TEST REPORT

Applicant:	Autel Digital Power Co., Ltd.
Address:	Floors 1, 2, 3 and 6 Caihong Keji Building 36 Hi-tech North Six Road, Songpingshan Community Xili Sub-district, Nanshan District 518000 Shenzhen, Guangdong PEOPLE'S REPUBLIC OF CHINA
Equipment Type:	SmartBox
Model Name:	AUS610
Brand Name:	Autel
FCC ID:	2BHGJ-AUS610
ISED Number:	28321-AUS610
Test Standard:	47 CFR Part 15 Subpart C RSS-Gen Issue 5 RSS-247 Issue 3 (refer to section 3.1)
Sample Arrival Date:	Jun. 25, 2024
Test Date:	Jul. 09, 2024 - Aug. 12, 2024
Date of Issue:	Aug. 26, 2024

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Si Xiao

Checked by: Ye Hongji

Approved by: Sunny Zou

(Technical Director)

Revision History

Version	Issue Date	Revisions
Rev. 01	Aug. 26, 2024	Initial Issue

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1 GENERAL INFORMATION

1.1 Test Laboratory

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

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Autel Digital Power Co., Ltd.
Address	Floors 1, 2, 3 and 6 Caihong Keji Building 36 Hi-tech North Six Road, Songpingshan Community Xili Sub-district, Nanshan District 518000 Shenzhen, Guangdong PEOPLE'S REPUBLIC OF CHINA

2.2 Manufacturer Information

Manufacturer	Autel Digital Power Co., Ltd.
Address	Floors 1, 2, 3 and 6 Caihong Keji Building 36 Hi-tech North Six Road, Songpingshan Community Xili Sub-district, Nanshan District 518000 Shenzhen, Guangdong PEOPLE'S REPUBLIC OF CHINA

2.3 General Description for Equipment under Test (EUT)

EUT Name	SmartBox
Model Name Under Test	AUS610
Series Model Name	N/A
Description of Model name differentiation	N/A
Serial Number	EG2R6C00017N
Hardware Version	EMS2321_EQ_V2
Software Version	V0.99.61
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	WIFI 802.11a, 802.11b, 802.11g, 802.11n and 802.11ac Wi-SUN, NFC (Only RX)

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

Modulation Technology	Frequency hopping system
Modulation Type	Wi-SUN
Product Type	☒ Mobile ☐ Portable ☐ Fix Location
Frequency Range	The frequency range used is 902 MHz to 928 MHz.
Number of channel	65
Tested Channel	0 (902.2 MHz), 32 (915.0 MHz), 64 (927.8 MHz)
Antenna Type	FPC Antenna
Antenna Gain	0 dBi
Antenna System(MIMO Smart Antenna)	N/A
About the Product	The EUT is supply the DTS, Frequency hopping system, only the frequency hopping system and were tested in this report.

All channel was listed on the following table:

Channel Number	Freq. (MHz)	Channel Number	Freq. (MHz)	Channel Number	Freq. (MHz)	Channel Number	Freq. (MHz)
0	**902.2**	17	909.0	34	915.8	51	922.6
1	902.6	18	909.4	35	916.2	52	923.0
2	903.0	19	909.8	36	916.6	53	923.4
3	903.4	20	910.2	37	917.0	54	923.8
4	903.8	21	910.6	38	917.4	55	924.2
5	904.2	22	911.0	39	917.8	56	924.6
6	904.6	23	911.4	40	918.2	57	925.0
7	905.0	24	911.8	41	918.6	58	925.4
8	905.4	25	912.2	42	919.0	59	925.8
9	905.8	26	912.6	43	919.4	60	926.2
10	906.2	27	913.0	44	919.8	61	926.6
11	906.6	28	913.4	45	920.2	62	927.0
12	907.0	29	913.8	46	920.6	63	927.4
13	907.4	30	914.2	47	921.0	**64**	**927.8**
14	907.8	31	914.6	48	921.4	/	/
15	908.2	**32**	**915.0**	49	921.8	/	/
16	908.6	33	915.4	50	922.2	/	/

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment
2	KDB Publication 558074 D01v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
3	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
4	RSS-247 Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
5	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Test Verdict

No.	Description	FCC Part No.	ISED Part No.	Modulation Technology	Channel	Test Result	Verdict
1	Antenna Requirement	15.203	RSS-247, 5.4 (d)	N/A	N/A	--	Pass[Note]
2	Number of Hopping Frequencies	15.247(a)	RSS-247, 5.1 (c)	Frequency hopping system	Hopping Mode	ANNEX A.1	Pass
3	Peak Output Power	15.247(b)	RSS-247, 5.4 (a)	Frequency hopping system	Low/Middle/ High	ANNEX A.2	Pass
4	Occupied Bandwidth	15.247(a)	RSS-247, 5.1 (a)	Frequency hopping system	Low/Middle/ High	ANNEX A.3	Pass
5	Carrier Frequency Separation	15.247(a)	RSS-247, 5.1 (b)	Frequency hopping system	Hopping Mode	ANNEX A.4	Pass
6	Time of Occupancy (Dwell time)	15.247(a)	RSS-247, 5.1 (c)	Frequency hopping system	Hopping Mode	ANNEX A.5	Pass
7	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	RSS-247, 5.5	Frequency hopping system	Low/Middle/ High, Hopping Mode	ANNEX A.6	Pass
8	Conducted Emission	15.207	RSS-GEN, 8.8	Frequency hopping system	Low/Middle/ High	ANNEX A.7	Pass
9	Radiated Spurious Emission	15.209 15.247(d)	RSS-247, 5.5	Frequency hopping system	Low/Middle/ High, Hopping Mode	ANNEX A.8	Pass
10	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	RSS-247, 5.5	Frequency hopping system	Low/Middle/ High, Hopping Mode	ANNEX A.9	Pass
Note: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203							

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

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

Relative Humidity	40% to 69%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+20.0℃ to +25.4℃
Working Voltage of the EUT	NV (Normal Voltage)	250 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY46471071	2024.07.04	2025.07.03
Spectrum Analyzer	KEYSIGHT	N9020A	MY52510065	2023.09.05	2024.09.04
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	01631	2022.02.23	2025.02.22
Test Antenna-Horn	A-INFO	LB-180400KF	J211060273	2024.06.15	2027.06.14
Anechoic Chamber	RAINFORD	9m*6m*6m	144	2022.02.19	2024.09.03
Amplifier	COM-MV	LSCX_LNA1-12G-01	180602	2023.09.05	2024.09.04
Amplifier	COM-MV	XKu_LNA7-18G-01	180601	2023.09.05	2024.09.04
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2023.09.05	2024.09.04
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9168	9168-01162	2023.08.04	2026.08.03
Test Antenna-Loop	SCHWARZBECK	FMZB 1519	1519-037	2024.01.23	2025.01.22
Amplifier	COM-MV	ZT30-1000M	B2018054558	2023.12.05	2024.12.04
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	130	2021.08.15	2024.08.14
EMI Receiver	KEYSIGHT	N9010B	MY57110309	2023.09.05	2024.09.04
LISN	SCHWARZBECK	NSLK 8127	8127-687	2024.05.09	2025.05.08
Shielded Enclosure	YiHeng Electronic Co., Ltd	3.5m*3.1m*2.8m	112	2022.02.19	2025.02.18
EMI Receiver	Agilent	N9038A	MY55330120	2023.09.05	2024.09.04
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9168	9168-00867	2022.04.12	2025.04.11
Amplifier	COM-MV	ZT30-1000M	B2017119081	2023.12.05	2024.12.04
Anechoic Chamber	YiHeng	9m*6m*6m	142	2021.08.19	2024.08.18

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.

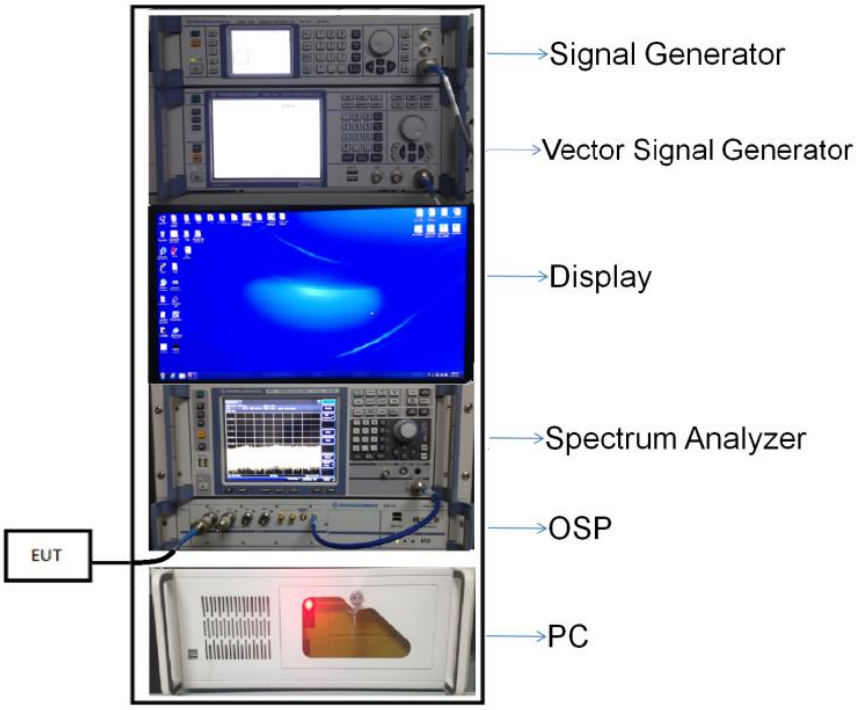
Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.8°C
Humidity	4%

4.4 Description of Test Setup

4.4.1 For Antenna Port Test

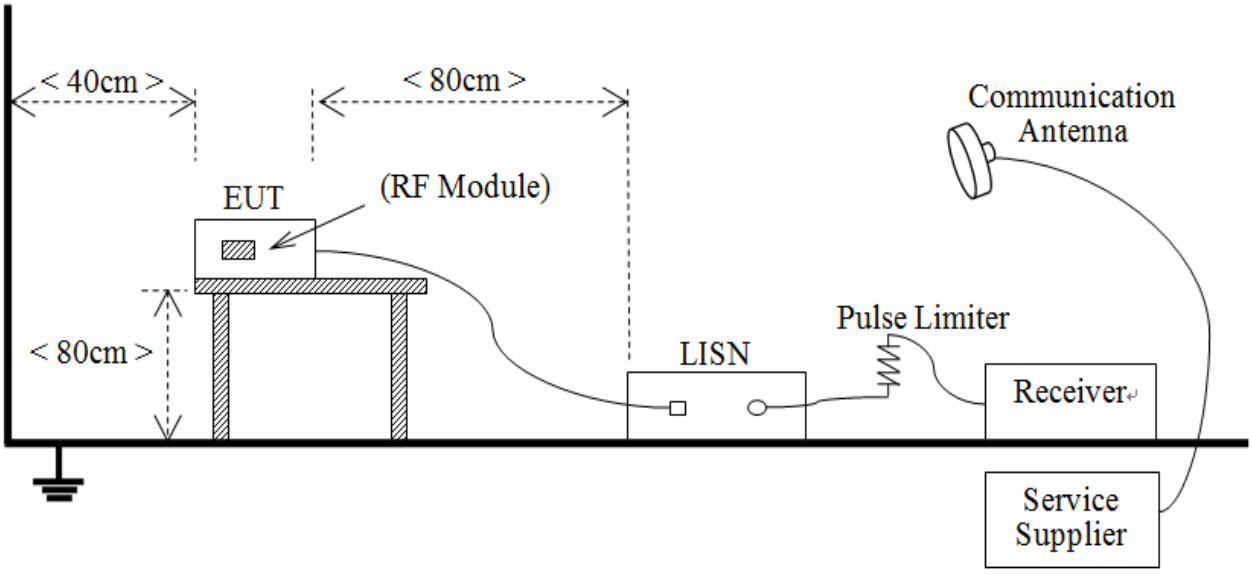
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



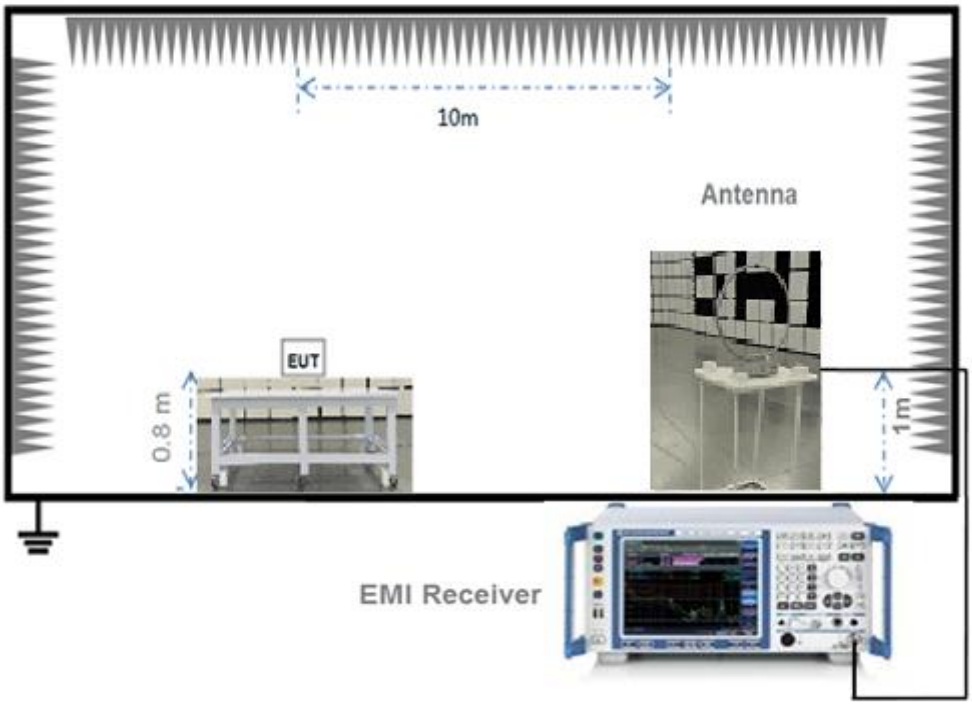
(Diagram 1)

4.4.2 For AC Power Supply Port Test



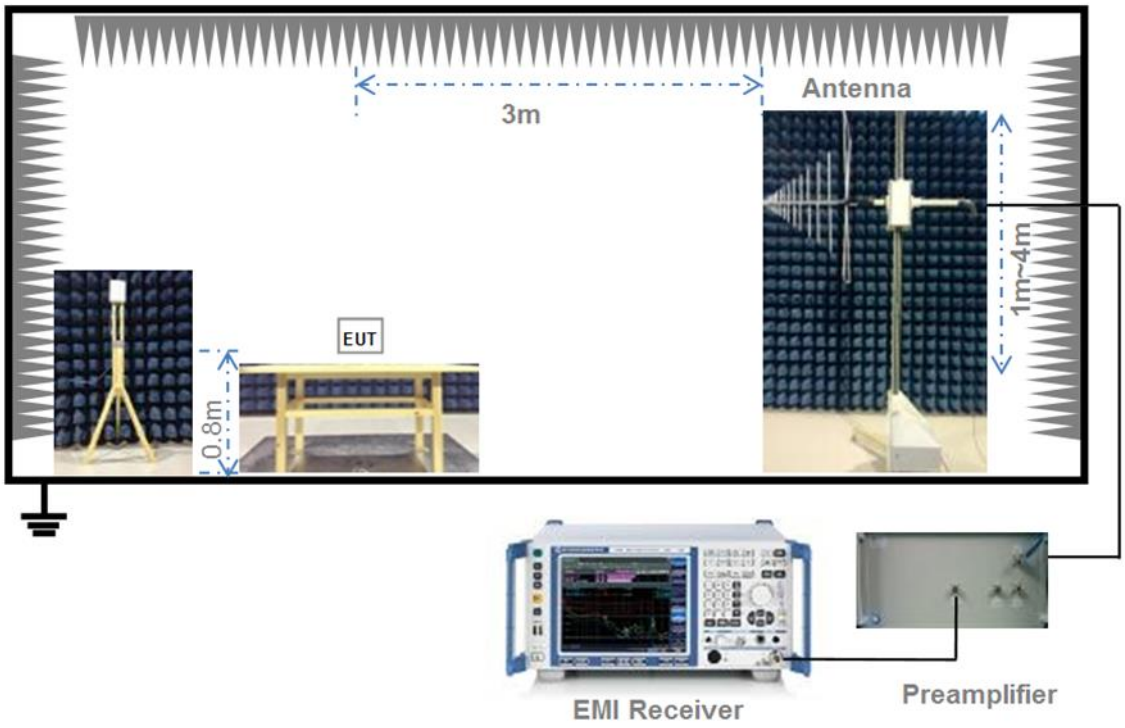
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



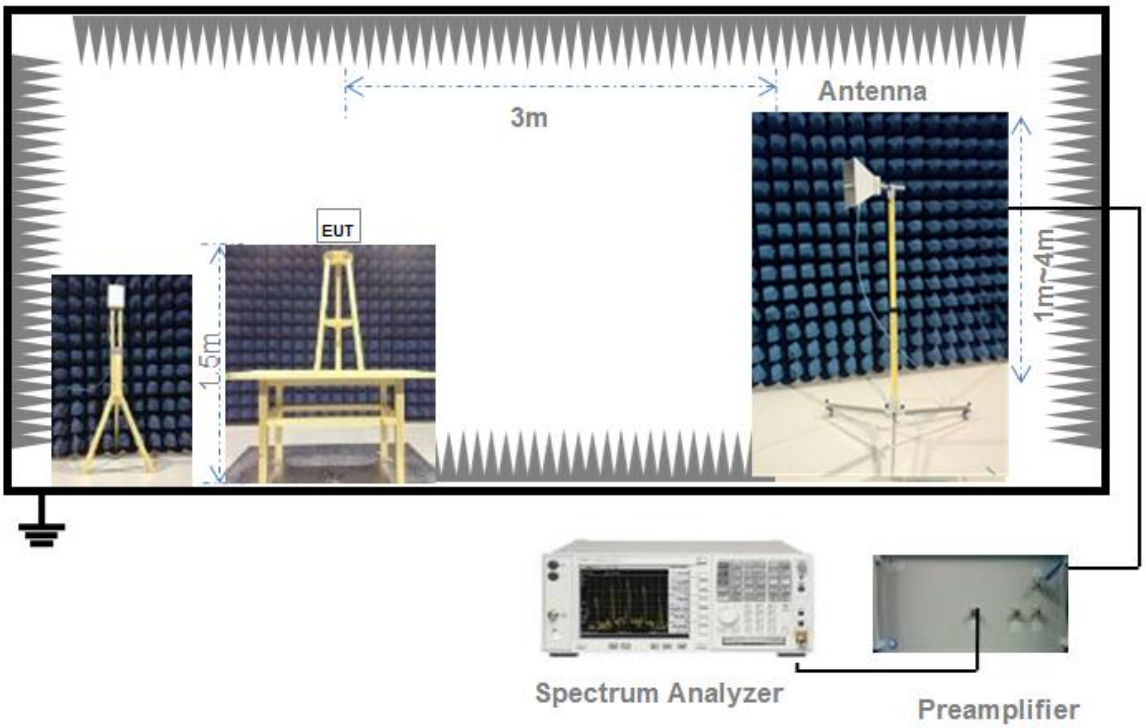
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.5 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203; RSS-247, 5.4 (d)
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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product	The antenna is welded on the mainboard, can’t be replaced by the consumer

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Number of Hopping Frequencies

5.2.1 Limit

FCC §15.247(a); RSS-247, 5.1 (c)

For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

5.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Peak Output Power and E.I.R.P

5.3.1 Test Limit

FCC § 15.247(b); RSS-247, 5.4 (a)

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

RSS-247, 5.4 (2)

For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

EIRP= conducted RF output peak power +Antenna Gain.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Occupied Bandwidth

5.4.1 Limit

FCC §15.247(a); RSS-247, 5.1 (a)

5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW = in the range of 1% to 5% of the OBW

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Carrier Frequency Separation

5.5.1 Limit

FCC §15.247(a); RSS-247, 5.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Time of Occupancy (Dwell time)

5.6.1 Limit

FCC §15.247(a); RSS-247, 5.1 (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.6.4 Test Result

Please refer to ANNEX A.5

5.7 Conducted Spurious Emission & Authorized-band band-edge

5.7.1 Limit

FCC §15.247(d); RSS-247, 5.5

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.7.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

5.7.4 Test Result

Please refer to ANNEX A.6 and A.7

5.8 Conducted Emission

5.8.1 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

5.8.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.8.3 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.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Radiated Spurious Emission

5.9.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

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	902/F(kHz)	300
0.490 - 1.705	9020/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. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, 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.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.9.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz 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
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Band Edge (Restricted-band band-edge)

5.10.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.10.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

The measurement frequency range is from 9 kHz 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

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.10.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

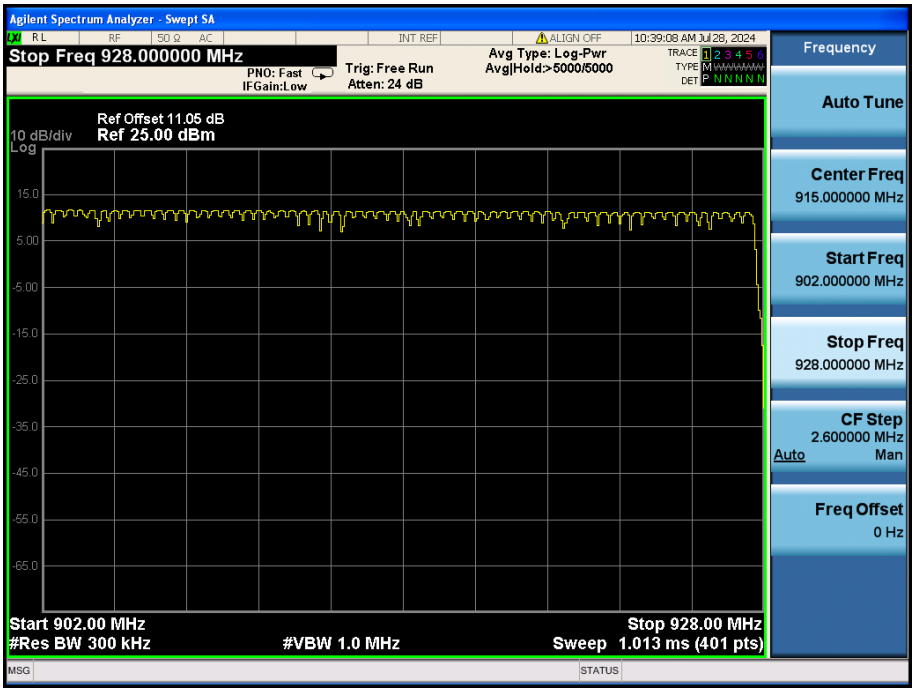
A.1 Number of Hopping Frequency

Test Data

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
Wi-SUN	902-928	65	50	Pass

Test Plots

Wi-SUN



A.2 Peak Output Power

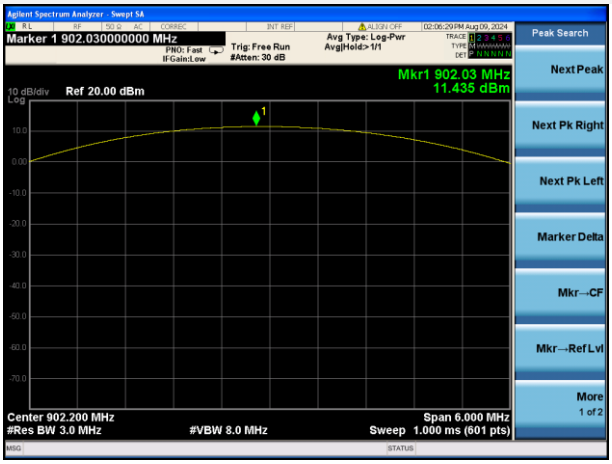
Test Data

Channel	Measured Output Peak Power		Limit		Verdict
	Wi-SUN		dBm	mW	
	dBm	mW			
Low	11.44	13.92	30	1000	Pass
Middle	11.15	13.03			Pass
High	10.86	12.18			Pass

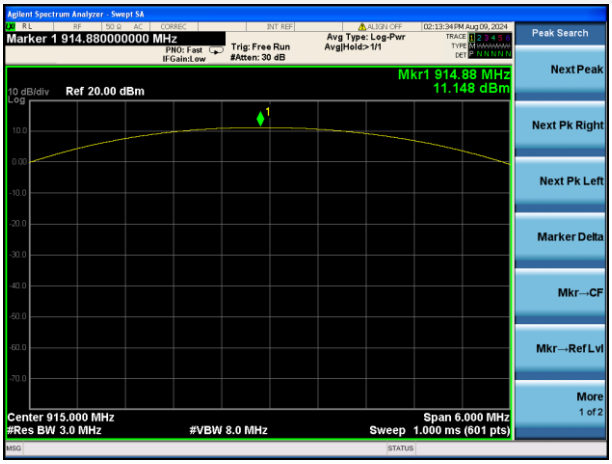
Channel	E.I.R.P		Limit		Verdict
	Wi-SUN		dBm	W	
	dBm	mW			
Low	11.44	13.92	36	4	Pass
Middle	11.15	13.03			Pass
High	10.86	12.18			Pass

Test Plots

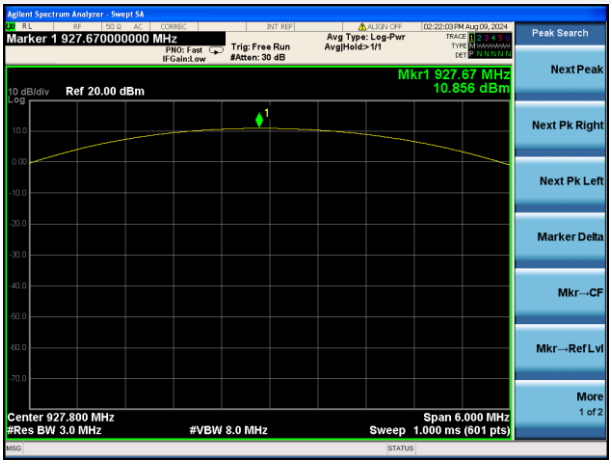
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



A.3 20 dB and 99% bandwidth

Test Data

Wi-SUN			
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Verdict
Low	0.102417	0.091522	Pass
Middle	0.100586	0.091304	Pass
High	0.101501	0.092634	Pass

Test Plots

20 dB Bandwidth

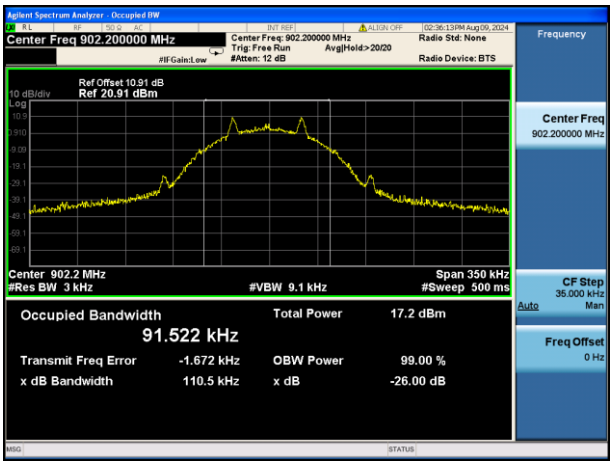
LOW CHANNEL

MIDDLE CHANNEL

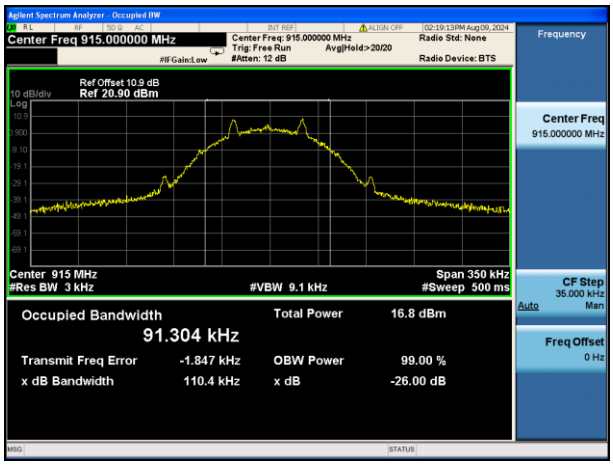
HIGH CHANNEL

99% Bandwidth

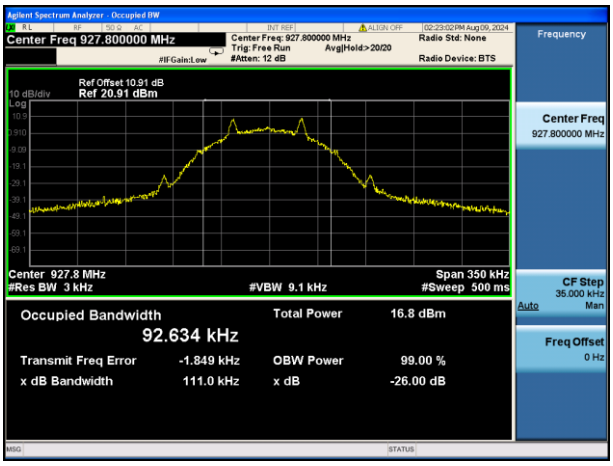
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



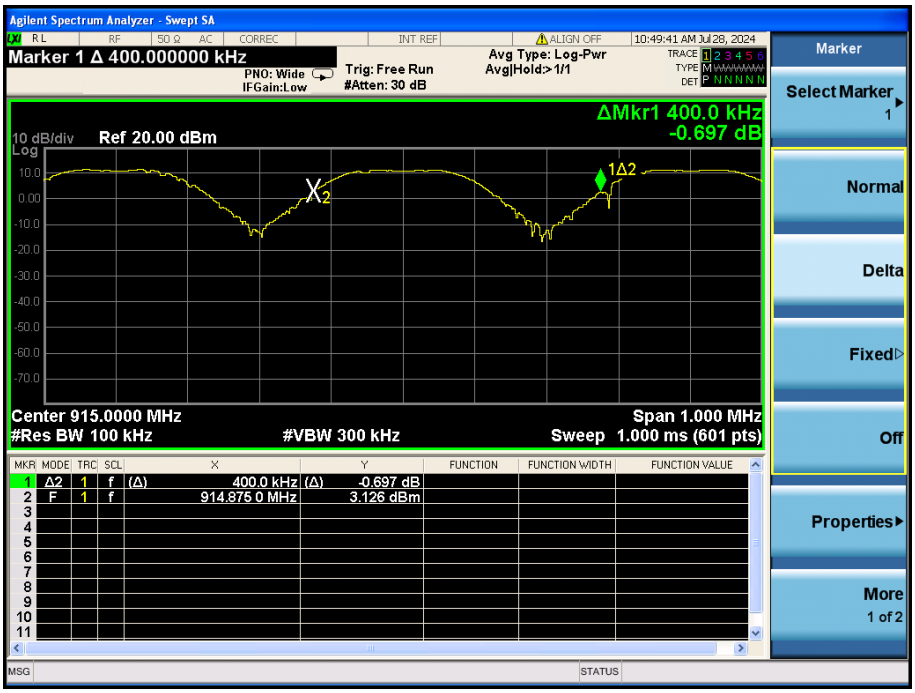
A.4 Hopping Frequency Separation

Test Data

Mode	Frequency Separation (MHz)	Max 20 dB Bandwidth (MHz)	Verdict
Wi-SUN	0.4	0.102	Pass

Test Plots

Wi-SUN



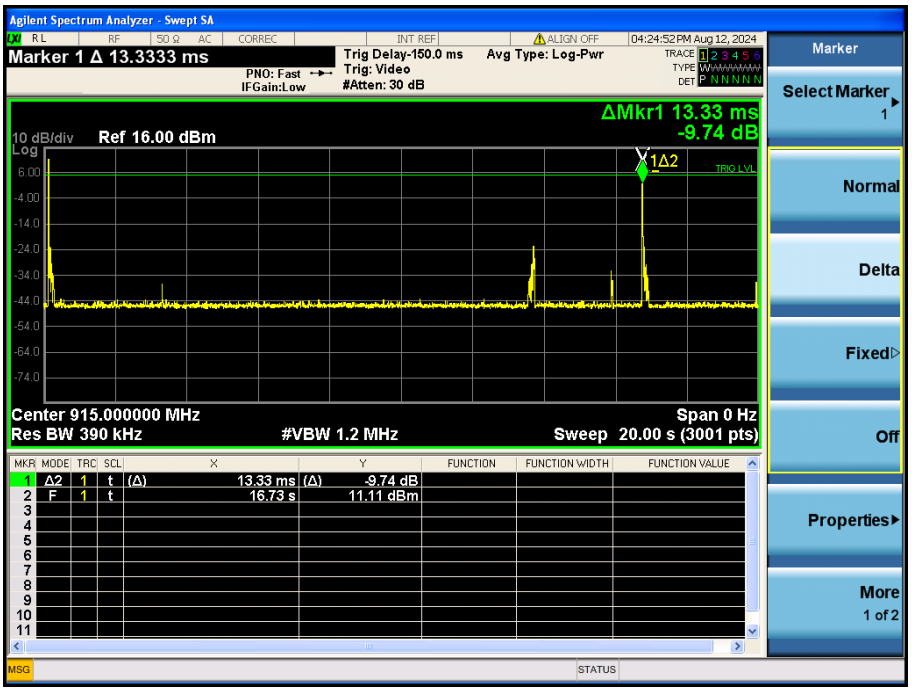
A.5 Average Time of Occupancy

Test Data

Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
13.330	26.660	0.4	Pass

Test Plots

Wi-SUN



A.6 Conducted Spurious Emissions & Authorized-band band-edge

Test Data

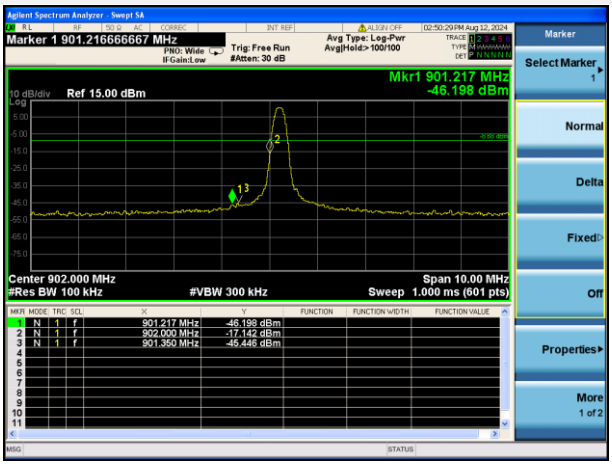
Wi-SUN				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-36.22	11.32	-8.68	Pass
Middle	-36.35	11.00	-9.00	Pass
High	-36.58	10.73	-9.27	Pass

Wi-SUN				
Mode	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Hopping	-35.61	11.84	-8.16	Pass

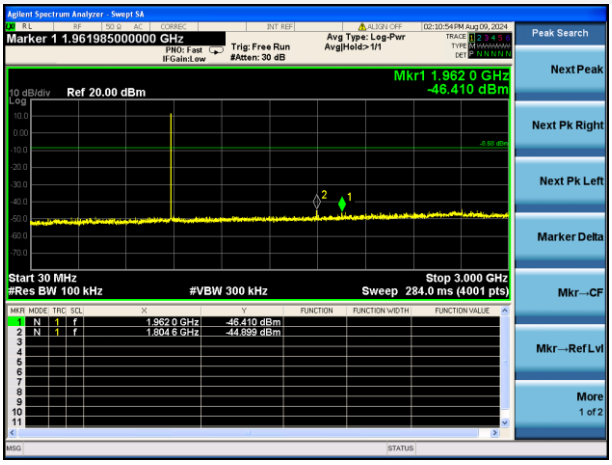
Test Plots

LOW CHANNEL, CARRIER LEVEL

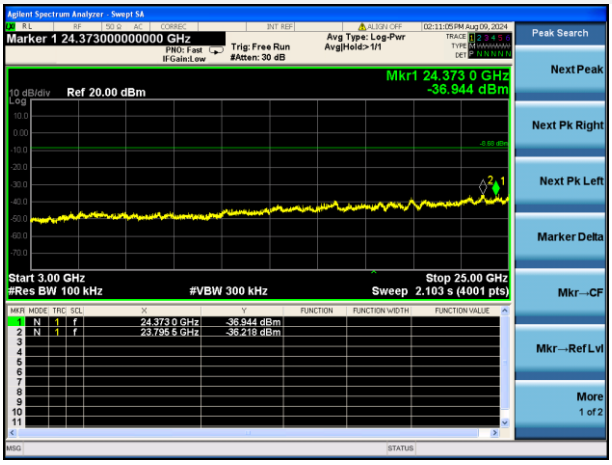
LOW CHANNEL, Band Edge



LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

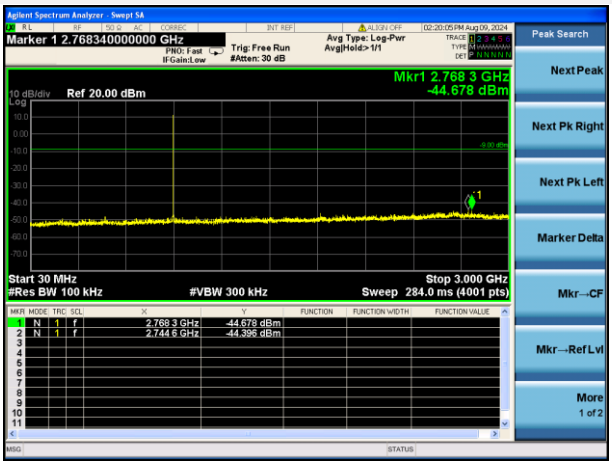


LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz

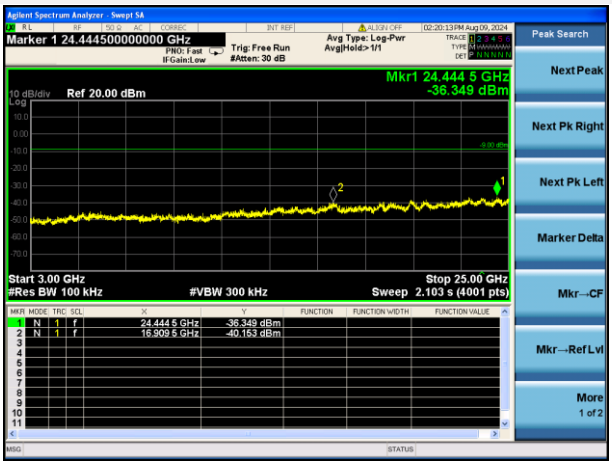


MIDDLE CHANNEL, CARRIER LEVEL

MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 3 GHz

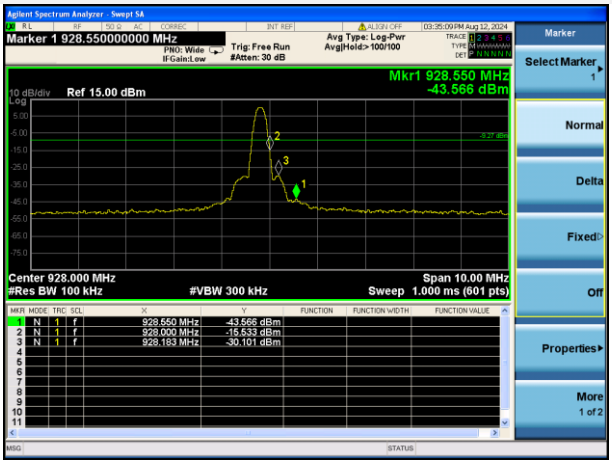


MIDDLE CHANNEL , SPURIOUS 3 GHz ~ 25 GHz

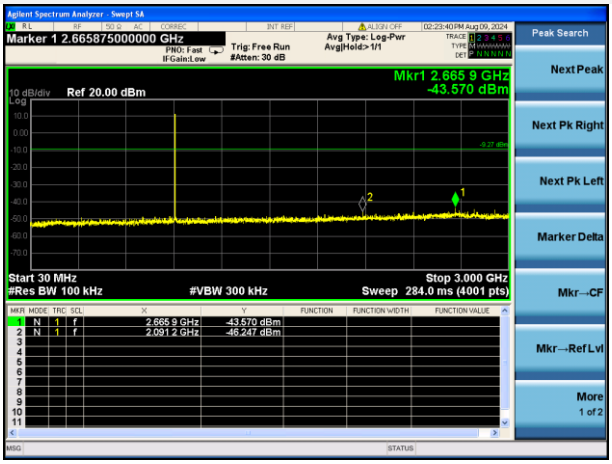


HIGH CHANNEL, CARRIER LEVEL

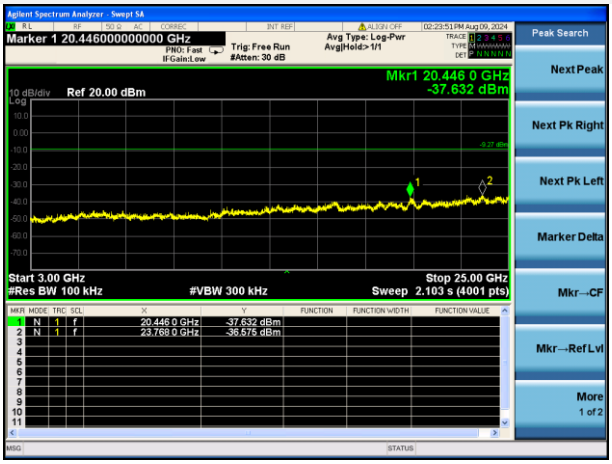
HIGH CHANNEL , BAND EDGE



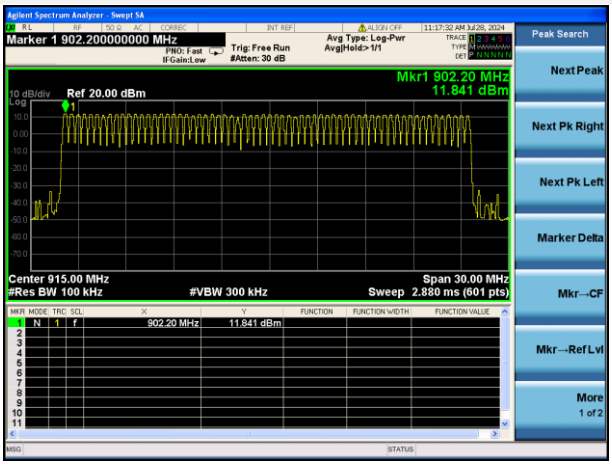
HIGH CHANNEL , SPURIOUS 30 MHz ~ 3 GHz



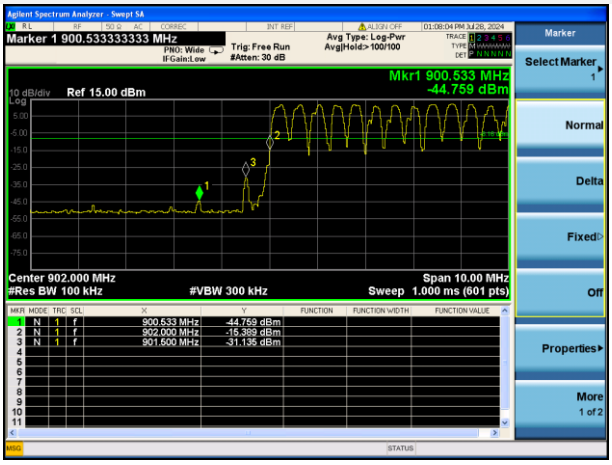
HIGH CHANNEL , SPURIOUS 3 GHz ~ 25 GHz



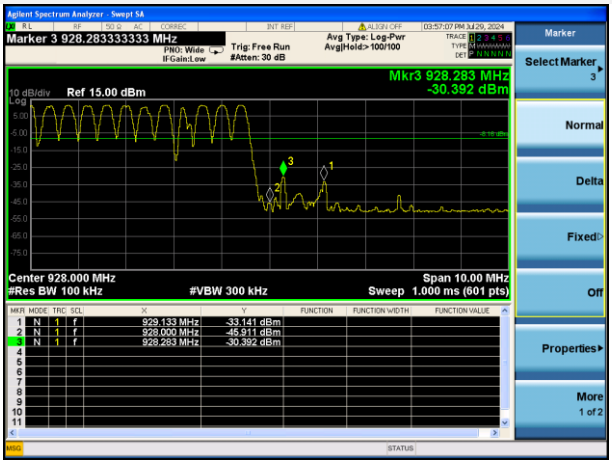
HOPPING, CARRIER LEVEL



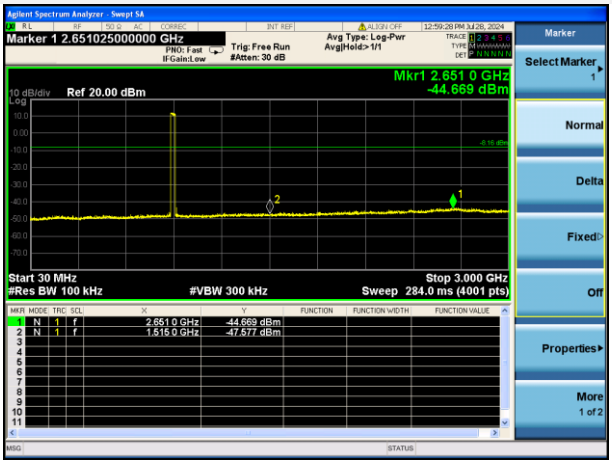
HOPPING BAND EDGE (LOW)



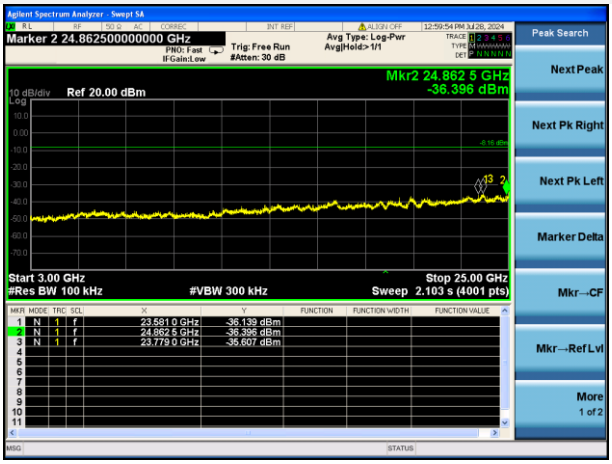
HOPPING BAND EDGE (HIGH)



HOPPING Mode, SPURIOUS 30 MHz ~ 3 GHz



Hopping Mode, SPURIOUS 3 GHz ~ 25 GHz



A.7 Conducted Emissions

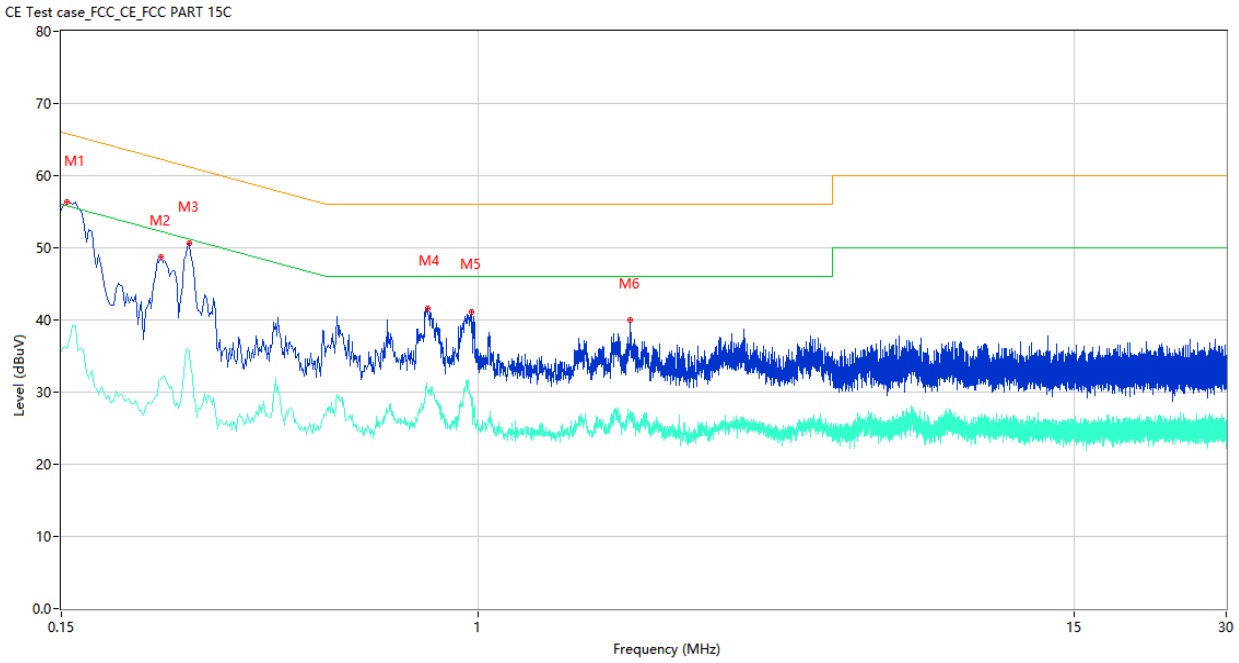
Note [1]: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

Note [2]: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Note [3]: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

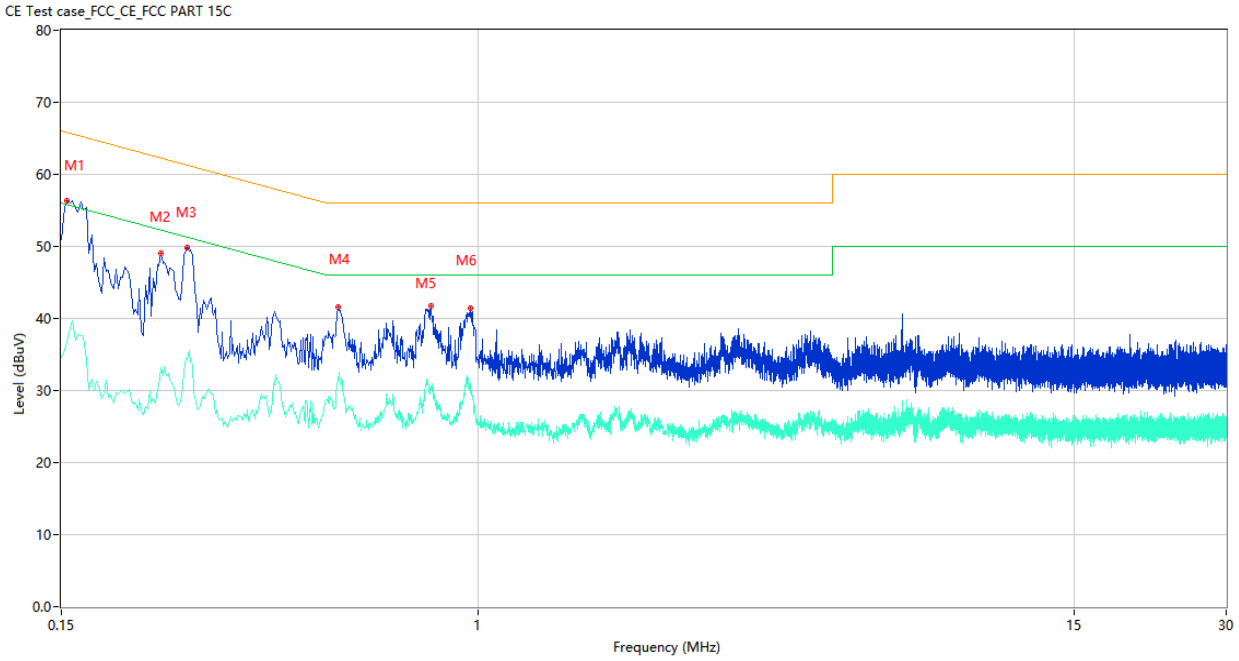
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.154	56.31	9.78	65.78	9.47	Peak	L	Pass
1**	0.154	36.09	9.78	55.78	19.69	AV	L	Pass
2	0.236	48.72	9.77	62.24	13.52	Peak	L	Pass
2**	0.236	31.78	9.77	52.24	20.46	AV	L	Pass
3	0.268	50.70	9.76	61.18	10.48	Peak	L	Pass
3**	0.268	35.75	9.76	51.18	15.43	AV	L	Pass
4	0.796	41.64	10.50	56.00	14.36	Peak	L	Pass
4**	0.796	30.14	10.50	46.00	15.86	AV	L	Pass
5	0.968	41.09	10.03	56.00	14.91	Peak	L	Pass
5**	0.968	29.35	10.03	46.00	16.65	AV	L	Pass
6	1.998	40.04	10.22	56.00	15.96	Peak	L	Pass
6**	1.998	27.39	10.22	46.00	18.61	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.154	56.38	9.78	65.78	9.40	Peak	N	Pass
1**	0.154	36.72	9.78	55.78	19.06	AV	N	Pass
2	0.236	49.11	9.77	62.24	13.13	Peak	N	Pass
2**	0.236	33.21	9.77	52.24	19.03	AV	N	Pass
3	0.266	49.77	9.76	61.24	11.47	Peak	N	Pass
3**	0.266	34.45	9.76	51.24	16.79	AV	N	Pass
4	0.528	41.61	10.01	56.00	14.39	Peak	N	Pass
4**	0.528	31.36	10.01	46.00	14.64	AV	N	Pass
5	0.806	41.71	10.54	56.00	14.29	Peak	N	Pass
5**	0.806	30.58	10.54	46.00	15.42	AV	N	Pass
6	0.962	41.46	10.04	56.00	14.54	Peak	N	Pass
6**	0.962	30.97	10.04	46.00	15.03	AV	N	Pass

A.8 Radiated Spurious Emission

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

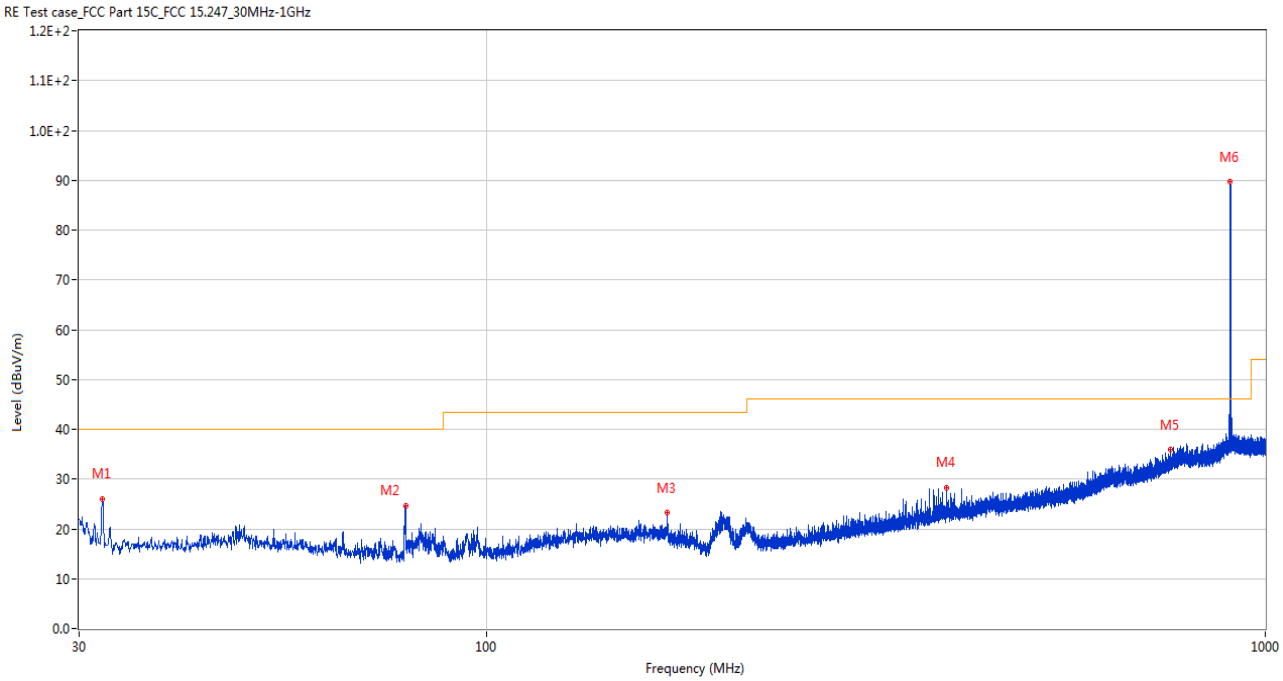
Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

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 marked spikes near 900 MHz with circle should be ignored because they are Fundamental signal.

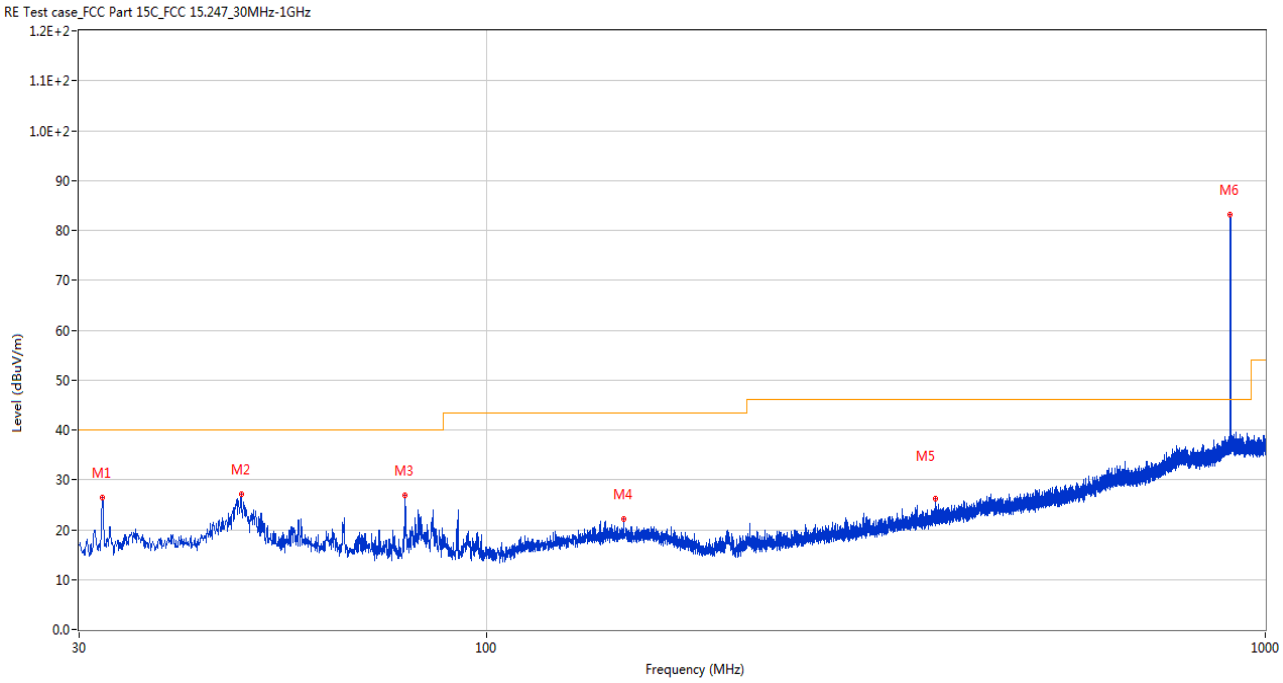
Test Data and Plots

LOW CHANNEL 30 MHz to 1 GHz, ANT H



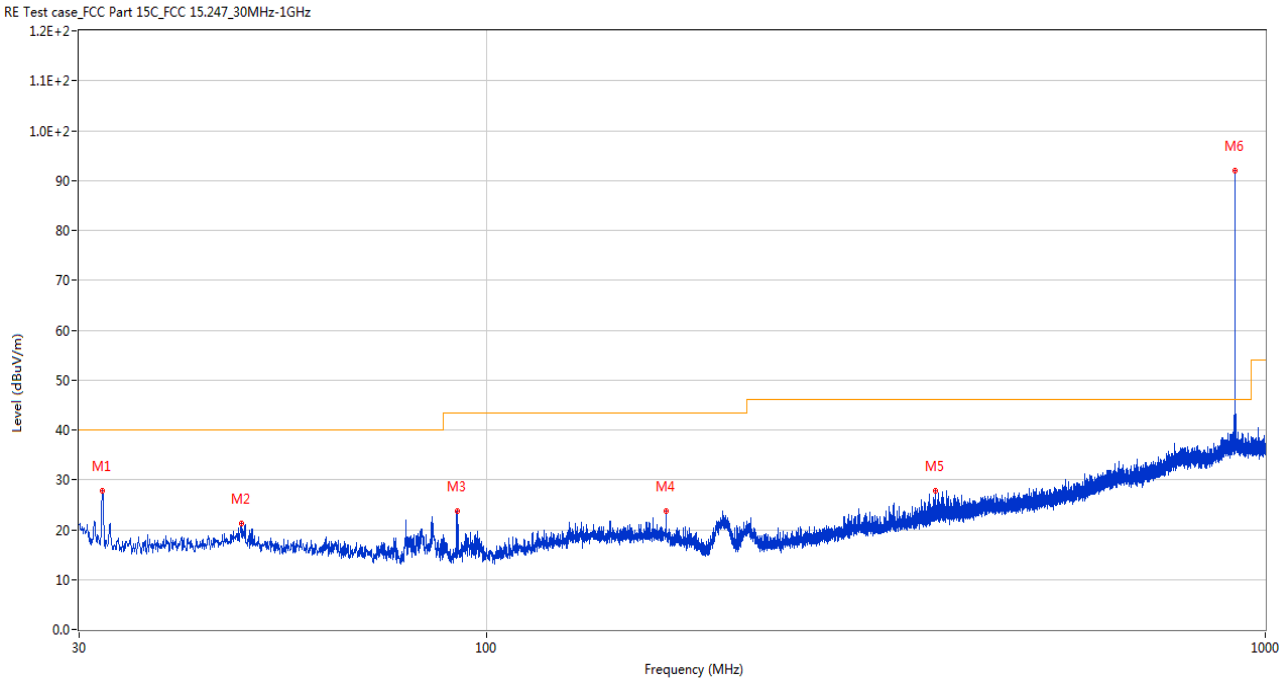
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	32.134	26.10	-26.92	40.0	13.90	Peak	162.00	150	Horizontal	Pass
2	78.840	24.70	-29.40	40.0	15.30	Peak	85.00	200	Horizontal	Pass
3	170.892	23.30	-25.05	43.5	20.20	Peak	360.00	100	Horizontal	Pass
4	389.385	28.35	-21.12	46.0	17.65	Peak	195.00	100	Horizontal	Pass
5	755.026	36.00	-10.67	46.0	10.00	Peak	93.00	150	Horizontal	Pass
6	902.224	89.67	-7.26	46.0	-43.67	Peak	162.00	150	Horizontal	N/A

LOW CHANNEL 30 MHz to 1 GHz, ANT V



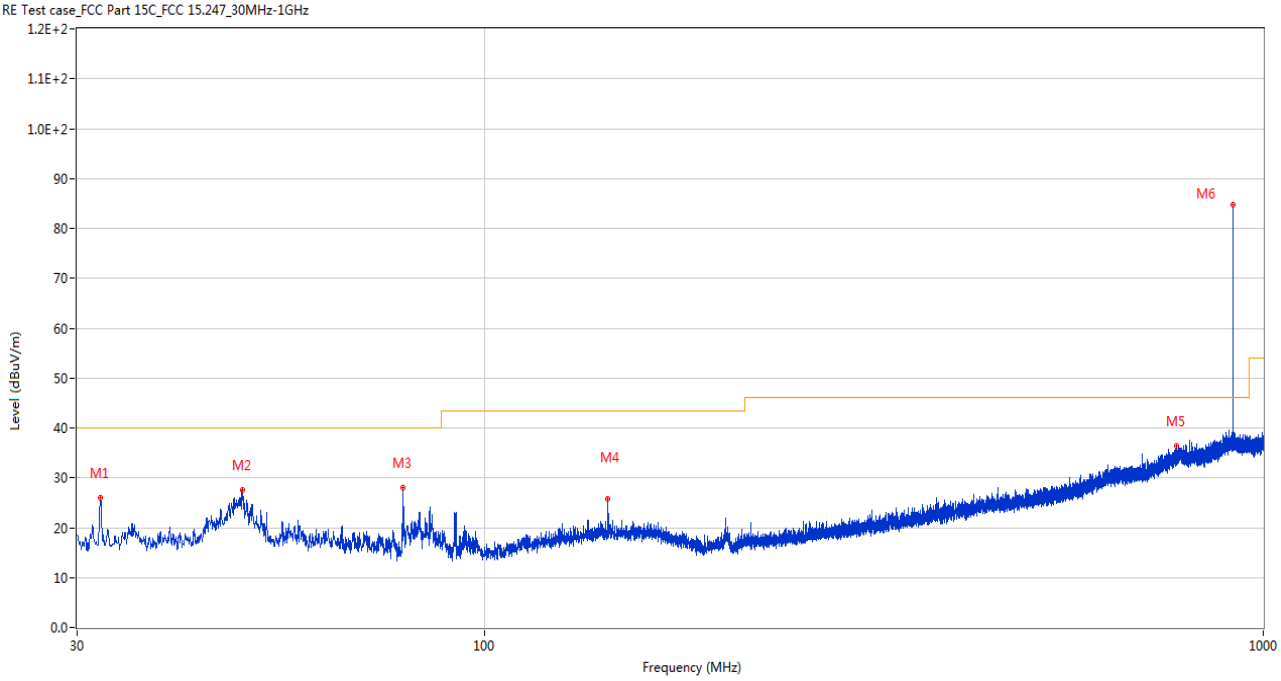
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	32.134	26.44	-26.92	40.0	13.56	Peak	222.00	150	Vertical	Pass
2	48.430	27.13	-26.00	40.0	12.87	Peak	358.00	200	Vertical	Pass
3	78.549	26.85	-29.39	40.0	13.15	Peak	341.00	100	Vertical	Pass
4	149.989	22.06	-24.16	43.5	21.44	Peak	2.00	100	Vertical	Pass
5	377.551	26.29	-21.40	46.0	19.71	Peak	0.00	150	Vertical	Pass
6	902.224	83.08	-7.26	46.0	-37.08	Peak	238.00	150	Vertical	N/A

MIDDLE CHANNEL 30 MHz to 1 GHz, ANT H



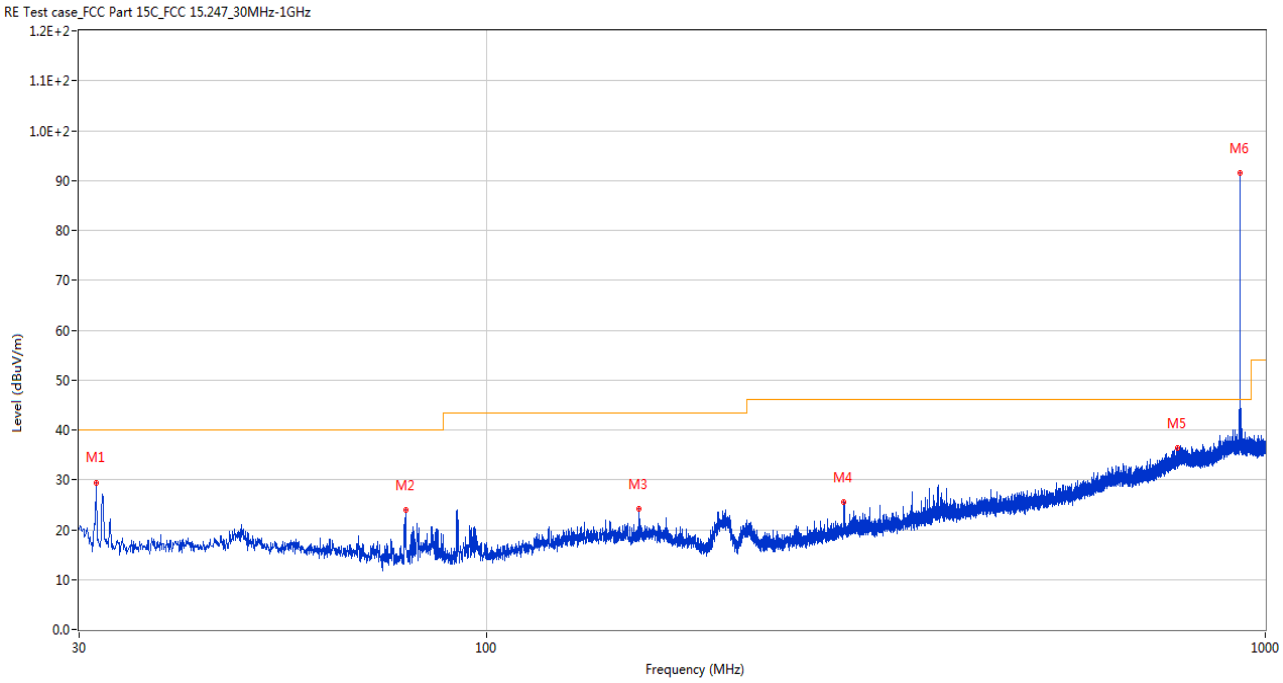
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	32.134	27.74	-26.92	40.0	12.26	Peak	122.00	200	Horizontal	Pass
2	48.430	21.15	-26.00	40.0	18.85	Peak	41.00	100	Horizontal	Pass
3	91.644	23.66	-29.32	43.5	19.84	Peak	236.00	200	Horizontal	Pass
4	170.214	23.72	-24.95	43.5	19.78	Peak	253.00	200	Horizontal	Pass
5	376.969	27.85	-21.42	46.0	18.15	Peak	195.00	100	Horizontal	Pass
6	914.980	91.95	-7.42	46.0	-45.95	Peak	167.00	150	Horizontal	N/A

MIDDLE CHANNEL 30 MHz to 1 GHz, ANT V



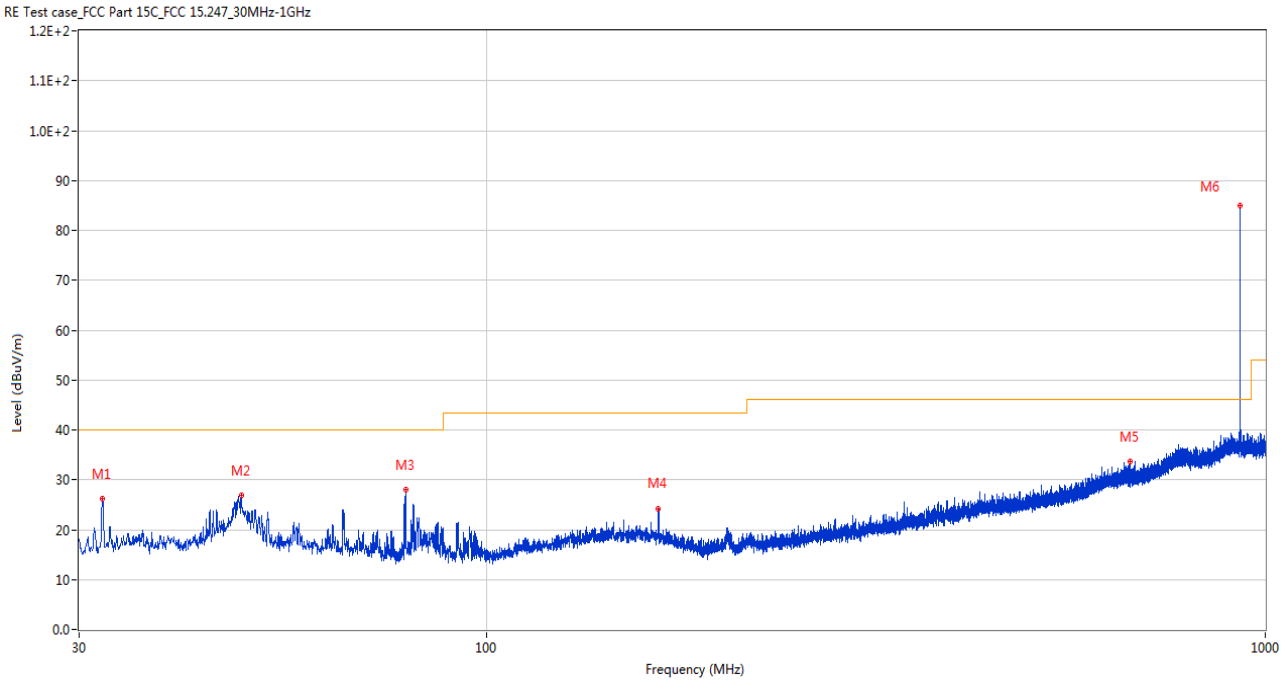
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	32.134	25.89	-26.92	40.0	14.11	Peak	165.00	150	Vertical	Pass
2	48.867	27.58	-26.00	40.0	12.42	Peak	348.00	200	Vertical	Pass
3	78.549	28.06	-29.39	40.0	11.94	Peak	339.00	150	Vertical	Pass
4	143.975	25.67	-24.50	43.5	17.83	Peak	342.00	200	Vertical	Pass
5	774.960	36.39	-9.76	46.0	9.61	Peak	342.00	100	Vertical	Pass
6	915.028	84.81	-7.42	46.0	-38.81	Peak	267.00	150	Vertical	N/A

HIGH CHANNEL 30 MHz to 1 GHz, ANT H



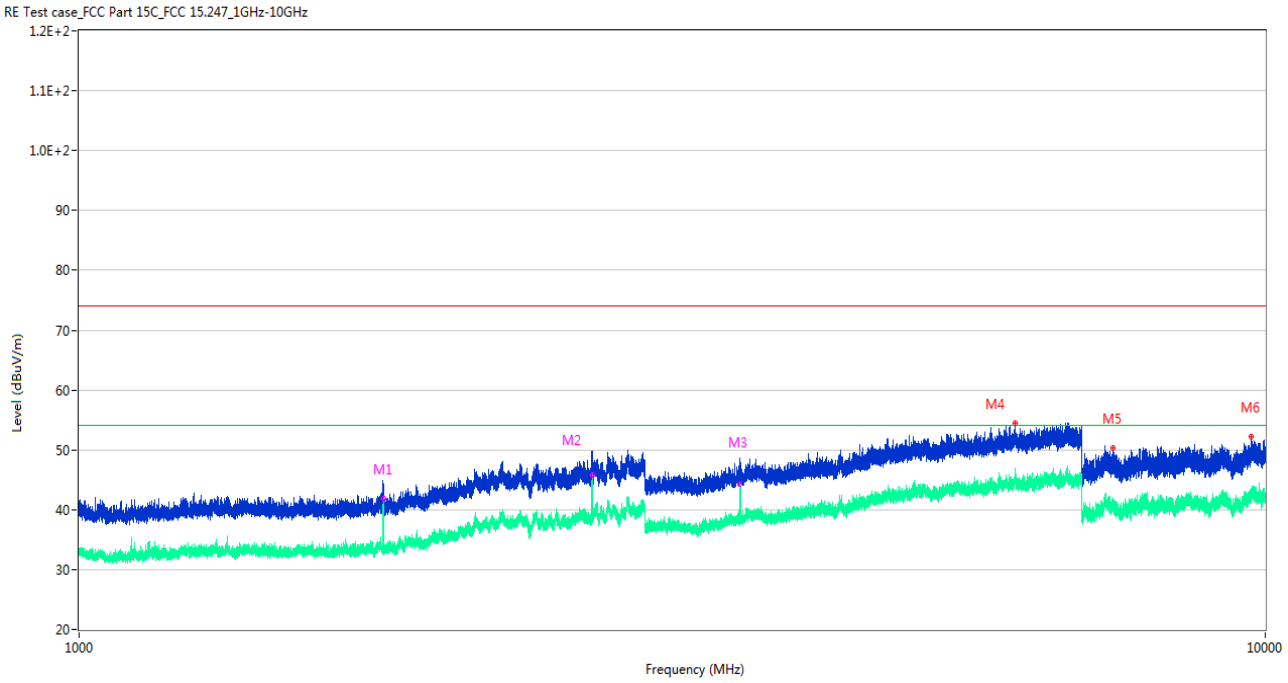
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	31.552	29.48	-26.91	40.0	10.52	Peak	231.00	150	Horizontal	Pass
2	78.791	23.90	-29.40	40.0	16.10	Peak	251.00	200	Horizontal	Pass
3	157.118	24.25	-24.00	43.5	19.25	Peak	217.00	100	Horizontal	Pass
4	287.971	25.55	-24.14	46.0	20.45	Peak	82.00	150	Horizontal	Pass
5	771.371	36.31	-9.86	46.0	9.69	Peak	155.00	150	Horizontal	Pass
6	927.832	91.56	-7.60	46.0	-45.56	Peak	164.00	200	Horizontal	N/A

HIGH CHANNEL 30 MHz to 1 GHz, ANT V



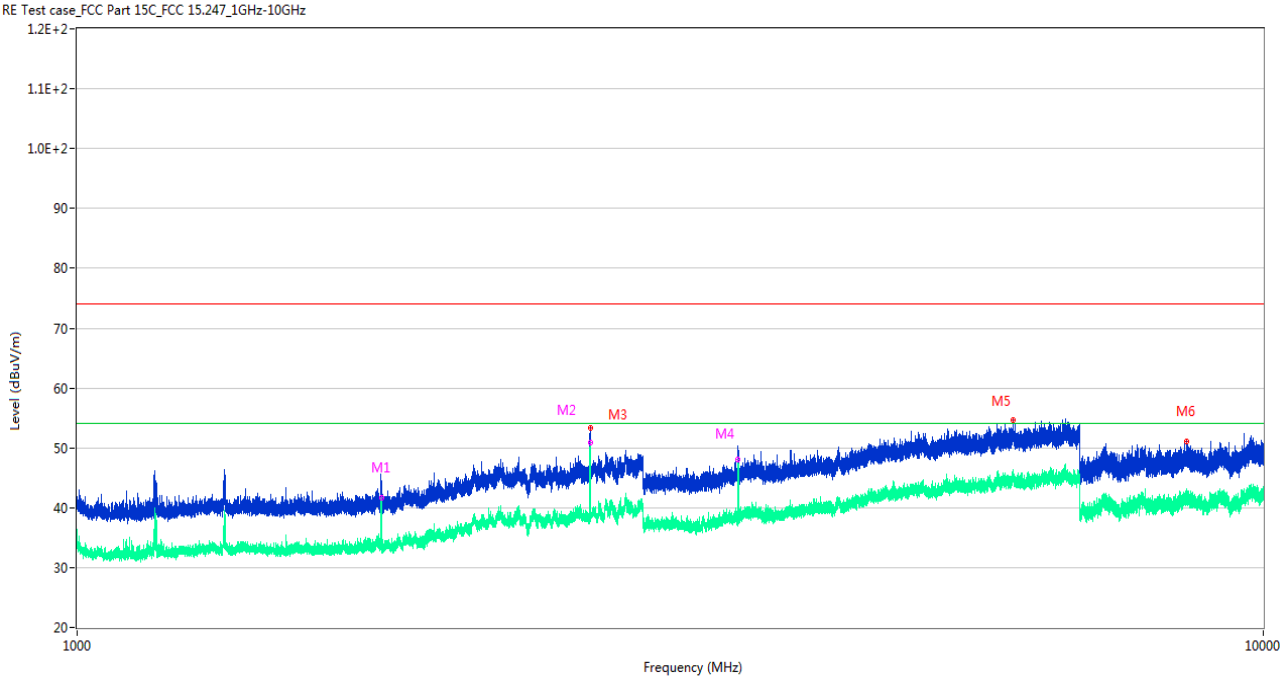
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	32.134	26.26	-26.92	40.0	13.74	Peak	198.00	150	Vertical	Pass
2	48.478	26.80	-26.00	40.0	13.20	Peak	316.00	100	Vertical	Pass
3	78.791	27.93	-29.40	40.0	12.07	Peak	318.00	150	Vertical	Pass
4	166.334	24.29	-24.53	43.5	19.21	Peak	89.00	150	Vertical	Pass
5	671.024	33.63	-13.12	46.0	12.37	Peak	182.00	200	Vertical	Pass
6	927.783	84.88	-7.59	46.0	-38.88	Peak	232.00	150	Vertical	N/A

LOW CHANNEL 1 GHz to 10 GHz, ANT H



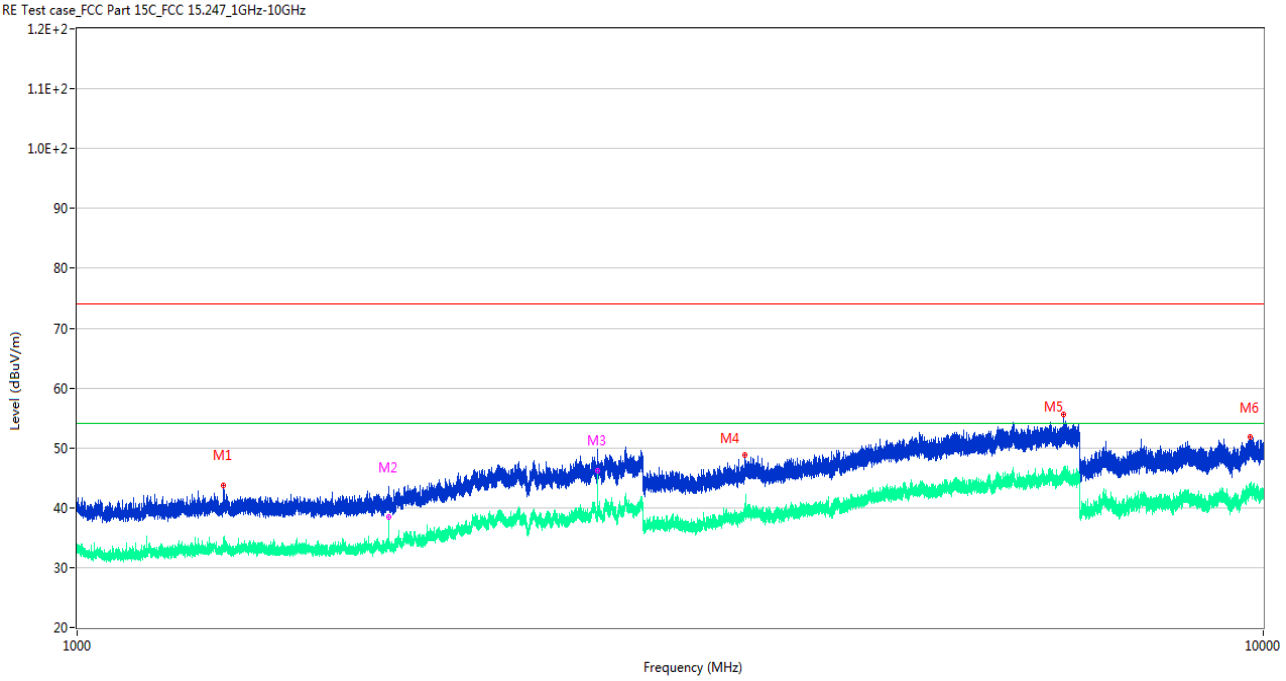
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1804.700	43.28	-12.90	74.0	30.72	Peak	145.00	200	Horizontal	Pass
1**	1804.700	41.78	-12.90	54.0	12.22	AV	145.00	200	Horizontal	Pass
2	2706.700	48.72	-7.24	74.0	25.28	Peak	44.00	150	Horizontal	Pass
2**	2706.700	45.72	-7.24	54.0	8.28	AV	44.00	150	Horizontal	Pass
3	3608.800	48.42	-6.56	74.0	25.58	Peak	201.00	200	Horizontal	Pass
3**	3608.800	44.33	-6.56	54.0	9.67	AV	201.00	200	Horizontal	Pass
4	6154.400	54.54	0.33	74.0	19.46	Peak	0.00	200	Horizontal	Pass
4**	6154.400	45.98	0.33	54.0	8.02	AV	0.00	200	Horizontal	Pass
5	7440.400	50.36	-3.50	74.0	23.64	Peak	360.00	100	Horizontal	Pass
5**	7440.400	40.45	-3.50	54.0	13.55	AV	360.00	100	Horizontal	Pass
6	9732.850	52.12	-0.49	74.0	21.88	Peak	360.00	100	Horizontal	Pass
6**	9732.850	42.29	-0.49	54.0	11.71	AV	360.00	100	Horizontal	Pass

LOW CHANNEL 1 GHz to 10 GHz, ANT V



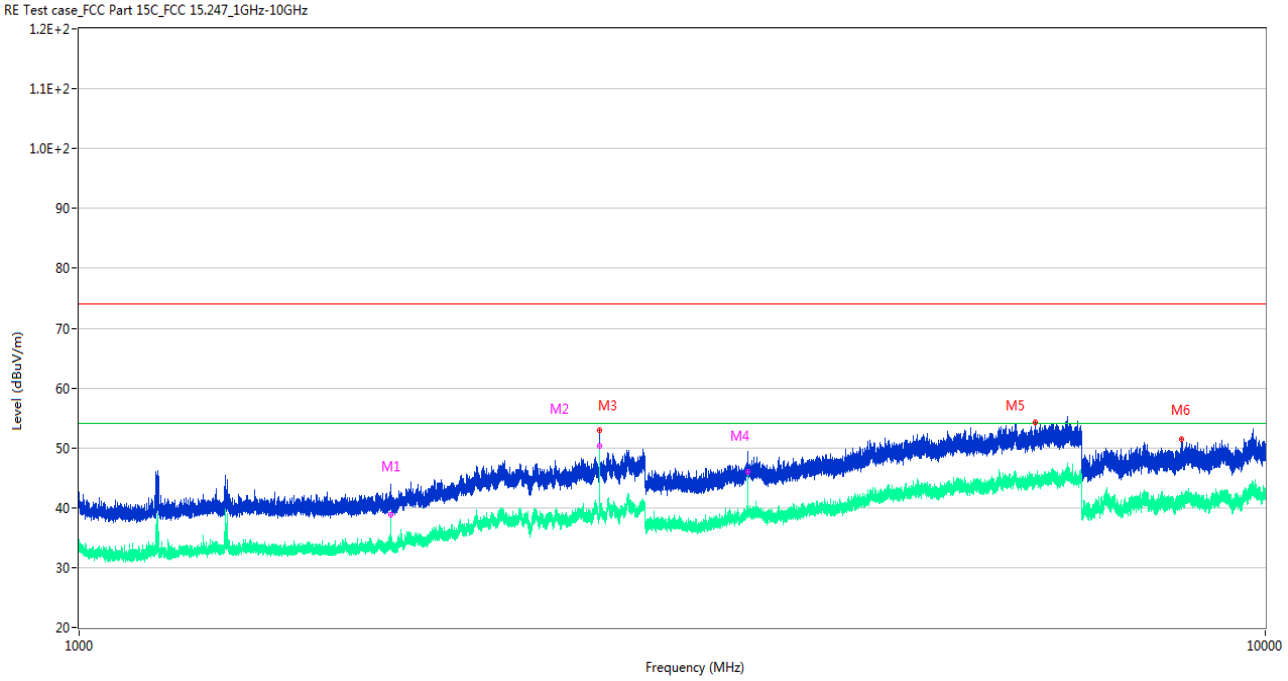
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1804.600	44.16	-12.88	74.0	29.84	Peak	130.00	150	Vertical	Pass
1**	1804.600	41.74	-12.88	54.0	12.26	AV	130.00	150	Vertical	Pass
2	2706.800	53.27	-7.23	74.0	20.73	Peak	207.00	100	Vertical	Pass
2**	2706.800	50.97	-7.23	54.0	3.03	AV	207.00	100	Vertical	Pass
3	2706.700	53.86	-7.24	74.0	20.14	Peak	212.00	150	Vertical	Pass
3**	2706.700	50.76	-7.24	54.0	3.24	AV	212.00	150	Vertical	Pass
4	3609.000	50.36	-6.54	74.0	23.64	Peak	107.00	150	Vertical	Pass
4**	3609.000	48.04	-6.54	54.0	5.96	AV	107.00	150	Vertical	Pass
5	6155.600	54.58	-0.06	74.0	19.42	Peak	255.00	200	Vertical	Pass
5**	6155.600	45.05	-0.06	54.0	8.95	AV	255.00	200	Vertical	Pass
6	8610.700	51.10	-2.15	74.0	22.90	Peak	143.00	100	Vertical	Pass
6**	8610.700	40.84	-2.15	54.0	13.16	AV	143.00	100	Vertical	Pass

MIDDLE CHANNEL 1 GHz to 10 GHz, ANT H



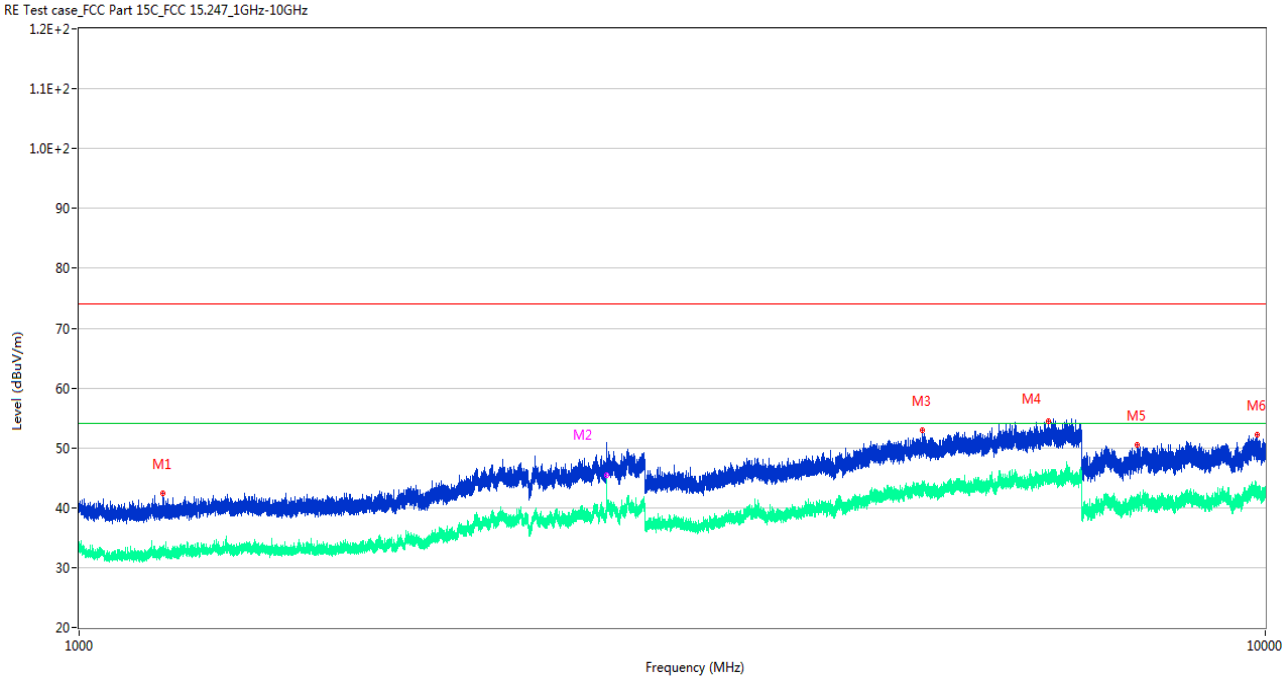
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1328.800	43.75	-13.45	74.0	30.25	Peak	135.00	100	Horizontal	Pass
1**	1328.800	33.95	-13.45	54.0	20.05	AV	135.00	100	Horizontal	Pass
2	1829.800	43.49	-12.56	74.0	30.51	Peak	135.00	150	Horizontal	Pass
2**	1829.800	38.38	-12.56	54.0	15.62	AV	135.00	150	Horizontal	Pass
3	2745.100	49.66	-6.83	74.0	24.34	Peak	21.00	200	Horizontal	Pass
3**	2745.100	46.27	-6.83	54.0	7.73	AV	21.00	200	Horizontal	Pass
4	3653.600	48.72	-5.59	74.0	25.28	Peak	145.00	100	Horizontal	Pass
4**	3653.600	38.82	-5.59	54.0	15.18	AV	145.00	100	Horizontal	Pass
5	6787.000	55.52	0.07	74.0	18.48	Peak	211.00	150	Horizontal	Pass
5**	6787.000	44.83	0.07	54.0	9.17	AV	211.00	150	Horizontal	Pass
6	9757.901	51.76	-0.39	74.0	22.24	Peak	42.00	150	Horizontal	Pass
6**	9757.901	42.80	-0.39	54.0	11.20	AV	42.00	150	Horizontal	Pass

MIDDLE CHANNEL 1 GHz to 10 GHz, ANT V



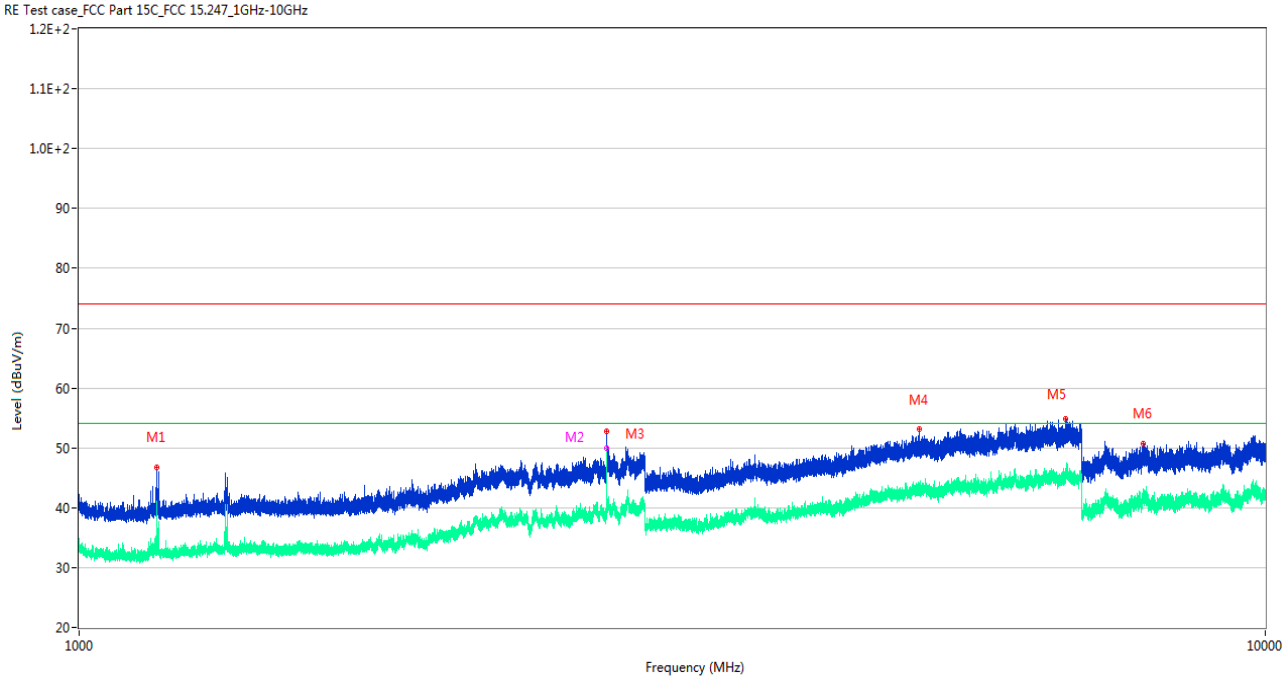
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1830.100	43.34	-12.55	74.0	30.66	Peak	133.00	200	Vertical	Pass
1**	1830.100	38.91	-12.55	54.0	15.09	AV	133.00	200	Vertical	Pass
2	2745.000	52.79	-6.84	74.0	21.21	Peak	226.00	100	Vertical	Pass
2**	2745.000	50.31	-6.84	54.0	3.69	AV	226.00	100	Vertical	Pass
3	2745.100	52.87	-6.83	74.0	21.13	Peak	226.00	150	Vertical	Pass
3**	2745.100	50.07	-6.83	54.0	3.93	AV	226.00	150	Vertical	Pass
4	3660.400	48.16	-5.68	74.0	25.84	Peak	113.00	150	Vertical	Pass
4**	3660.400	45.93	-5.68	54.0	8.07	AV	113.00	150	Vertical	Pass
5	6396.600	54.27	-1.12	74.0	19.73	Peak	79.00	200	Vertical	Pass
5**	6396.600	44.57	-1.12	54.0	9.43	AV	79.00	200	Vertical	Pass
6	8506.900	51.42	-1.41	74.0	22.58	Peak	0.00	100	Vertical	Pass
6**	8506.900	42.49	-1.41	54.0	11.51	AV	0.00	100	Vertical	Pass

HIGH CHANNEL 1 GHz to 10 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1175.600	42.40	-13.89	74.0	31.60	Peak	297.00	100	Horizontal	Pass
1**	1175.600	32.67	-13.89	54.0	21.33	AV	297.00	100	Horizontal	Pass
2	2783.600	48.16	-6.05	74.0	25.84	Peak	360.00	150	Horizontal	Pass
2**	2783.600	45.39	-6.05	54.0	8.61	AV	360.00	150	Horizontal	Pass
3	5134.200	52.93	-1.77	74.0	21.07	Peak	189.00	400	Horizontal	Pass
3**	5134.200	43.44	-1.77	54.0	10.56	AV	189.00	400	Horizontal	Pass
4	6562.000	54.47	-0.98	74.0	19.53	Peak	0.00	150	Horizontal	Pass
4**	6562.000	45.10	-0.98	54.0	8.90	AV	0.00	150	Horizontal	Pass
5	7802.200	50.54	-2.65	74.0	23.46	Peak	142.00	200	Horizontal	Pass
5**	7802.200	41.18	-2.65	54.0	12.82	AV	142.00	200	Horizontal	Pass
6	9853.600	52.12	-0.71	74.0	21.88	Peak	284.00	150	Horizontal	Pass
6**	9853.600	42.11	-0.71	54.0	11.89	AV	284.00	150	Horizontal	Pass

HIGH CHANNEL 1 GHz to 10 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1162.600	46.75	-13.92	74.0	27.25	Peak	33.00	150	Vertical	Pass
1**	1162.600	37.73	-13.92	54.0	16.27	AV	33.00	150	Vertical	Pass
2	2783.400	51.63	-6.06	74.0	22.37	Peak	246.00	100	Vertical	Pass
2**	2783.400	50.02	-6.06	54.0	3.98	AV	246.00	100	Vertical	Pass
3	2783.300	52.81	-6.06	74.0	21.19	Peak	218.00	150	Vertical	Pass
3**	2783.300	49.06	-6.06	54.0	4.94	AV	218.00	150	Vertical	Pass
4	5105.800	53.06	-2.25	74.0	20.94	Peak	116.00	100	Vertical	Pass
4**	5105.800	42.74	-2.25	54.0	11.26	AV	116.00	100	Vertical	Pass
5	6791.600	54.84	0.88	74.0	19.16	Peak	332.00	150	Vertical	Pass
5**	6791.600	45.37	0.88	54.0	8.63	AV	332.00	150	Vertical	Pass
6	7898.200	50.70	-3.04	74.0	23.30	Peak	189.00	400	Vertical	Pass
6**	7898.200	40.65	-3.04	54.0	13.35	AV	189.00	400	Vertical	Pass

A.9 Band Edge (Restricted-band band-edge)

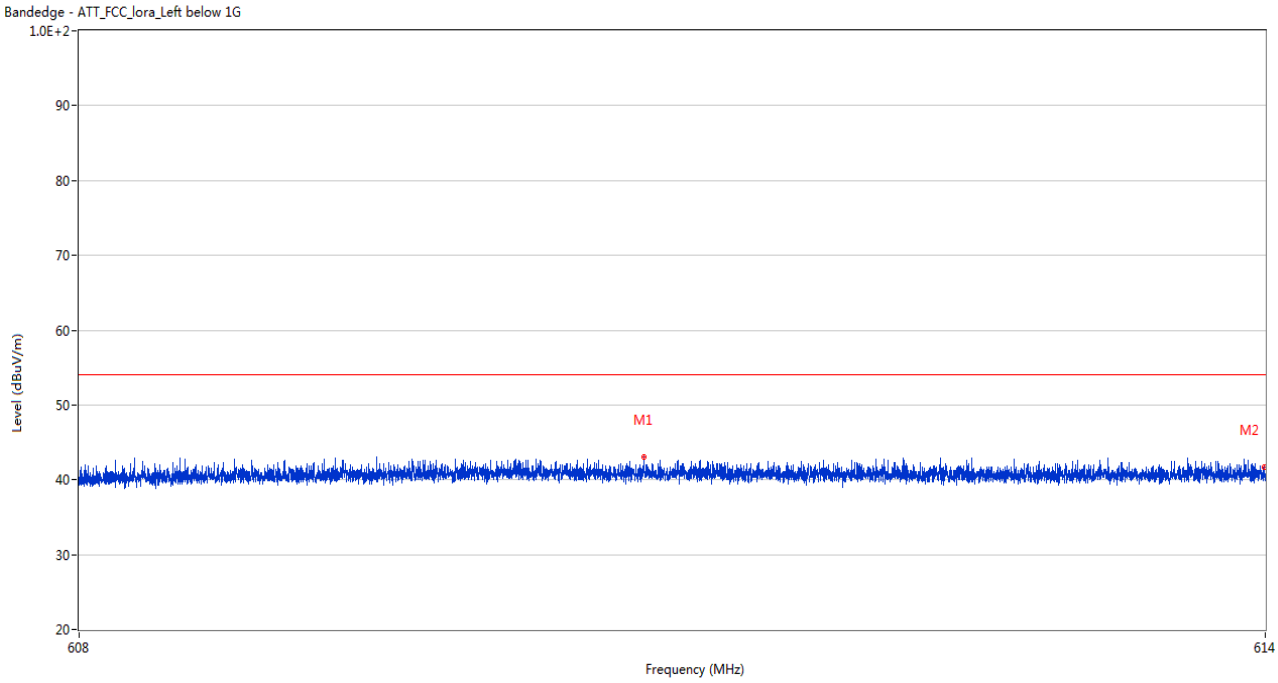
Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note [3]: According the ANSI C63.10-2013, 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.

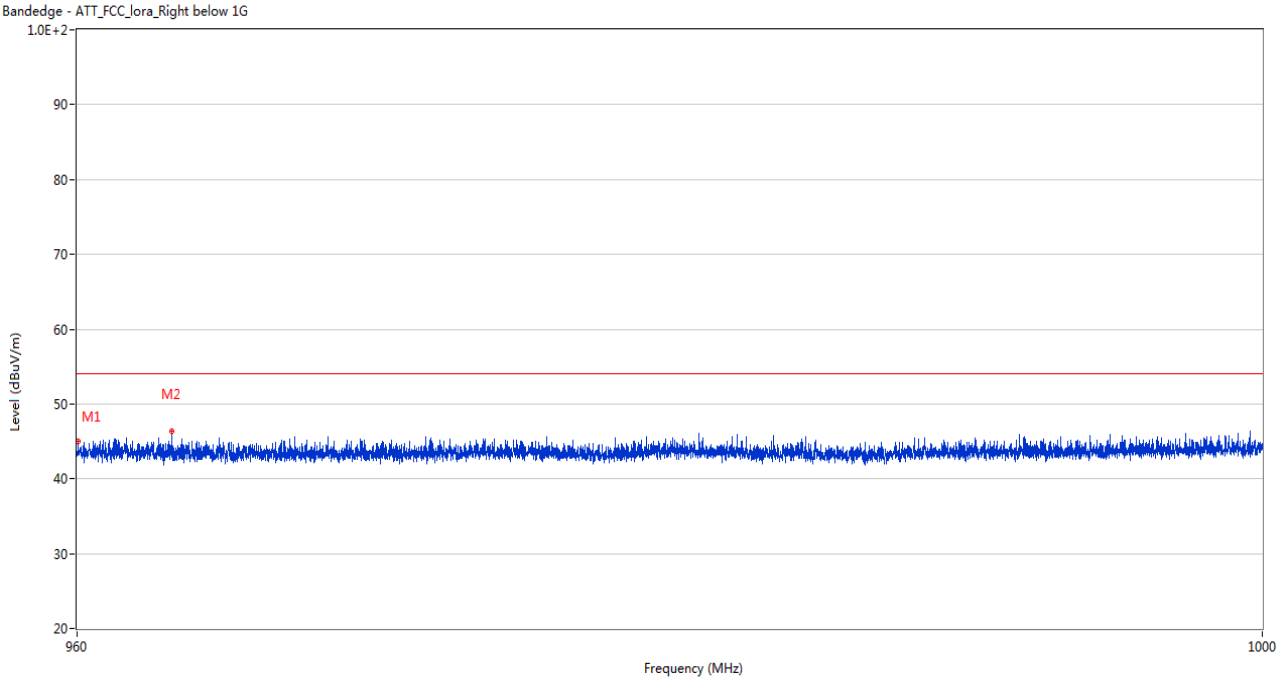
Test Data and Plots

LOW CHANNEL



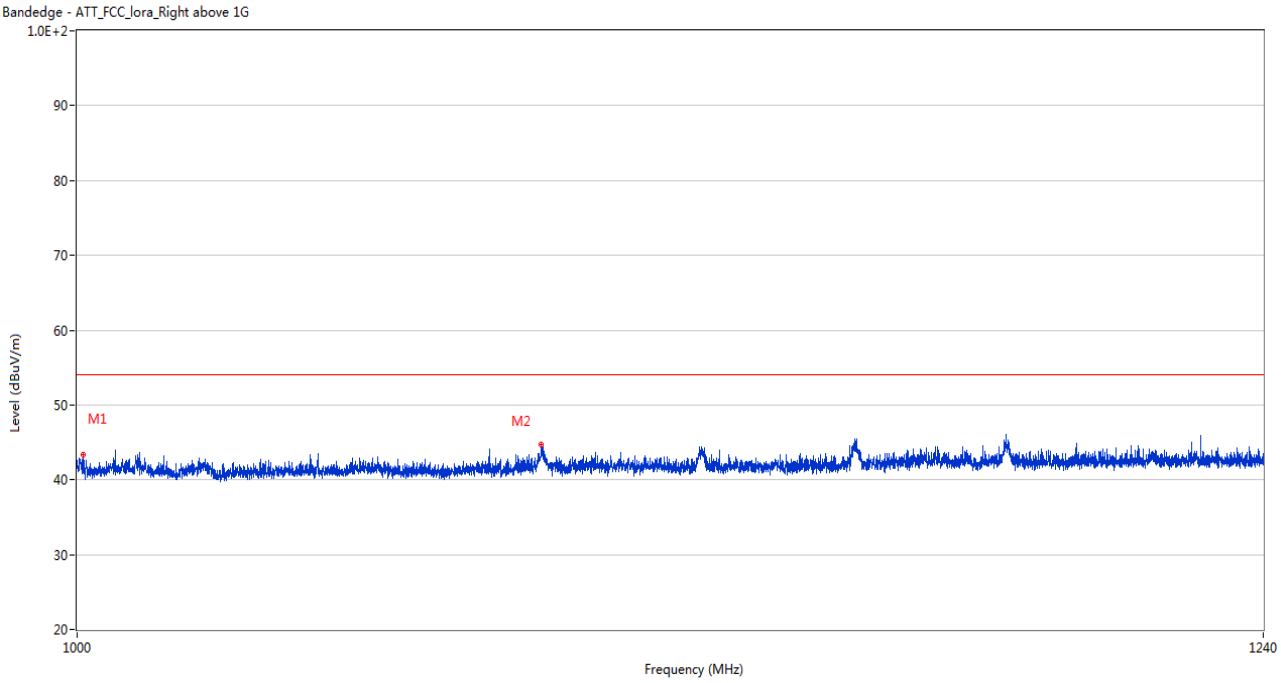
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	610.849	43.05	6.40	54.0	10.95	Peak	107.00	150	Horizontal	Pass
2	613.994	41.69	6.27	54.0	12.31	Peak	307.00	150	Horizontal	Pass

MIDDLE CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	960.027	44.97	9.61	54.0	9.03	Peak	274.00	150	Horizontal	Pass
2	963.133	46.33	9.57	54.0	7.67	Peak	133.00	150	Horizontal	Pass

HIGH CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1001.040	43.32	-12.54	54.0	10.68	Peak	340.00	150	Horizontal	Pass
2	1087.760	44.67	-12.97	54.0	9.33	Peak	135.00	150	Horizontal	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2461161-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2461161-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2461161-AI.PDF”.

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--END OF REPORT--