

TEST REPORT



CTK Co., Ltd.
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Report No.:
CTK-2017-01215
Page (1) / (27) Pages

1. Client

- Name : TO21 COMMS Co.,Ltd.
- Address : 2-504, Ace high-end tower, 61, Digital-ro-26-gil, Guro-gu, Seoul
152-724, Korea
- Date of Receipt : 2017-05-19

2. Manufacturer

- Name : TO21 COMMS Co.,Ltd.
- Address : 2-504, Ace high-end tower, 61, Digital-ro-26-gil, Guro-gu, Seoul
152-724, Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: Pocket Theater / RTSB7000L

5. Date of Test : 2017-05-29 to 2017-06-01

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247

7. Testing Environment: Temp.: (24 ± 5) °C, Humidity: (61 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by  Ji-hye, Kim: (Signature)	Technical Manager  Won-Jae, Hwang: (Signature)
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2017-06-13

Republic of KOREA **CTK Co., Ltd.**



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Page (2) / (27) Pages

REPORT REVISION HISTORY

Date	Revision	Page No
2017-06-13	Issued (CTK-2017-01215)	all

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1.0 General Product Description

FCC ID	2AMJ7-RTSB7000L										
Equipment model name	RTSB7000L										
Serial number	Prototype										
EUT condition	Pre-production, not damaged										
Frequency Range	802.11n_HT20 : 2412 MHz - 2462 MHz										
RF output power :											
<table><tr><td>Frequency Range (MHz)</td><td>Mode</td><td>Channel Bandwidth (MHz)</td><td>RF output power (dBm)</td></tr><tr><td>2412 - 2462</td><td>802.11n</td><td>20</td><td>9.03</td></tr></table>				Frequency Range (MHz)	Mode	Channel Bandwidth (MHz)	RF output power (dBm)	2412 - 2462	802.11n	20	9.03
Frequency Range (MHz)	Mode	Channel Bandwidth (MHz)	RF output power (dBm)								
2412 - 2462	802.11n	20	9.03								
Number of channels	11										
Transfer Rate	802.11n : up to 72.2 Mbps										
Type of Modulation	802.11n : OFDM										
Power Source	DC 3.7 V										
Duty Cycle	802.11n_HT20 : 97.8 %										
Antenna Type	PCB antenna										
Antenna Gain	-2 dBi										
Hardware Rev	1.2										
Software Rev	1.0.0										
Firmware Rev	2.2										

1.1 Tested Frequency

Test Item	Modulation	Data Rate
6 dB Bandwidth Maximum Output Power Conducted Spurious emission Band Edge Power Spectral Density Radiated Emissions Above 1GHz	802.11n	MCS 0
Radiated Emissions Below 1GHz AC Conducted Emissions	Nomal Mode	Auto

1.2 EUT Operation Test Setup

For WLAN function, the engineering test program was provided and enabled to make EUT continuous transmit/receive.

1.3 Tested Frequency

802.11n_HT20

	LOW	MID	HIGH
Frequency (MHz)	2412	2437	2462

1.4 Device Modifications

The following modifications were necessary for compliance:

	 Core penetration:EMI-5525 _Taejin INT
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1.5 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	ProBook 650 G1	5CG5114KD2
AC ADAPTER	HP	PPP012D-S	-
AC / DC ADAPTER	TIANJIN E&P ELECTRONICS Inc.	ETA-U90KWK	DK3D314TS/B-E

1.6 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

1.7 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.8 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.0 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	Maximum Output Power	< 1 Watt		C
15.247(d)	Conducted Spurious emission	> 30 dBc		C
15.247(d)	Band Edge	> 30 dBc		C
15.247(e)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz		C
				C
15.209	Field Strength of Harmonics	15.209(a)	Radiated	C
15.207	AC Conducted Emissions	15.207(a)	Line Conducted	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

The sample was tested according to the following specification:
- FCC Part 15.247, ANSI C63.10-2013

The tests were performed according to the method of measurements prescribed in
KDB No.558074.

2.1 Technical Characteristic Test

2.1.1 ON Time, Duty Cycle

Procedure:

KDB 558074 Zero-Span Spectrum Analyzer Method.

Test Data:

	ON Time (ms)	Period (ms)	TX OFF (ms)	Duty Cycle (linear)	Duty Cycle (%)
802.11n_HT20	1.335	1.365	0.030	0.978	97.8



Duty Cycle_802.11n_HT20

2.1.2 6dB Bandwidth

Test Procedures(ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Procedures(ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

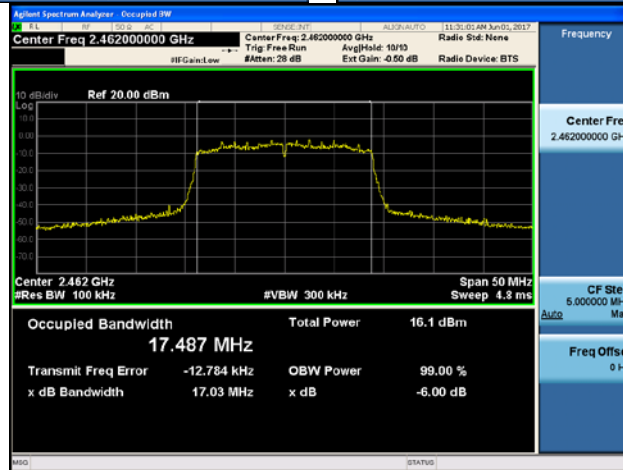
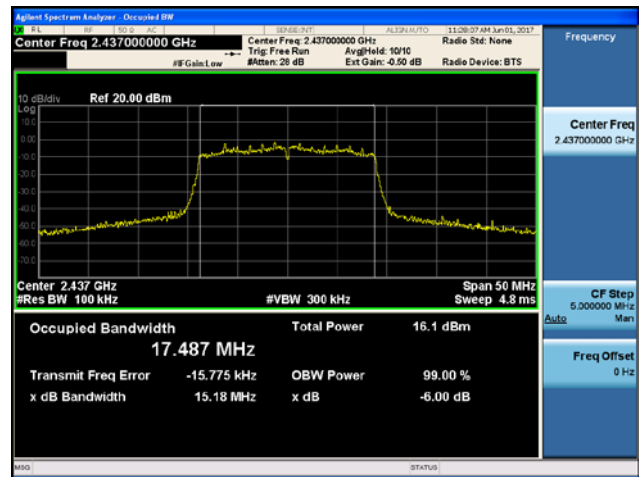
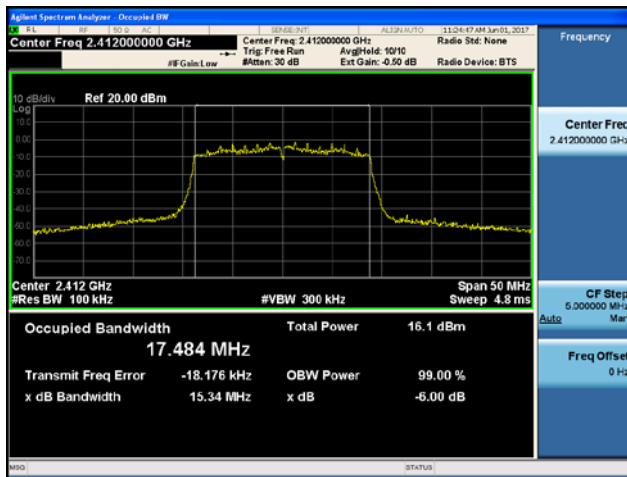
- a) RBW = 100 kHz
- b) VBW $\geq 3 \times$ RBW
- c) Detector = peak
- d) Trace mode = Max hold
- e) Sweep = auto couple
- f) Allow trace to fully stabilize
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Minimum Standard:

6 dB Bandwidth > 500kHz

Test Data:

	6 dB Bandwidth and 99% Bandwidth (MHz)					
Frequency	2412 MHz		2437 MHz		2462 MHz	
Mode	6dB	99%	6dB	99%	6dB	99%
802.11n HT20	15.34	17.48	15.18	17.49	17.03	17.49
Measurement uncertainty	± 3 dB					



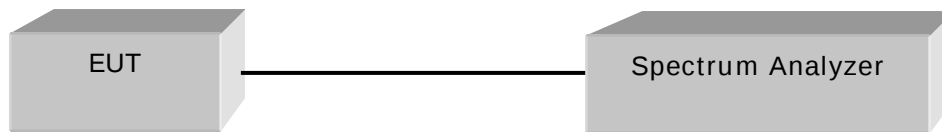
802.11n_HT20

2.1.3 OUTPUT POWER

Test Procedures

Average Power(Procedure 9.2.2.2 in KDB 558074, Method AVGSA-1)

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



Test Settings:

Center frequency = the highest, middle and the lowest channels

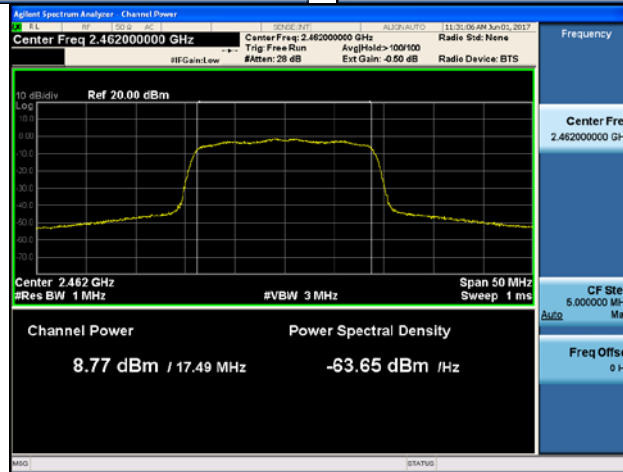
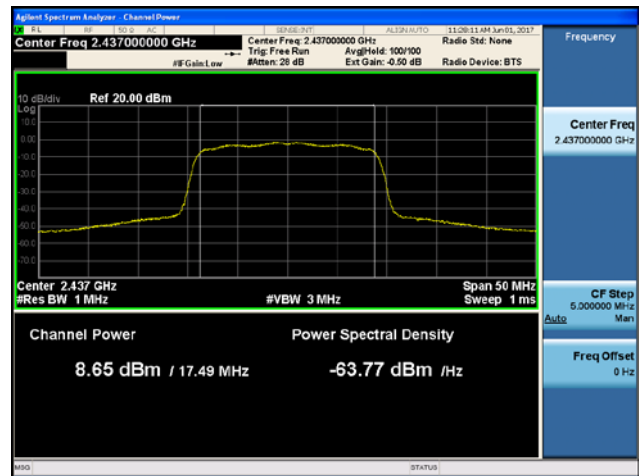
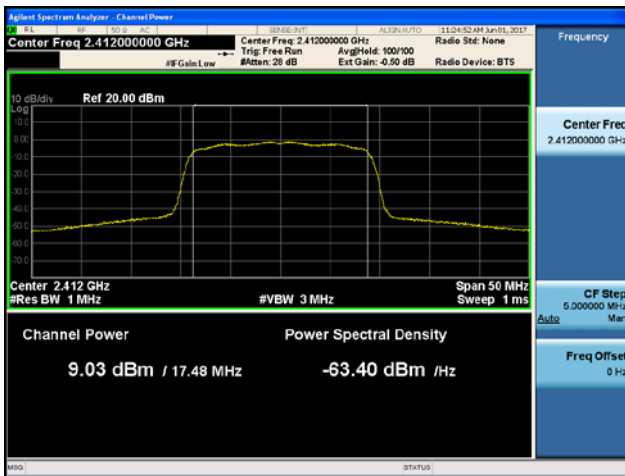
- | | |
|--------------------------------------|-------------------------|
| a) span $\geq 1.5 \times \text{OBW}$ | b) RBW = 1 MHz |
| c) VBW $\geq 3 \times \text{RBW}$ | d) Sweep time = auto |
| e) Detector = RMS | f) average at least 100 |

Limit

Mode	ANT Gain (dBi)	Limit (dBm)
802.11n_HT20	-2	30

Test Data

Mode	Measured Output Power (dBm)		
	2412 MHz	2437 MHz	2462 MHz
802.11n_HT20	9.03	8.65	8.77
Measurement uncertainty	± 3 dB		



802.11n

2.1.4 Power Spectral Density

Procedure:

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Test Settings:

Center frequency = the highest, middle and the lowest channels

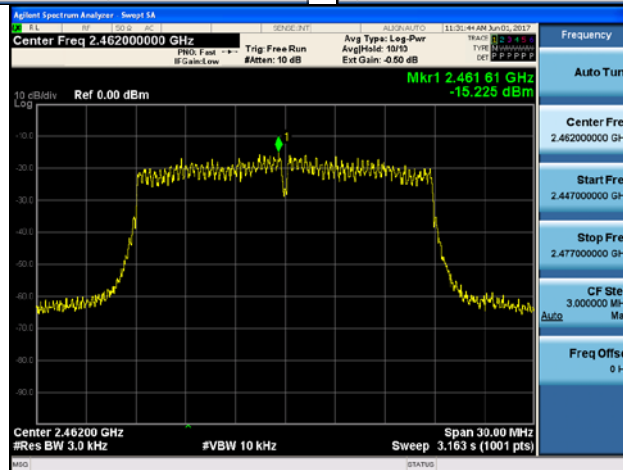
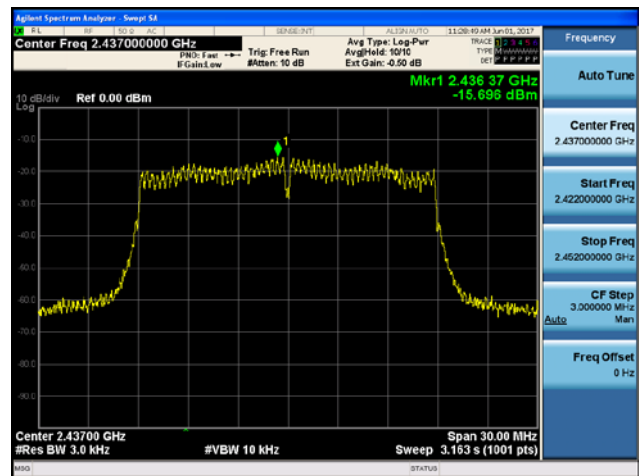
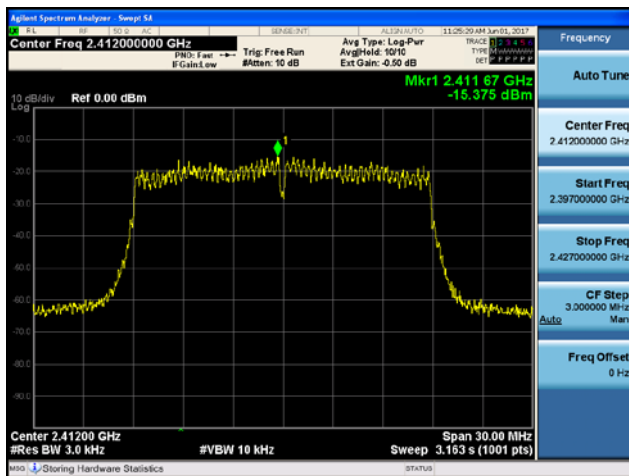
- a) RBW : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- b) VBW $\geq 3 \times \text{RBW}$
- c) span $\geq 1.5 \times \text{DTS bandwidth}$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode = max hold
- g) Allow trace to fully stabilize
- h) Use the peak marker function to determine the maximum amplitude level within the RBW.

Limit

Mode	ANT Gain (dBi)	Limit (dBm)
802.11n_HT20	-2	8

Test Data

Measured Power Density (dBm)			
Mode	2412 MHz	2437 MHz	2462 MHz
802.11n_HT20	-15.37	-15.69	-15.22
Measurement uncertainty	± 3 dB		



802.11n

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2.1.5 Band - edge

Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW $\geq 3 \times$ RBW
- c) Detector = peak
- d) Sweep time = auto couple
- e) Trace mode= max hold
- f) Allow trace to fully stabilize
- g) Use the peak marker function to determine the maximum amplitude level.

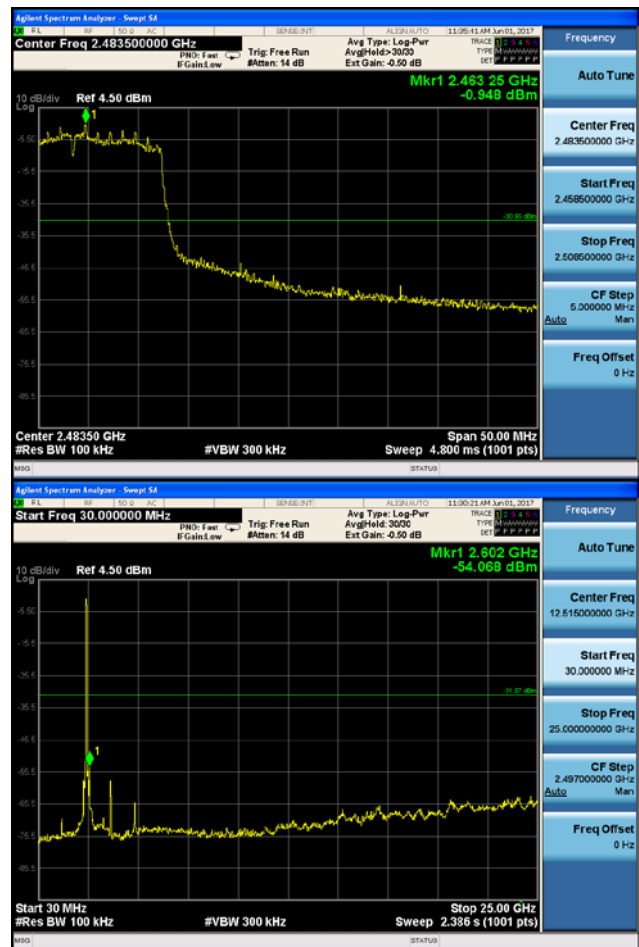
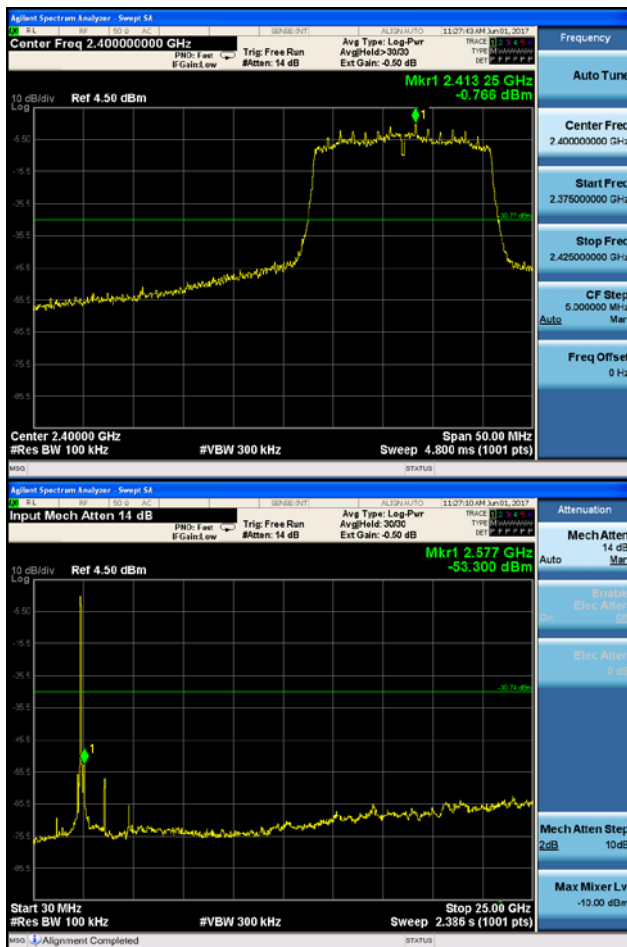
Limit :

Emission level < 30 dBc

Test Data: Complies

- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 30dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.



802.11n

2.1.6 Field Strength of Emissions

Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Test Settings:

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
- b) VBW $\geq$ RBW
- c) Sweep time = auto couple

Limit

- 15.209(a)

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

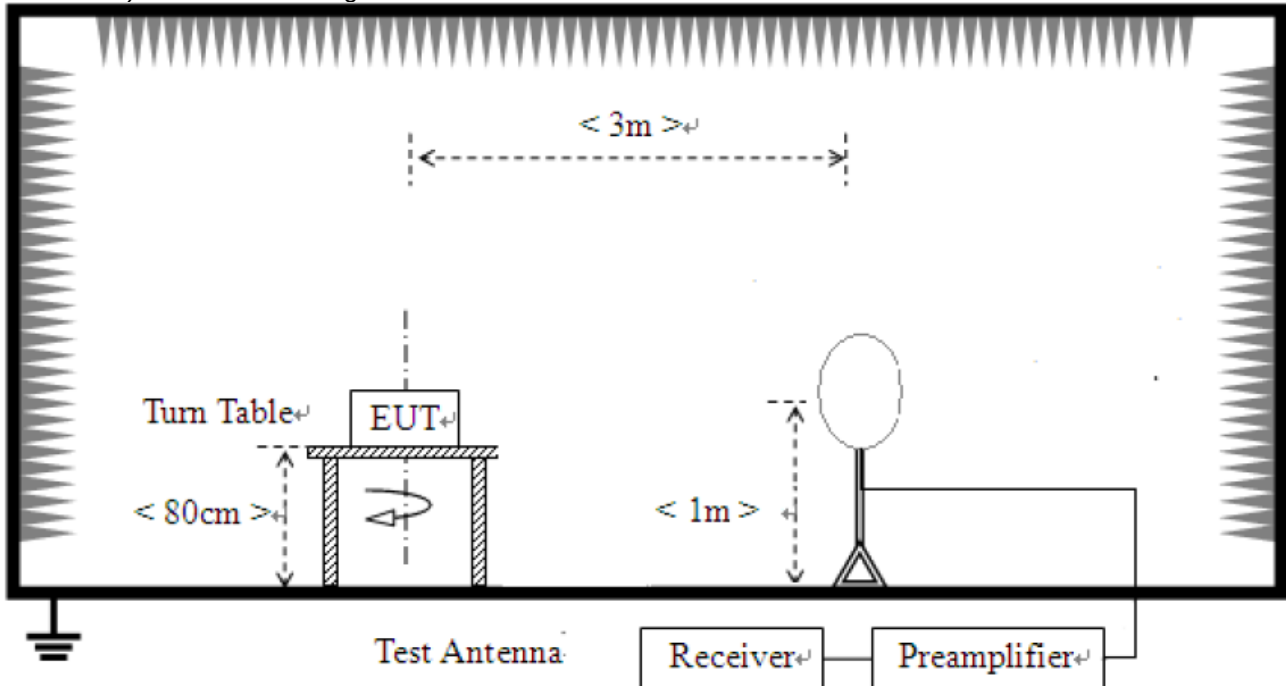
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

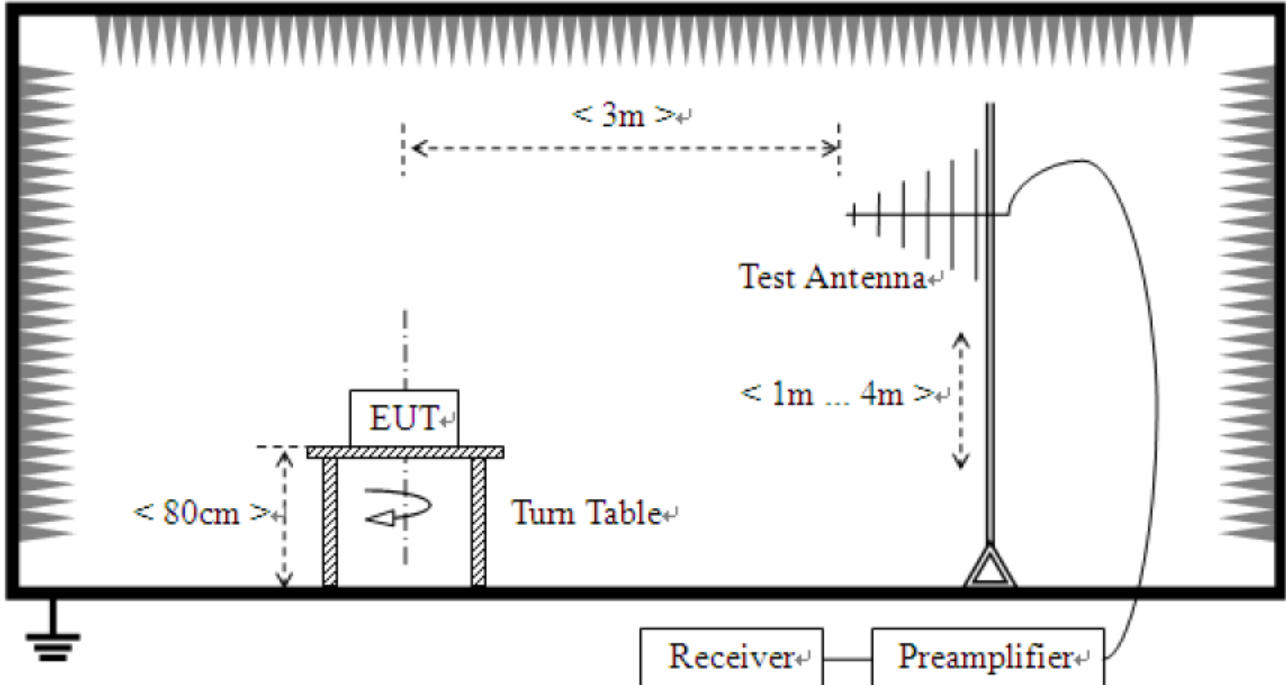
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

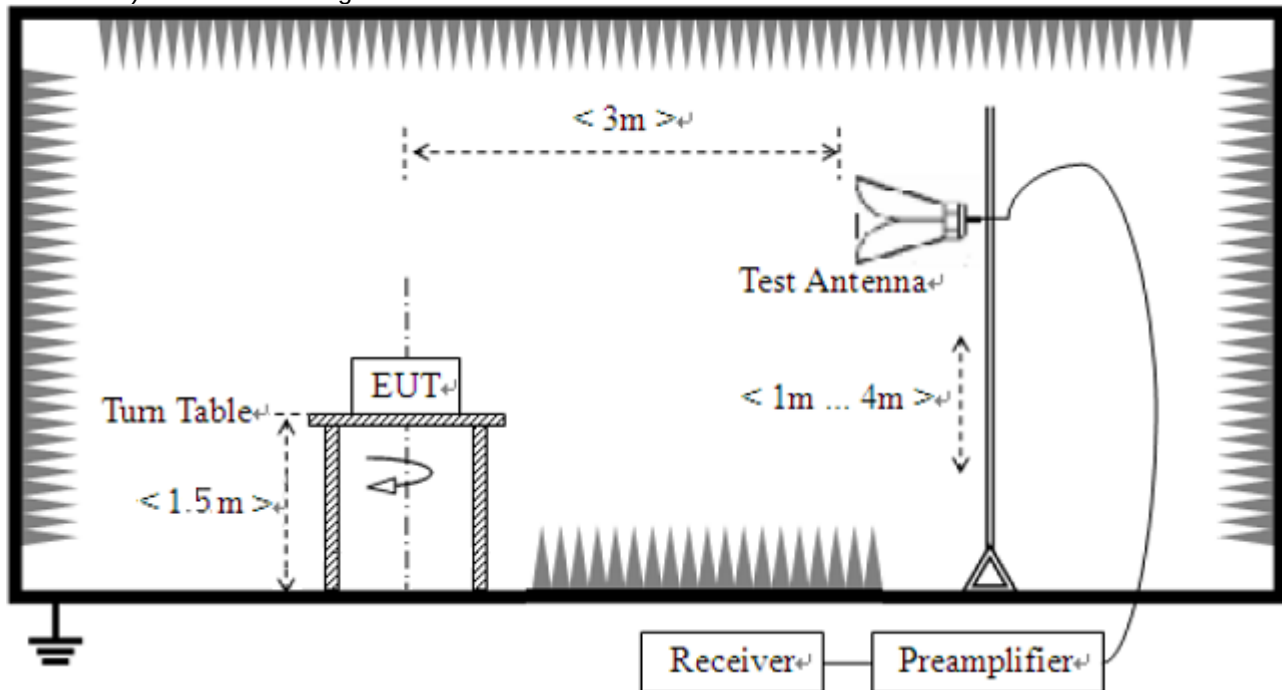
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



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Test Results

1) 9 kHz to 30 MHz

EUT	Pocket Theater	Measurement Detail	
Model	RTSB7000L	Frequency Range	9 kHz – 30 MHz
Test mode	802.11n	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)

2) 30 MHz to 1 GHz

Test mode : 802.11n(Worst Case)

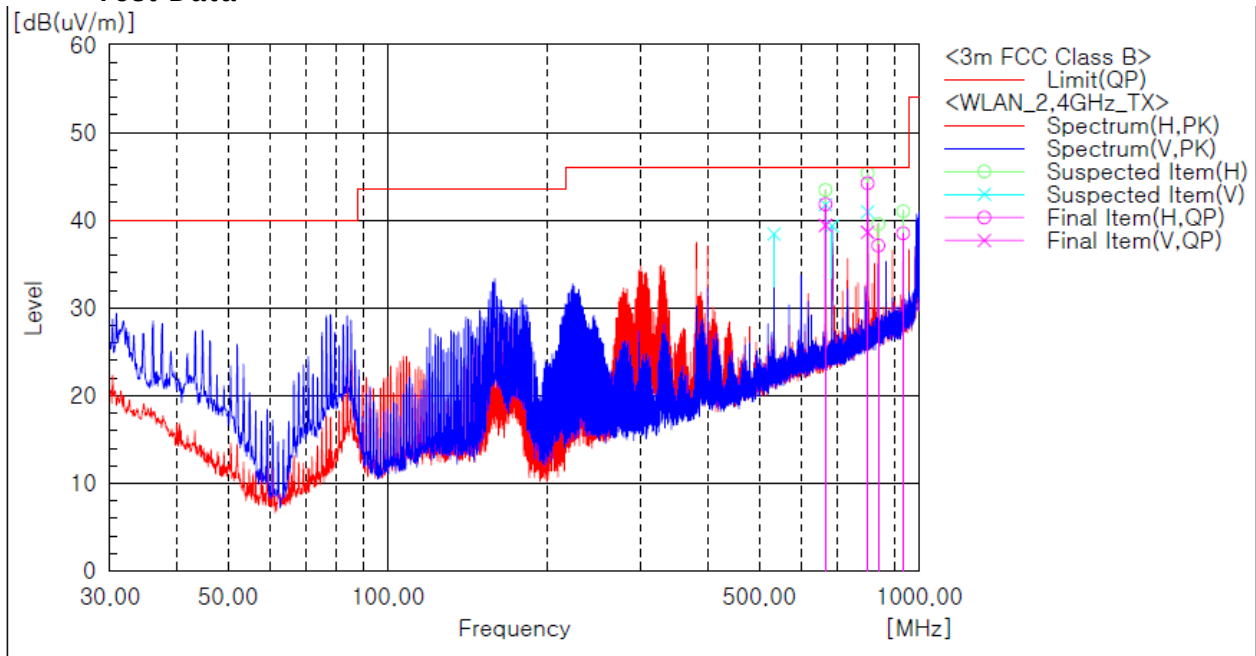
EUT	Pocket Theater	Measurement Detail	
Model	RTSB7000L	Frequency Range	Below 1000MHz
Configuration	802.11n	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
800.180	44.2	1.8	Quasi-peak

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	666.684	H	41.9	-0.1	41.8	46.0	4.2	101.0	0.0
2	666.684	V	39.5	-0.1	39.4	46.0	6.6	101.0	322.0
3	800.059	V	36.0	2.6	38.6	46.0	7.4	200.0	300.0
4	800.180	H	41.6	2.6	44.2	46.0	1.8	101.0	322.0
5	838.131	H	33.7	3.4	37.1	46.0	8.9	101.0	87.0
6	933.312	H	33.1	5.4	38.5	46.0	7.5	101.0	4.0

Remark :

1. The field strength of spurious emission was measured in the following position: EUT and antenna stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.

3) above 1 GHz

Test mode : 802.11n

EUT	Pocket Theater	Measurement Detail	
Model	RTSB7000L	Frequency Range	1-25GHz
Mode	802.11n	Detector function	Average / Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (Z axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4924.00	52.97	1.03	Average

Ch.1(2412 MHz)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1200.00	H	54.00	74.00	36.19	50.93	17.81	23.07
1980.00	H	54.00	74.00	40.70	50.29	13.30	23.71
1980.00	V	54.00	74.00	46.77	50.74	7.23	23.26
2390.00	H	54.00	74.00	35.76	48.61	18.24	25.39
2390.00	V	54.00	74.00	41.23	53.69	12.77	20.31
4824.00	H	54.00	74.00	39.53	53.02	14.47	20.98
4824.00	V	54.00	74.00	48.61	62.00	5.39	12.00
7236.00	V	54.00	74.00	41.15	55.00	12.85	19.00

Ch.6(2437 MHz)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1200.00	H	54.00	74.00	35.52	47.05	18.48	26.95
1980.00	H	54.00	74.00	39.34	51.19	14.66	22.81
1980.00	V	54.00	74.00	38.94	49.26	15.06	24.74
4874.00	H	54.00	74.00	40.69	54.94	13.31	19.06
4874.00	V	54.00	74.00	49.90	62.30	4.10	11.70
7311.00	V	54.00	74.00	41.34	52.36	12.66	21.64

Ch.11(2462 MHz)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1200.00	H	54.00	74.00	37.84	49.88	16.16	24.12
1980.00	H	54.00	74.00	41.6	55.99	12.40	18.01
1980.00	V	54.00	74.00	40.9	55.58	13.14	18.42
2483.50	H	54.00	74.00	37.49	49.98	16.51	24.02
2483.50	V	54.00	74.00	42.86	54.74	11.14	19.26
4924.00	H	54.00	74.00	41.73	52.68	12.27	21.32
4924.00	V	54.00	74.00	52.97	65.30	1.03	8.70
7386.00	V	54.00	74.00	41.94	54.47	12.06	19.53

2.1.7 AC Conducted Emissions

Test Location
Shielded Room

Frequency Range of Measurement
150 kHz to 30 MHz

Instrument Settings
IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

- **15.207(a)**

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency.

Test Results
The requirements are:

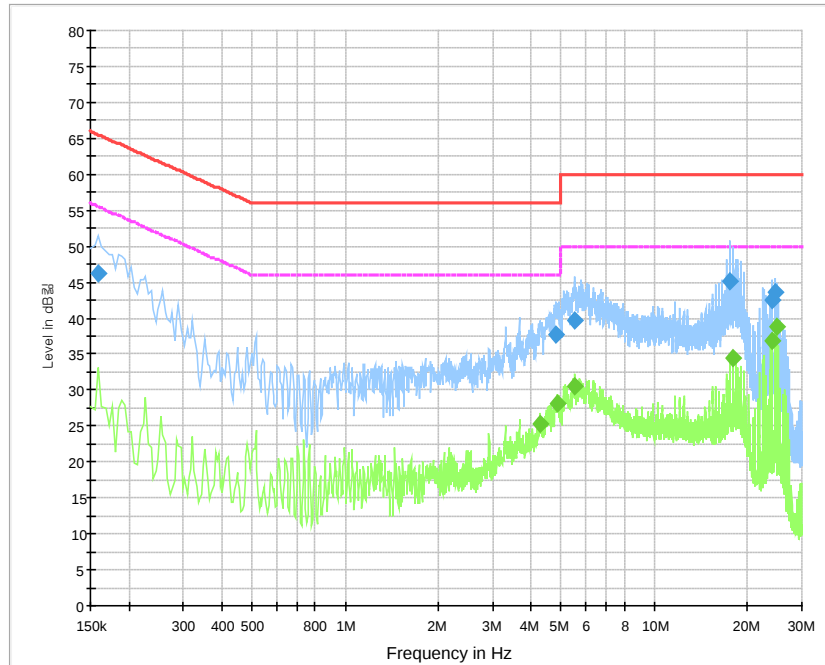
☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
24.882 000	38.8	11.2	Average

Test Data

[LINE]

Class B_L1



Final Result 1

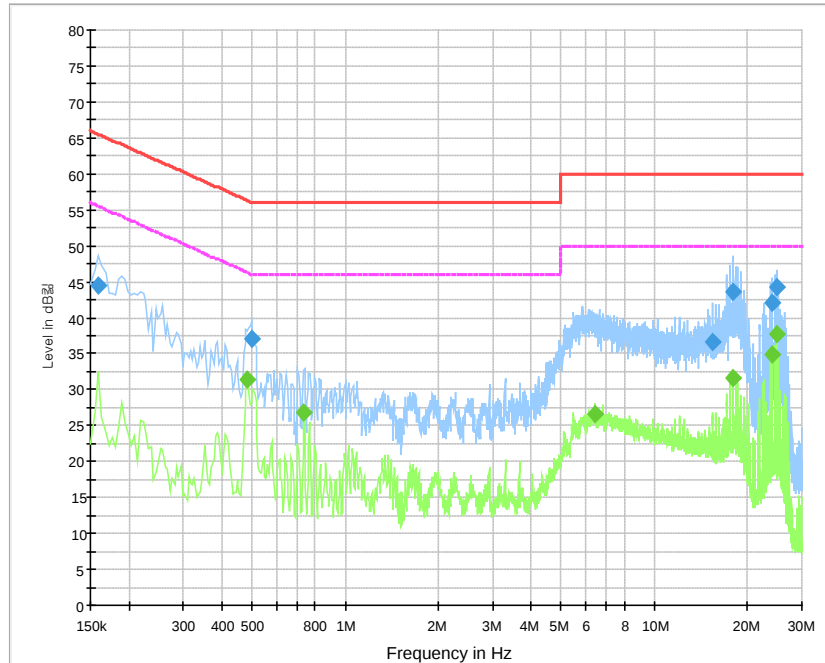
Frequency (MHz)	QuasiPeak (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.159000	46.1	1000.0	9.000	On	L1	9.8	19.4	65.5
4.812000	37.6	1000.0	9.000	On	L1	9.8	18.4	56.0
5.550000	39.8	1000.0	9.000	On	L1	9.8	20.2	60.0
17.560500	45.2	1000.0	9.000	On	L1	9.9	14.8	60.0
24.148500	42.4	1000.0	9.000	On	L1	10.0	17.6	60.0
24.513000	43.7	1000.0	9.000	On	L1	10.0	16.3	60.0

Final Result 2

Frequency (MHz)	CAverage (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
4.276500	25.3	1000.0	9.000	On	L1	9.8	20.7	46.0
4.843500	28.1	1000.0	9.000	On	L1	9.8	17.9	46.0
5.536500	30.6	1000.0	9.000	On	L1	9.8	19.4	50.0
17.934000	34.4	1000.0	9.000	On	L1	9.9	15.6	50.0
24.153000	36.9	1000.0	9.000	On	L1	10.0	13.1	50.0
24.882000	38.8	1000.0	9.000	On	L1	10.0	11.2	50.0

[NEUTRAL]

Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.159000	44.5	1000.0	9.000	On	N	9.8	21.1	65.5
0.496500	37.2	1000.0	9.000	On	N	9.9	18.9	56.1
15.369000	36.7	1000.0	9.000	On	N	10.0	23.3	60.0
17.925000	43.5	1000.0	9.000	On	N	10.0	16.5	60.0
24.148500	42.2	1000.0	9.000	On	N	10.1	17.8	60.0
24.882000	44.3	1000.0	9.000	On	N	10.1	15.7	60.0

Final Result 2

Frequency (MHz)	CAverage (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.483000	31.4	1000.0	9.000	On	N	9.9	14.9	46.3
0.735000	26.8	1000.0	9.000	On	N	9.8	19.2	46.0
6.391500	26.6	1000.0	9.000	On	N	9.8	23.4	50.0
17.929500	31.6	1000.0	9.000	On	N	10.0	18.4	50.0
24.153000	35.0	1000.0	9.000	On	N	10.1	15.0	50.0
24.882000	37.7	1000.0	9.000	On	N	10.1	12.3	50.0

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Rohde & Schwarz	FSV30	100925	2017-02-02	2018-02-02
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2016-11-01	2017-11-01
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2016-11-01	2017-11-01
4	Bilog Antenna	Schaffner	CBL6111C	2551	2016-05-13	2018-05-13
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2016-05-25	2018-05-25
6	6dB Attenuator	R&S	DNF	272.4110.50-2	2016-11-01	2017-11-01
7	6dB Attenuator	R&S	DNF	272.4110.50-1	2017-02-03	2018-02-03
8	AMPLIFIER	SONOMA	310	291721	2017-02-02	2018-02-02
9	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2017-05-12	2018-05-12
10	LISN	Rohde & Schwarz	ENV216	101760	2017-02-03	2018-02-03
11	Preamplifier	Agilent	8449B	3008A02011	2016-12-01	2017-12-01
12	Horn Antenna	ETS-Lindgren	3115	00078894	2015-09-02	2017-09-02
13	Horn Antenna	ETS-Lindgren	3116	00062504	2015-09-04	2017-09-04
14	Horn Antenna	ETS-Lindgren	3117	00154525	2015-09-02	2017-09-02
15	Band Reject Filter	Micro Tronics	BRM50702	G233	2017-02-03	2018-02-03
16	Band Reject Filter	Micro Tronics	BRM50716	G184	2017-02-03	2018-02-03
17	Temp&Humi Chamber	ESPEC CORP.	SH-241	92000872	2017-02-02	2018-02-02