	Peak	L	Pass
5**	8.400	22.96	11.06	50.00	-27.04	AV	L	Pass
6*	13.126	30.44	11.13	60.00	-29.56	Peak	L	Pass
6**	13.126	25.96	11.13	50.00	-24.04	AV	L	Pass

N Line



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1*	0.150	50.54	11.16	66.00	-15.46	Peak	N	Pass
1**	0.150	29.63	11.16	56.00	-26.37	AV	N	Pass
2*	0.180	46.70	11.14	64.49	-17.79	Peak	N	Pass
2**	0.180	34.42	11.14	54.49	-20.07	AV	N	Pass
3*	0.492	40.72	11.11	56.13	-15.41	Peak	N	Pass
3**	0.492	35.92	11.11	46.13	-10.21	AV	N	Pass
4*	1.186	32.03	11.22	56.00	-23.97	Peak	N	Pass
4**	1.186	28.20	11.22	46.00	-17.80	AV	N	Pass
5*	5.742	25.36	11.19	60.00	-34.64	Peak	N	Pass
5**	5.742	23.25	11.19	50.00	-26.75	AV	N	Pass
6*	13.030	29.47	11.06	60.00	-30.53	Peak	N	Pass
6**	13.030	25.66	11.06	50.00	-24.34	AV	N	Pass

A.6 Radiated Spurious Emissions and Band Edge (Restricted-band)

Test Data

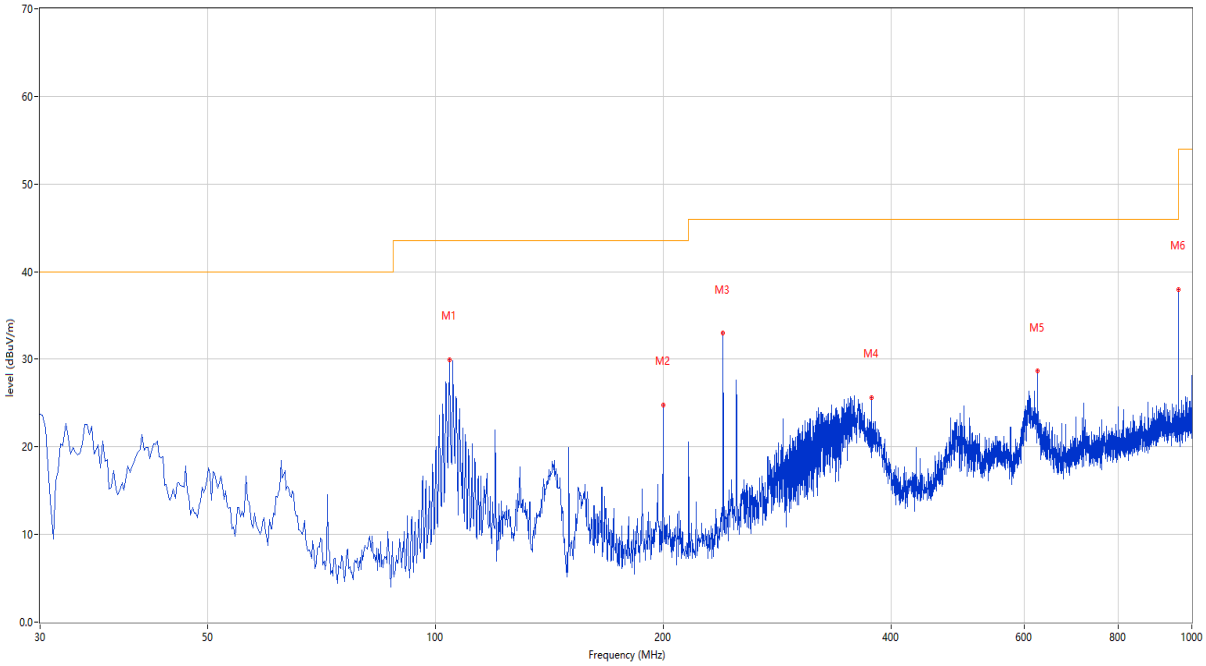
Note [1]: The symbol of "--" in the table which means not application.

Note [2]: For the test data above 1 GHz， According the ANSI C63.4, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [3]: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

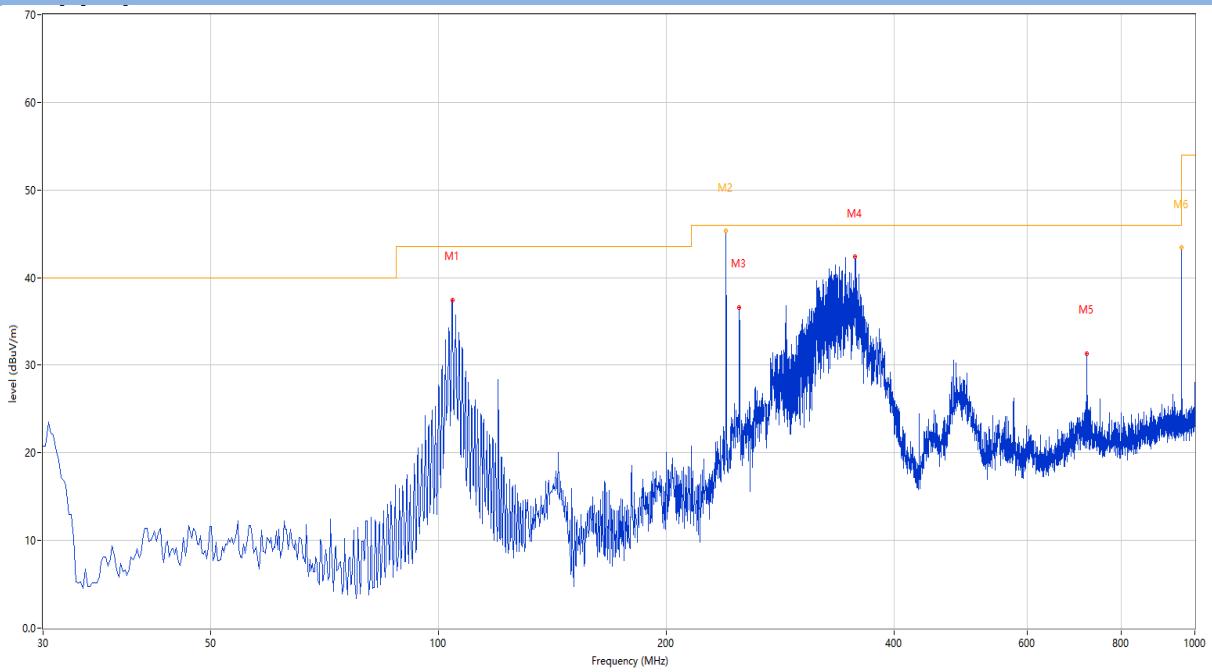
Note [4]: The EUT is working in the Normal link mode below 1 GHz.

30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	104.448	29.99	-25.66	43.5	-13.51	Peak	203.00	100	Vertical	Pass
2	199.992	24.82	-25.81	43.5	-18.68	Peak	321.00	100	Vertical	Pass
3	240.005	32.96	-24.75	46.0	-13.04	Peak	173.00	100	Vertical	Pass
4	376.775	25.58	-21.98	46.0	-20.42	Peak	350.00	100	Vertical	Pass
5	625.095	28.64	-16.06	46.0	-17.36	Peak	360.00	100	Vertical	Pass
6	959.987	37.97	-10.48	46.0	-8.03	Peak	203.00	100	Vertical	Pass

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	104.448	37.44	-25.66	43.5	-6.06	Peak	114.00	200	Horizontal	Pass
2	240.005	46.57	-24.75	46.0	0.57	Peak	207.00	104	Horizontal	N/A
2*	240.005	45.32	-24.75	46.0	-0.68	QP	207.00	104	Horizontal	Pass
3	249.947	36.62	-24.72	46.0	-9.38	Peak	207.00	100	Horizontal	Pass
4	355.678	42.34	-21.96	46.0	-3.66	Peak	261.00	100	Horizontal	Pass
5	719.912	31.32	-14.57	46.0	-14.68	Peak	59.00	100	Horizontal	Pass
6	960.022	45.69	-10.48	46.0	-0.31	Peak	113.00	100	Horizontal	N/A
6*	960.022	43.47	-10.48	46.0	-2.53	QP	113.00	100	Horizontal	Pass

Note 1: The spurious above 18GHz is noise only, do not show on the report.

1 GHz to 18 GHz, ANT V Band IV 11a Low channel

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1260.000	38.73	-16.22	68.2	-29.47	Peak	351.00	100	Vertical	Pass
1**	1260.000	28.78	-16.22	54.0	-25.22	AV	351.00	100	Vertical	Pass
2	2018.500	42.44	-14.21	68.2	-25.76	Peak	154.00	100	Vertical	Pass
2**	2018.500	25.22	-14.21	54.0	-28.78	AV	154.00	100	Vertical	Pass
3	5182.000	53.15	-1.93	68.2	-15.05	Peak	54.00	100	Vertical	Pass
3**	5182.000	44.49	-1.93	54.0	-9.51	AV	54.00	100	Vertical	Pass
4	5749.000	106.89	-0.72	68.2	38.69	Peak	140.00	100	Vertical	N/A
4**	5749.000	103.53	-0.72	54.0	49.53	AV	140.00	100	Vertical	N/A
5	11490.750	56.78	7.67	74.0	-17.22	Peak	147.00	100	Vertical	Pass
5**	11490.750	39.82	7.67	54.0	-14.18	AV	147.00	100	Vertical	Pass
6	14375.500	54.36	12.65	68.2	-13.84	Peak	42.00	100	Vertical	Pass
6**	14375.500	43.67	12.65	54.0	-10.33	AV	42.00	100	Vertical	Pass

1 GHz to 18 GHz, ANT H Band IV 11a Low channel

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1333.000	40.11	-15.91	74.0	-33.89	Peak	44.00	100	Horizontal	Pass
1**	1333.000	24.19	-15.91	54.0	-29.81	AV	44.00	100	Horizontal	Pass
2	2411.000	44.96	-11.83	68.2	-23.24	Peak	71.00	100	Horizontal	Pass
2**	2411.000	24.15	-11.83	54.0	-29.85	AV	71.00	100	Horizontal	Pass
3	2820.000	44.00	-9.17	74.0	-30.00	Peak	71.00	100	Horizontal	Pass
3**	2820.000	31.39	-9.17	54.0	-22.61	AV	71.00	100	Horizontal	Pass
4	5748.000	107.06	-0.75	68.2	38.86	Peak	160.00	100	Horizontal	N/A
4**	5748.000	102.85	-0.75	54.0	48.85	AV	160.00	100	Horizontal	N/A
5	11490.750	51.84	7.67	74.0	-22.16	Peak	347.00	100	Horizontal	Pass
5**	11490.750	39.73	7.67	54.0	-14.27	AV	347.00	100	Horizontal	Pass
6	14598.250	54.33	12.46	68.2	-13.87	Peak	190.00	100	Horizontal	Pass
6**	14598.250	44.60	12.46	54.0	-9.40	AV	190.00	100	Horizontal	Pass

1 GHz to 18 GHz, ANT V Band IV 11a MID channel

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1621.000	42.58	-16.40	74.0	-31.42	Peak	18.00	100	Vertical	Pass
1**	1621.000	32.33	-16.40	54.0	-21.67	AV	18.00	100	Vertical	Pass
2	2000.000	47.21	-14.12	68.2	-20.99	Peak	358.00	100	Vertical	Pass
2**	2000.000	32.03	-14.12	54.0	-21.97	AV	358.00	100	Vertical	Pass
3	2458.500	44.42	-11.79	68.2	-23.78	Peak	229.00	100	Vertical	Pass
3**	2458.500	30.86	-11.79	54.0	-23.14	AV	229.00	100	Vertical	Pass
4	5783.000	108.61	-1.21	68.2	40.41	Peak	159.00	100	Vertical	N/A
4**	5783.000	100.97	-1.21	54.0	46.97	AV	159.00	100	Vertical	N/A
5	10712.500	50.87	6.90	74.0	-23.13	Peak	141.00	100	Vertical	Pass
5**	10712.500	41.93	6.90	54.0	-12.07	AV	141.00	100	Vertical	Pass
6	14590.000	56.04	12.45	68.2	-12.16	Peak	77.00	100	Vertical	Pass
6**	14590.000	48.08	12.45	54.0	-5.92	AV	77.00	100	Vertical	Pass

1 GHz to 18 GHz, ANT H Band IV 11a MID channel

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1346.000	38.31	-15.65	74.0	-35.69	Peak	288.00	100	Horizontal	Pass
1**	1346.000	27.20	-15.65	54.0	-26.80	AV	288.00	100	Horizontal	Pass
2	2000.000	46.61	-14.12	68.2	-21.59	Peak	31.00	100	Horizontal	Pass
2**	2000.000	32.03	-14.12	54.0	-21.97	AV	31.00	100	Horizontal	Pass
3	2429.000	45.06	-12.37	68.2	-23.14	Peak	72.00	100	Horizontal	Pass
3**	2429.000	39.44	-12.37	54.0	-14.56	AV	72.00	100	Horizontal	Pass
4	5780.000	108.87	-1.18	68.2	40.67	Peak	31.00	100	Horizontal	N/A
4**	5780.000	102.11	-1.18	54.0	48.11	AV	31.00	100	Horizontal	N/A
5	11435.750	51.59	6.76	74.0	-22.41	Peak	69.00	100	Horizontal	Pass
5**	11435.750	42.65	6.76	54.0	-11.35	AV	69.00	100	Horizontal	Pass
6	14570.750	56.97	11.86	68.2	-11.23	Peak	194.00	100	Horizontal	Pass
6**	14570.750	47.06	11.86	54.0	-6.94	AV	194.00	100	Horizontal	Pass

1 GHz to 18 GHz, ANT V Band IV 11a HIGH channel

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1621.000	41.07	-16.40	74.0	-32.93	Peak	361.00	100	Vertical	Pass
1**	1621.000	33.46	-16.40	54.0	-20.54	AV	361.00	100	Vertical	Pass
2	2000.000	46.34	-14.12	68.2	-21.86	Peak	345.00	100	Vertical	Pass
2**	2000.000	33.71	-14.12	54.0	-20.29	AV	345.00	100	Vertical	Pass
3	2428.500	46.14	-12.37	68.2	-22.06	Peak	54.00	100	Vertical	Pass
3**	2428.500	40.44	-12.37	54.0	-13.56	AV	54.00	100	Vertical	Pass
4	5830.000	109.25	-0.89	68.2	41.05	Peak	158.00	100	Vertical	N/A
4**	5830.000	101.83	-0.89	54.0	47.83	AV	158.00	100	Vertical	N/A
5	10822.500	51.26	7.17	74.0	-22.74	Peak	188.00	100	Vertical	Pass
5**	10822.500	41.52	7.17	54.0	-12.48	AV	188.00	100	Vertical	Pass
6	14567.999	56.20	11.77	68.2	-12.00	Peak	107.00	100	Vertical	Pass
6**	14567.999	47.40	11.77	54.0	-6.60	AV	107.00	100	Vertical	Pass

1 GHz to 18 GHz, ANT H Band IV 11a HIGH channel

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1197.500	41.97	-17.14	74.0	-32.03	Peak	294.00	100	Horizontal	Pass
1**	1197.500	24.92	-17.14	54.0	-29.08	AV	294.00	100	Horizontal	Pass
2	1999.500	45.06	-14.34	68.2	-23.14	Peak	16.00	100	Horizontal	Pass
2**	1999.500	29.94	-14.34	54.0	-24.06	AV	16.00	100	Horizontal	Pass
3	2460.000	44.15	-11.53	68.2	-24.05	Peak	46.00	100	Horizontal	Pass
3**	2460.000	38.57	-11.53	54.0	-15.43	AV	46.00	100	Horizontal	Pass
4	5818.000	109.16	-0.98	68.2	40.96	Peak	51.00	100	Horizontal	N/A
4**	5818.000	100.11	-0.98	54.0	46.11	AV	51.00	100	Horizontal	N/A
5	11405.500	51.26	7.12	74.0	-22.74	Peak	59.00	100	Horizontal	Pass
5**	11405.500	42.59	7.12	54.0	-11.41	AV	59.00	100	Horizontal	Pass
6	14581.750	56.08	12.24	68.2	-12.12	Peak	320.00	100	Horizontal	Pass
6**	14581.750	47.99	12.24	54.0	-6.01	AV	320.00	100	Horizontal	Pass

A.6.2 Band Edge (Restricted-band)

Test Band	Mode	Channel	Verdict
Band IV	802.11a	Low	Pass
Band IV	802.11a	High	Pass

Test Plots

802.11a Band IV LOW CHANNEL

802.11a Band IV HIGH CHANNEL

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-EC2060327-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-EC2060327-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-EC2060327-AI.PDF”.

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