

TEST REPORT

Reference No..... : WTH20X12103639W
FCC ID : N73-UT33
Applicant : Mine Site Technologies Pty Ltd
Address..... : 113 Wicks Road, North Ryde, NSW, 2113, Australia
Product Name : UT33 Tag
Test Model. : ET3310
Standards : FCC Part 15.247
Date of Receipt sample : Dec.29, 2020
Date of Test..... : Dec.29, 2020 to Mar.15, 2021
Date of Issue : Mar.15, 2021
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:

Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road,
Block 70 Bao'an District, Shenzhen, Guangdong, China

Tel.: +86-755-33663308

Fax.: +86-755-33663309

Tested by:

Reviewed By:

Approved & Authorized By:

Jack Huang

Lion Cai

Silin Chen

Jack Huang / Project Engineer

Lion Cai / RF Manager

Silin Chen / Manager

TABLE OF CONTENTS

1. GENERAL INFORMATION	4
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	4
1.2 TEST STANDARDS.....	5
1.3 TEST METHODOLOGY	5
1.4 TEST FACILITY	5
1.5 EUT SETUP AND TEST MODE.....	6
1.6 MEASUREMENT UNCERTAINTY	7
1.7 TEST EQUIPMENT LIST AND DETAILS	8
2. SUMMARY OF TEST RESULTS	10
3. ANTENNA REQUIREMENT	11
3.1 STANDARD APPLICABLE.....	11
3.2 EVALUATION INFORMATION.....	11
4. POWER SPECTRAL DENSITY	12
4.1 STANDARD APPLICABLE.....	12
4.2 TEST SETUP BLOCK DIAGRAM	12
4.3 TEST PROCEDURE.....	12
4.4 SUMMARY OF TEST RESULTS/PLOTS	12
5. DTS BANDWIDTH	13
5.1 STANDARD APPLICABLE.....	13
5.2 TEST SETUP BLOCK DIAGRAM	13
5.3 TEST PROCEDURE.....	13
5.4 SUMMARY OF TEST RESULTS/PLOTS	13
6. RF OUTPUT POWER	14
6.1 STANDARD APPLICABLE.....	14
6.2 TEST SETUP BLOCK DIAGRAM	14
6.3 TEST PROCEDURE.....	14
6.4 SUMMARY OF TEST RESULTS/PLOTS	14
7. FIELD STRENGTH OF SPURIOUS EMISSIONS	15
7.1 STANDARD APPLICABLE.....	15
7.2 TEST PROCEDURE.....	15
7.3 CORRECTED AMPLITUDE & MARGIN CALCULATION.....	17
7.4 SUMMARY OF TEST RESULTS/PLOTS	17
8. OUT OF BAND EMISSIONS	25
8.1 STANDARD APPLICABLE.....	25
8.2 TEST PROCEDURE.....	25
8.3 SUMMARY OF TEST RESULTS/PLOTS	26
9. CONDUCTED EMISSIONS	30
9.1 TEST PROCEDURE.....	30
9.2 BASIC TEST SETUP BLOCK DIAGRAM.....	30
9.3 TEST RECEIVER SETUP	30
9.4 SUMMARY OF TEST RESULTS/PLOTS	30
APPENDIX SUMMARY	33
APPENDIX A	34
APPENDIX B	36
APPENDIX C	38
APPENDIX D	40
APPENDIX PHOTOGRAPHS	42

Report version

Version No.	Date of issue	Description
Rev.00	Mar.15, 2021	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Mine Site Technologies Pty Ltd
Address of applicant:	113 Wicks Road, North Ryde, NSW, 2113, Australia
Manufacturer:	Mine Site Technologies China Co. Ltd.
Address of manufacturer:	4F Building, 1413 Moganshan Road, Hangzhou, China

General Description of EUT	
Product Name:	UT33 Tag
Trade Name:	MINE SITE TECHNOLOGIES
Model No.:	ET3310
Adding Model(s):	PT3311
Rated Voltage:	DC 3.6V
Battery Capacity	/
Power Adapter Model:	/
<p><i>Note: The test data is gathered from a production sample provided by the manufacturer. The appearance of others models listed in the report is different from main-test model ET3310, but the circuit and the electronic construction do not change, declared by the manufacturer.</i></p>	

Technical Characteristics of EUT	
Support Standards:	802.11b
Frequency Range:	2412-2462MHz for 802.11b
RF Output Power:	13.73dBm (Conducted)
Type of Modulation:	DBPSK,BPSK,DQPSK,QPSK
Quantity of Channels:	11 for 802.11b
Channel Separation:	5MHz
Type of Antenna:	Chip Antenna
Antenna Gain:	1.5dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

558074 D01 15.247 Meas Guidance v05r02: 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.

662911 D01 Multiple Transmitter Output v02r01: Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 662911 D01 Multiple Transmitter Output v02r01

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory

Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

FCC – Registration No.: 125990

Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	802.11b	Low:2412MHz, Middle:2437MHz,High:2462MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	50~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
AC Cable	0.80	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
TRAK Orb	Mine Site	CL01	/
ADAPTER	/	HXY-049V2000A	/
Notebook	Lenovo	E445	EB12648265

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Power Spectral Density	Conducted	$\pm 1.8\text{dB}$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	9-150kHz $\pm 3.74\text{dB}$
		0.15-30MHz $\pm 3.34\text{dB}$
Transmitter Spurious Emissions	Radiated	30-200MHz $\pm 4.52\text{dB}$
		0.2-1GHz $\pm 5.56\text{dB}$
		1-6GHz $\pm 3.84\text{dB}$
		6-26GHz $\pm 3.92\text{dB}$

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2020-04-28	2021-04-27
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2020-04-28	2021-04-27
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2020-04-28	2021-04-27
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2020-04-28	2021-04-27
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2020-04-28	2021-04-27
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2019-05-05	2021-05-04
SEMT-1042	Horn Antenna	ETS	3117	00086197	2019-05-05	2021-05-04
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2019-05-05	2021-05-04
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2019-05-05	2021-05-04
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2020-04-28	2021-04-27
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2020-04-28	2021-04-27
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2020-04-28	2021-04-27
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2020-04-28	2021-04-27
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2020-04-28	2021-04-27
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2020-04-28	2021-04-27
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2019-05-05	2021-05-04
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2020-04-28	2021-04-27
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2020-04-28	2021-04-27
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2020-04-28	2021-04-27
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2020-03-17	2021-03-16
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2020-03-17	2021-03-16
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2020-03-17	2021-03-16
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2020-03-17	2021-03-16
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2020-03-17	2021-03-16
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2020-03-17	2021-03-16

Software List			
Description	Manufacturer	Model	Version
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

*Remark: indicates software version used in the compliance certification testing

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§15.203; §15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§15.207(a)	Conducted Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.247(a)(2)	DTS Bandwidth	Compliant
§15.247(b)(3)	RF Output Power	Compliant
§15.209(a)	Radiated Emission	Compliant
§15.247(d)	Band Edge (Out of Band Emissions)	Compliant

N/A: Not applicable

3. Antenna Requirement

3.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Evaluation Information

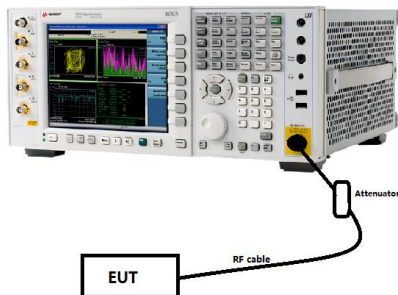
This product has a Chip antenna, fulfill the requirement of this section.

4. Power Spectral Density

4.1 Standard Applicable

According to 15.247(a)(1)(iii), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.2 Test Setup Block Diagram



4.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.3, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set span to at least 1.5 times the OBW.
- c) Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set VBW $\geq 3 \times \text{RBW}$.
- e) Detector = power averaging (RMS) or sample detector (when RMS not available).
- f) Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span}/\text{RBW}$.
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

4.4 Summary of Test Results/Plots

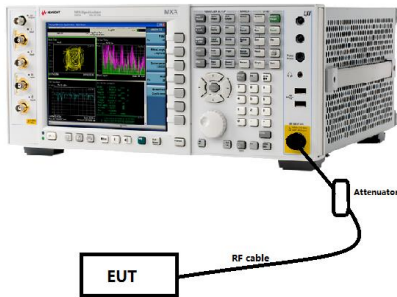
Please refer to Appendix A

5. DTS Bandwidth

5.1 Standard Applicable

According to 15.247(a)(2), systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2 Test Setup Block Diagram



5.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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.

5.4 Summary of Test Results/Plots

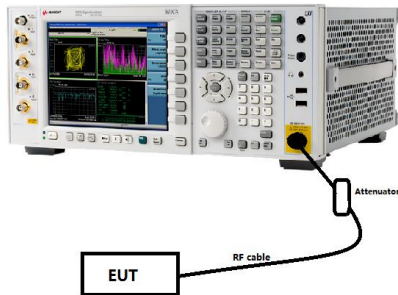
Please refer to Appendix B

6. RF Output Power

6.1 Standard Applicable

According to 15.247(b)(3), for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

6.2 Test Setup Block Diagram



6.3 Test Procedure

According to the KDB-558074 D01 v05r02 Subclause 8.3.2.2 and ANSI C63.10-2013 Subclause 11.9.2.2, when this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth

- a) Set span to at least 1.5 times the OBW.
- b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Number of points in sweep $\geq 2 \times$ span / RBW. (This gives bin-to-bin spacing \leq RBW/2, so that narrowband signals are not lost between frequency bins.)
- e) Sweep time = auto.
- f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- g) If transmit duty cycle < 98 %, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run” .
- h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
- i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

6.4 Summary of Test Results/Plots

Please refer to Appendix C

7. Field Strength of Spurious Emissions

7.1 Standard Applicable

According to §15.247(d), 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

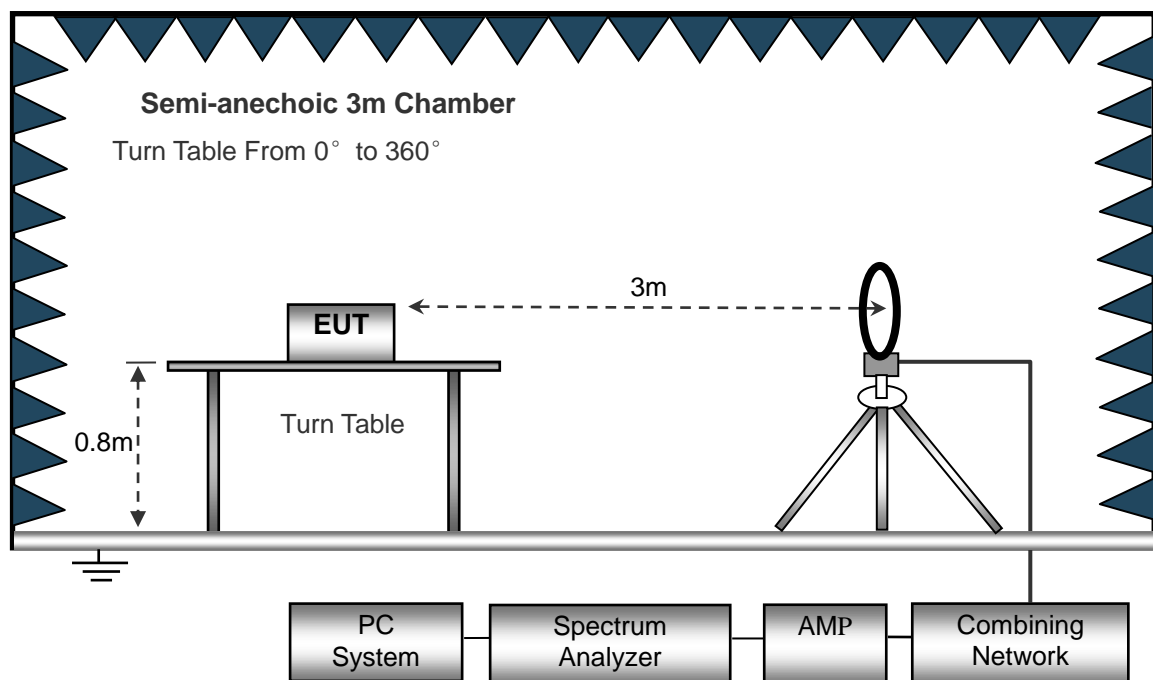
7.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

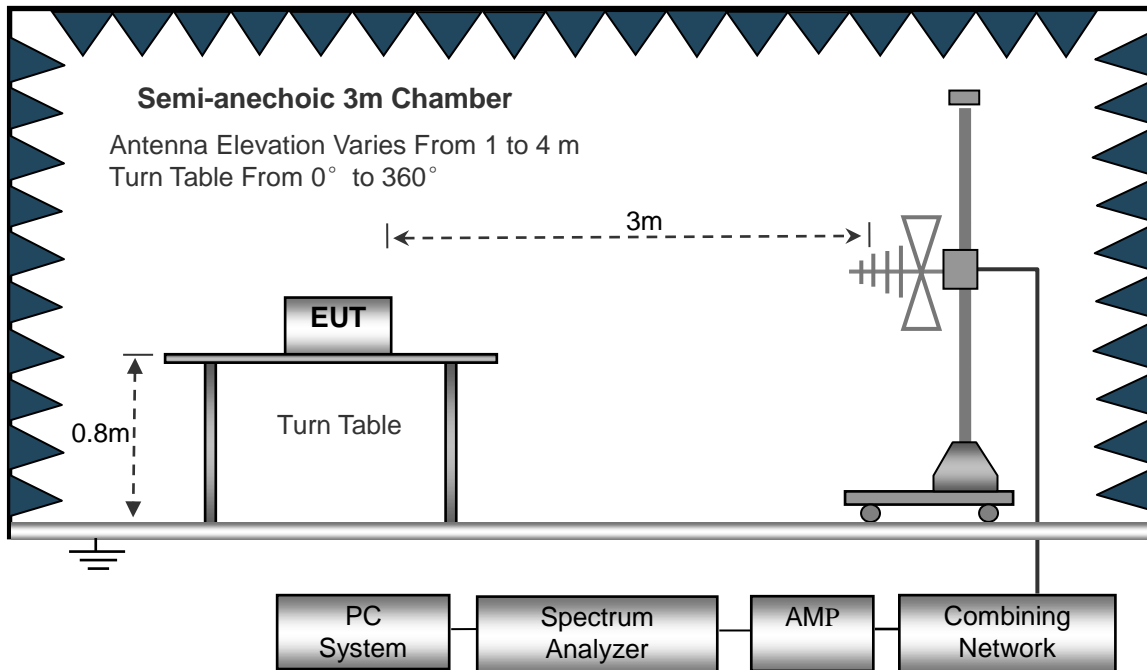
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

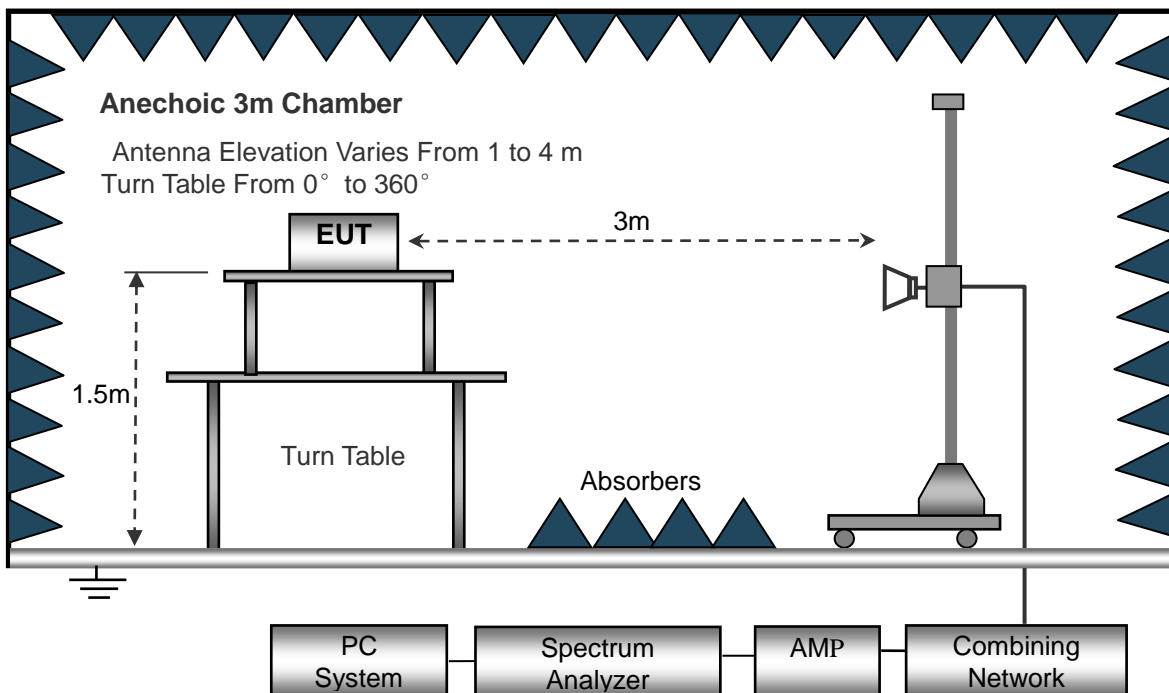
The test setup for emission measurement below 30MHz..



The test setup for emission measurement from 30 MHz to 1 GHz..



The test setup for emission measurement above 1 GHz..



Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

7.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

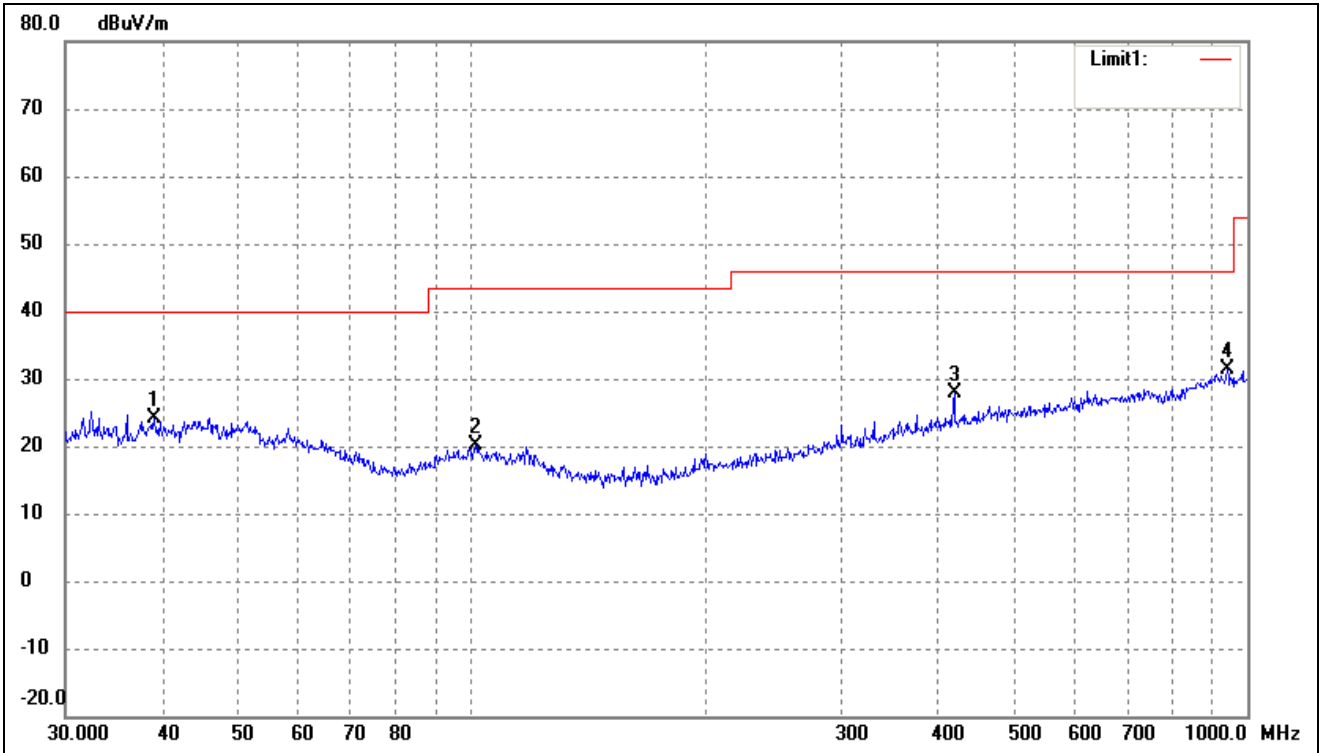
$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

7.4 Summary of Test Results/Plots

Note: 1.This EUT was tested in 3 orthogonal positions and the worst case position data was reported.

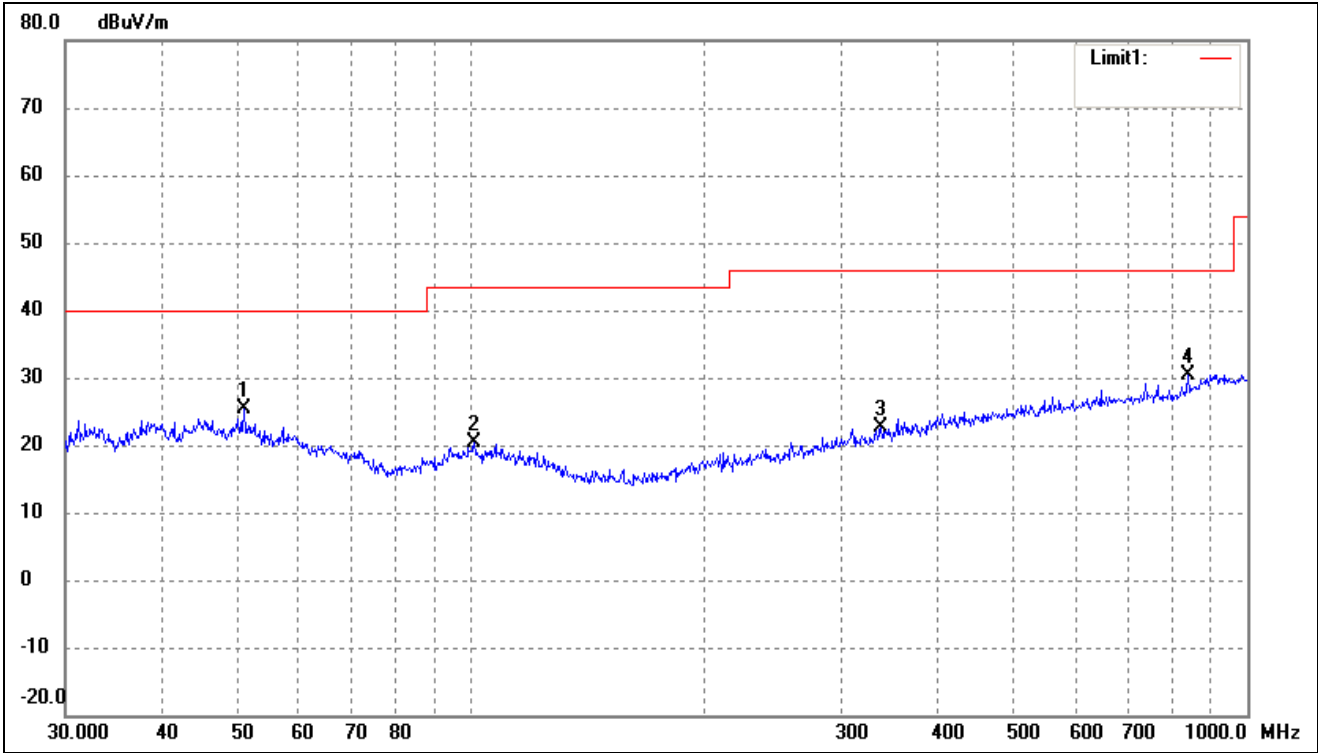
➤ Spurious Emissions Below 1GHz

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal



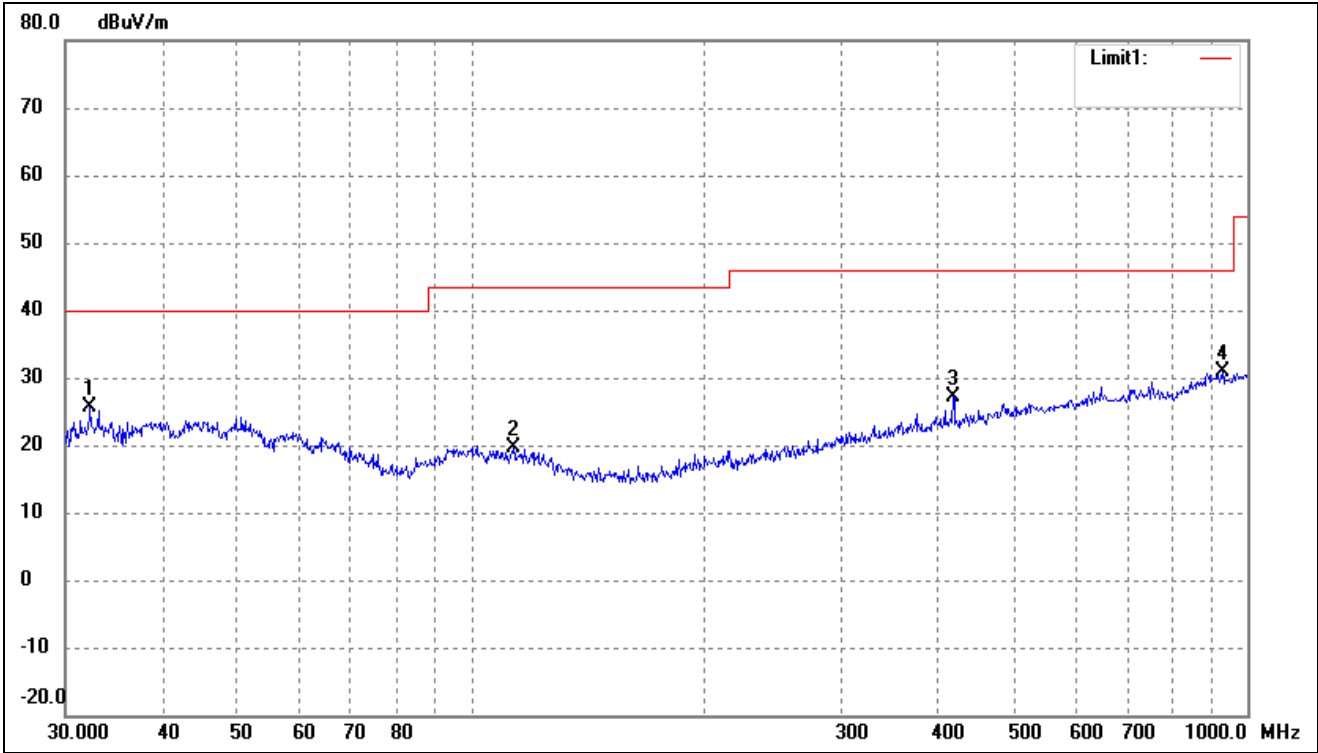
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.0245	36.45	-12.35	24.10	40.00	-15.90	-	-	peak
2	101.2885	33.56	-13.31	20.25	43.50	-23.25	-	-	peak
3	419.1081	33.78	-6.02	27.76	46.00	-18.24	-	-	peak
4	942.1305	29.97	1.51	31.48	46.00	-14.52	-	-	peak

802.11b_11Mbps			
Test Channel	Low	Polarity:	Vertical



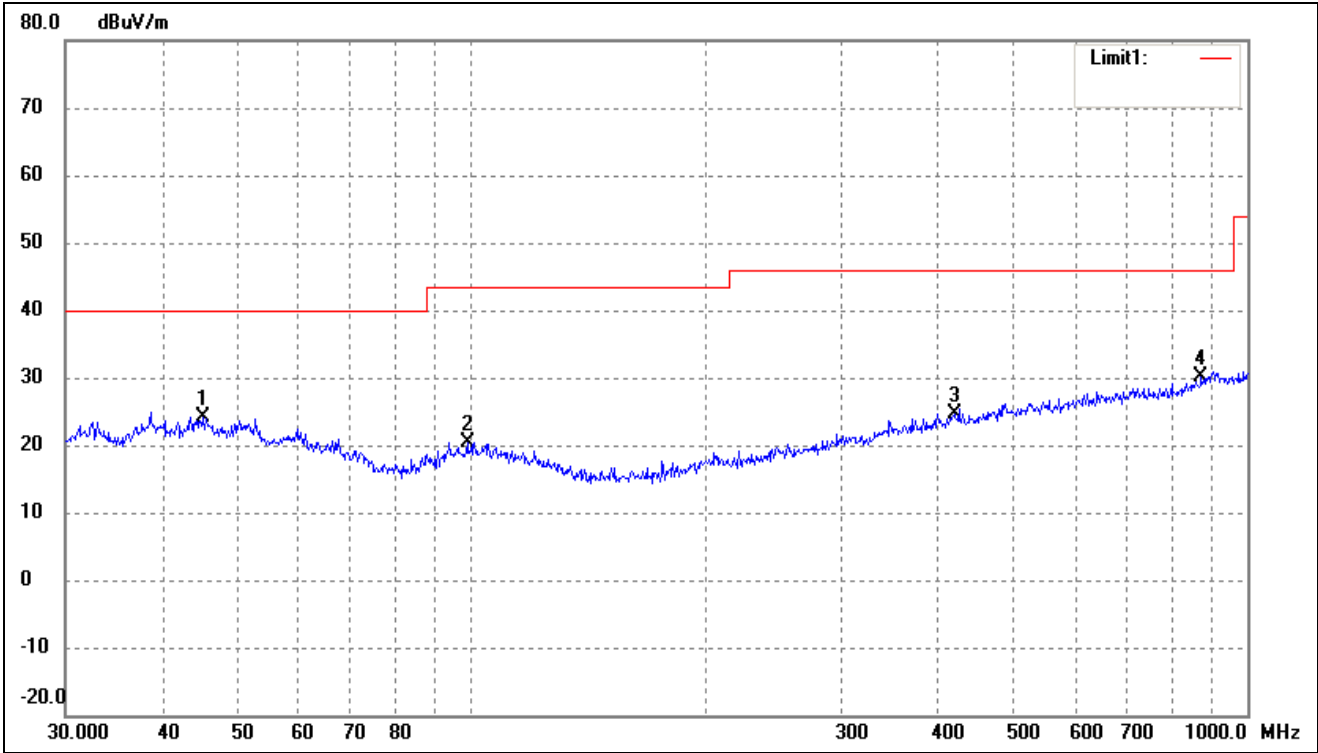
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	50.9420	37.29	-11.80	25.49	40.00	-14.51	-	-	peak
2	100.9339	33.61	-13.32	20.29	43.50	-23.21	-	-	peak
3	337.2155	30.82	-8.21	22.61	46.00	-23.39	-	-	peak
4	839.1818	30.27	0.19	30.46	46.00	-15.54	-	-	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Horizontal



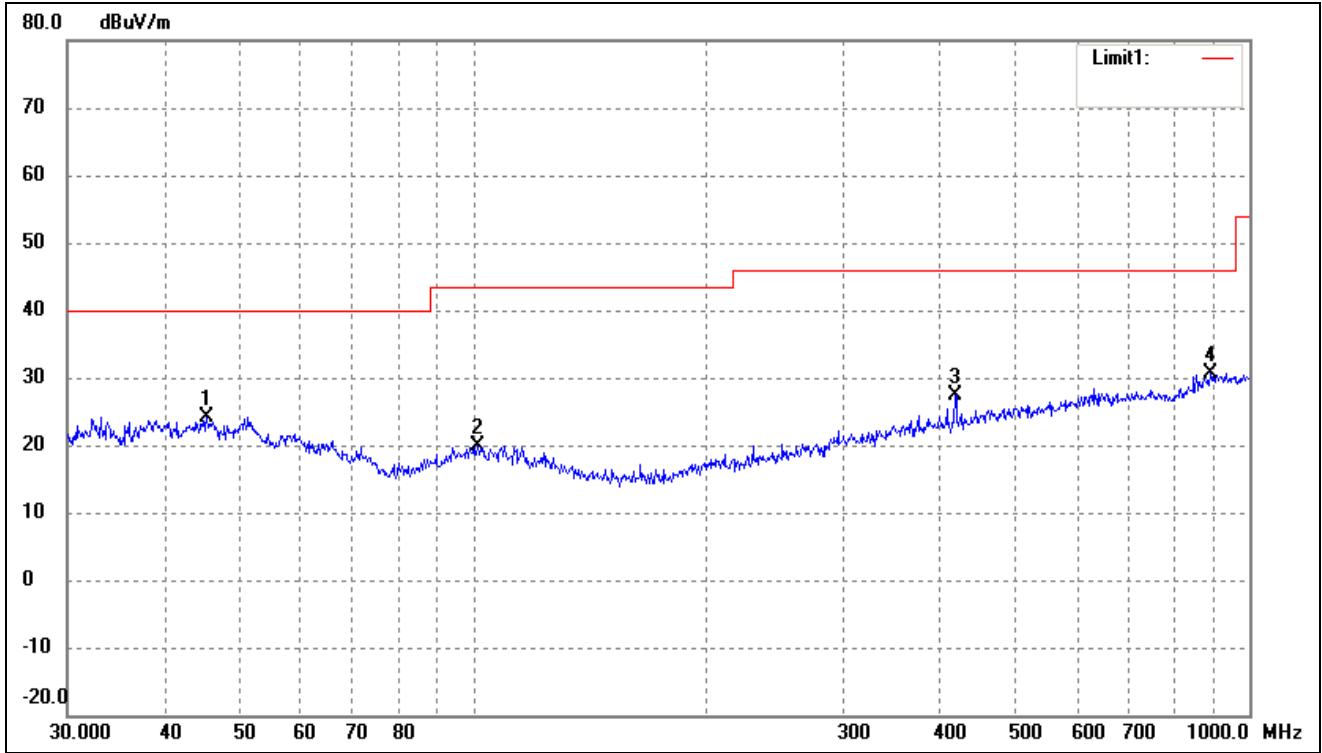
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	32.2925	39.54	-14.03	25.51	40.00	-14.49	-	-	peak
2	113.3163	33.15	-13.63	19.52	43.50	-23.98	-	-	peak
3	417.6411	33.09	-6.05	27.04	46.00	-18.96	-	-	peak
4	929.0082	28.99	1.77	30.76	46.00	-15.24	-	-	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Vertical



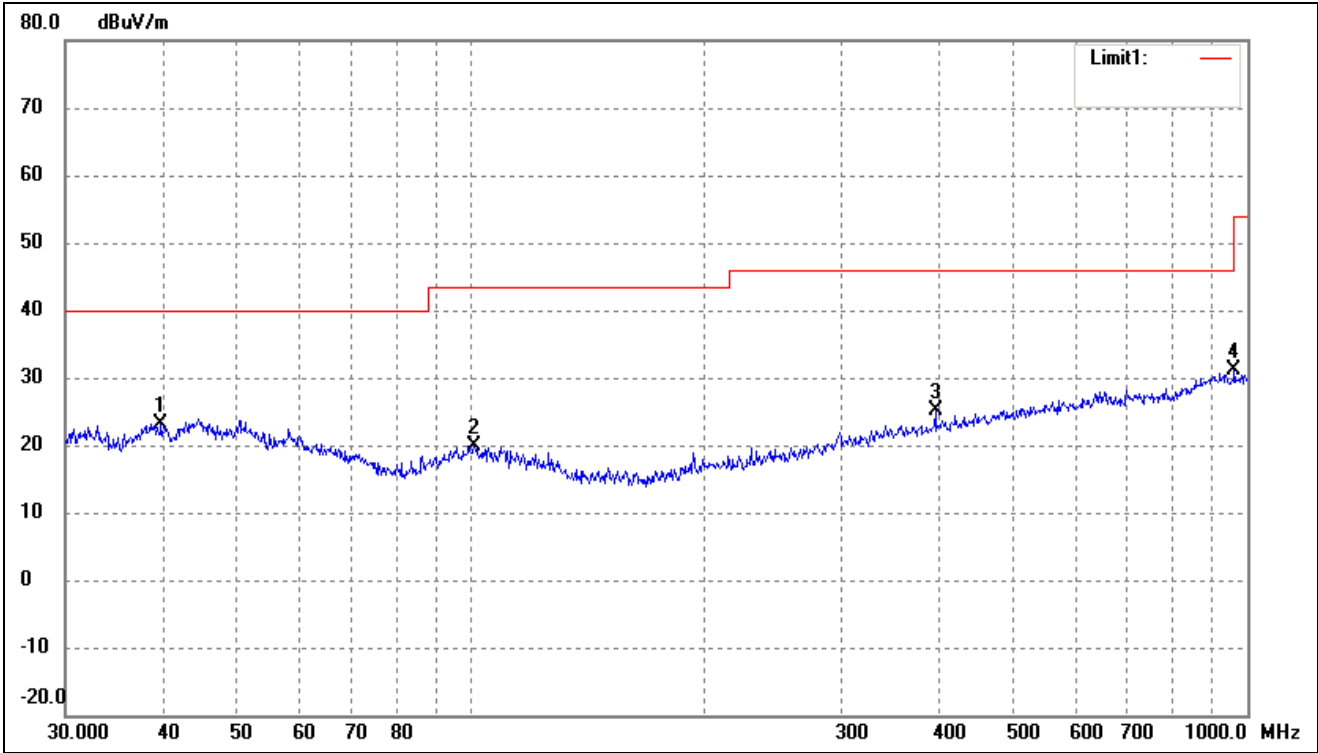
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	45.0583	35.86	-11.80	24.06	40.00	-15.94	-	-	peak
2	98.8326	33.93	-13.52	20.41	43.50	-23.09	-	-	peak
3	419.1081	30.74	-6.02	24.72	46.00	-21.28	-	-	peak
4	872.1832	29.66	0.51	30.17	46.00	-15.83	-	-	peak

802.11b_11Mbps			
Test Channel	High	Polarity:	Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	45.3755	35.81	-11.78	24.03	40.00	-15.97	-	-	peak
2	101.2885	33.25	-13.31	19.94	43.50	-23.56	-	-	peak
3	417.6411	33.39	-6.05	27.34	46.00	-18.66	-	-	peak
4	890.7278	29.40	1.18	30.58	46.00	-15.42	-	-	peak

802.11b_11Mbps			
Test Channel	High	Polarity:	Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.8542	35.16	-12.03	23.13	40.00	-16.87	-	-	peak
2	100.9340	33.16	-13.32	19.84	43.50	-23.66	-	-	peak
3	396.2415	31.61	-6.57	25.04	46.00	-20.96	-	-	peak
4	962.1623	29.72	1.41	31.13	54.00	-22.87	-	-	peak

Remark: '-' Means' the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

- Spurious Emissions Above 1GHz
- Test Mode: 802.11b_11Mbps

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2412MHz							
4821.298	42.27	-4.50	37.77	54.00	-16.23	H	AV
4821.757	70.49	-4.50	65.99	74.00	-8.01	H	PK
7236.000	50.96	-2.20	48.76	74.00	-25.24	H	PK
4821.757	55.92	-4.50	51.42	74.00	-22.58	V	PK
7236.000	50.08	-2.20	47.88	74.00	-26.12	V	PK
Middle Channel-2437MHz							
4871.032	40.40	-4.47	35.93	54.00	-18.07	H	AV
4871.103	63.28	-4.47	58.81	74.00	-15.19	H	PK
7311.000	49.57	-2.17	47.40	74.00	-26.60	H	PK
4874.000	50.12	-4.47	45.65	74.00	-28.35	V	PK
7311.000	50.65	-2.17	48.48	74.00	-25.52	V	PK
High Channel-2462MHz							
4924.000	50.49	-4.44	46.05	74.00	-27.95	H	PK
7386.000	50.13	-2.15	47.98	74.00	-26.02	H	PK
4924.000	50.52	-4.44	46.08	74.00	-27.92	V	PK
7386.000	50.33	-2.15	48.18	74.00	-25.82	V	PK

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

8. Out of Band Emissions

8.1 Standard Applicable

According to §15.247(d), 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

8.2 Test Procedure

According to the KDB 558074D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW $\geq [3 \times \text{RBW}]$.
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r02 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

A. Radiated emission measurements:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement

KDB publication number: 913591 may be used for the radiated bandedge measurements.

B. Antenna-port conducted measurements

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

- a) RBW = as specified in Table 9.
- b) VBW \geq $[3 \times \text{RBW}]$.
- 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 lengthened for low-duty-cycle applications.)

Table 9—RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1000 MHz	100 kHz to 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.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

8.3 Summary of Test Results/Plots

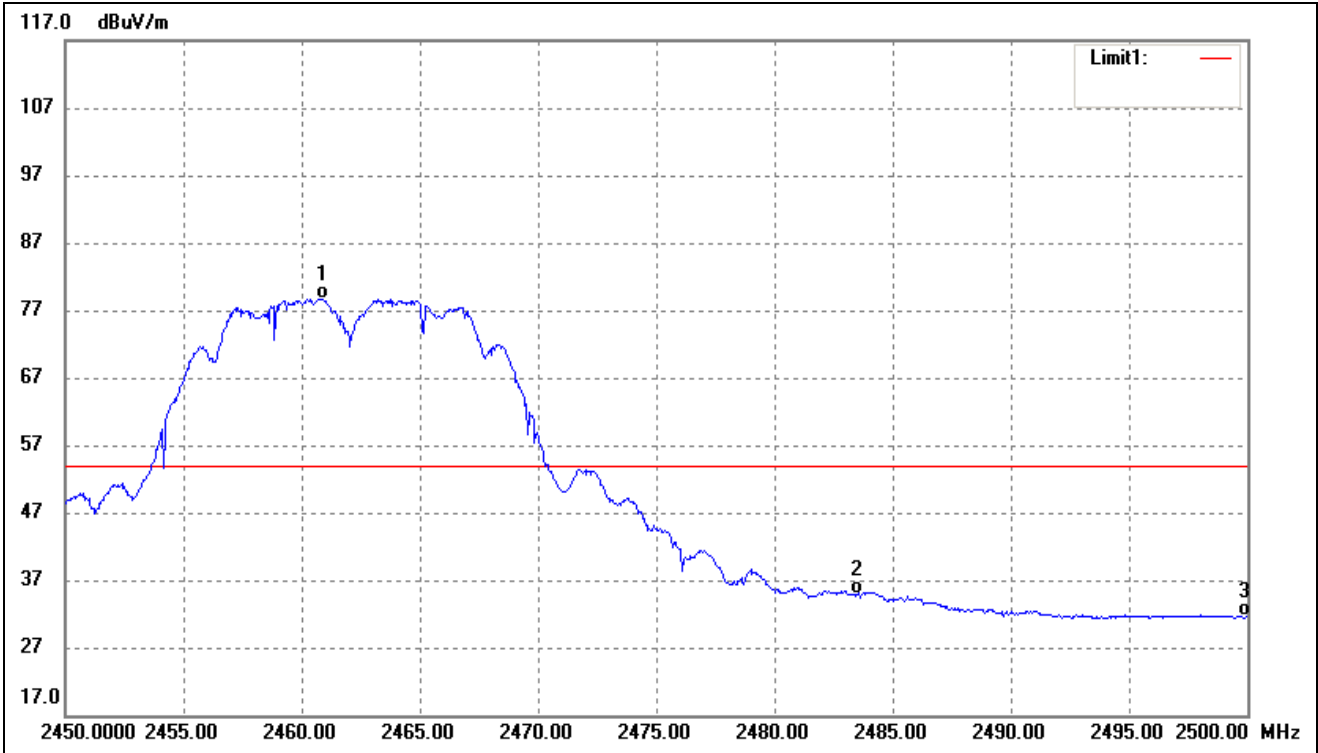
➤ Radiated test

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal (worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	40.80	-9.66	31.14	54.00	-22.86	Average Detector
		63.64	-9.66	53.98	74.00	-20.02	Peak Detector
2	2390.000	59.09	-9.50	49.59	54.00	-4.41	Average Detector
		70.28	-9.50	60.78	74.00	-13.22	Peak Detector
3	2413.200	98.59	-9.46	89.13	/	/	Average Detector
		104.61	-9.46	95.15	/	/	Peak Detector

802.11b_11Mbps			
Test Channel	High	Polarity:	Horizontal (worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2460.900	88.10	-9.36	78.74	/	/	Average Detector
	2461.600	96.50	-9.36	87.14	/	/	Peak Detector
2	2483.500	44.19	-9.31	34.88	54.00	-19.12	Average Detector
	2483.500	56.78	-9.31	47.47	74.00	-26.53	Peak Detector
3	2500.000	40.91	-9.28	31.63	54.00	-22.37	Average Detector
	2500.000	53.98	-9.28	44.70	74.00	-29.30	Peak Detector

➤ Conducted test

Please refer to Appendix D

9. Conducted Emissions

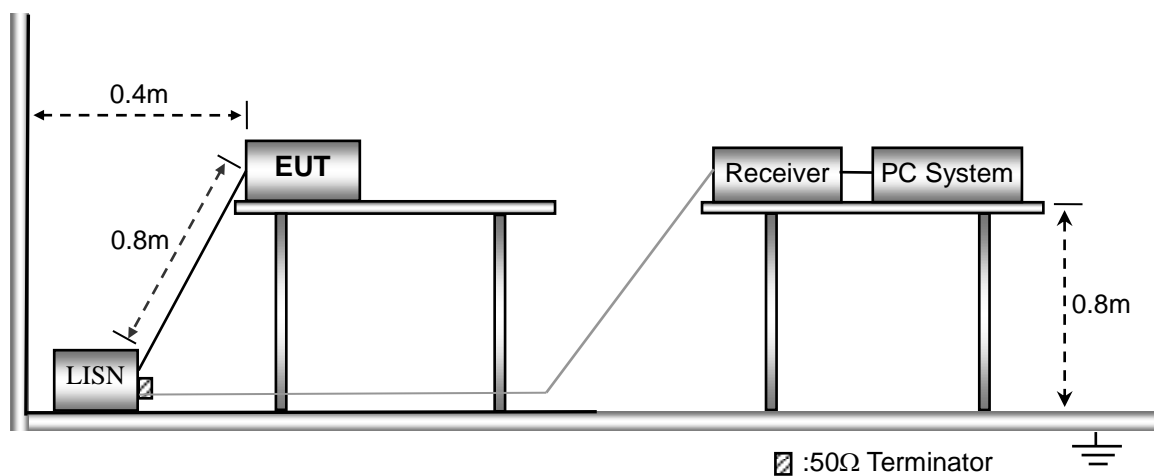
9.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

9.2 Basic Test Setup Block Diagram



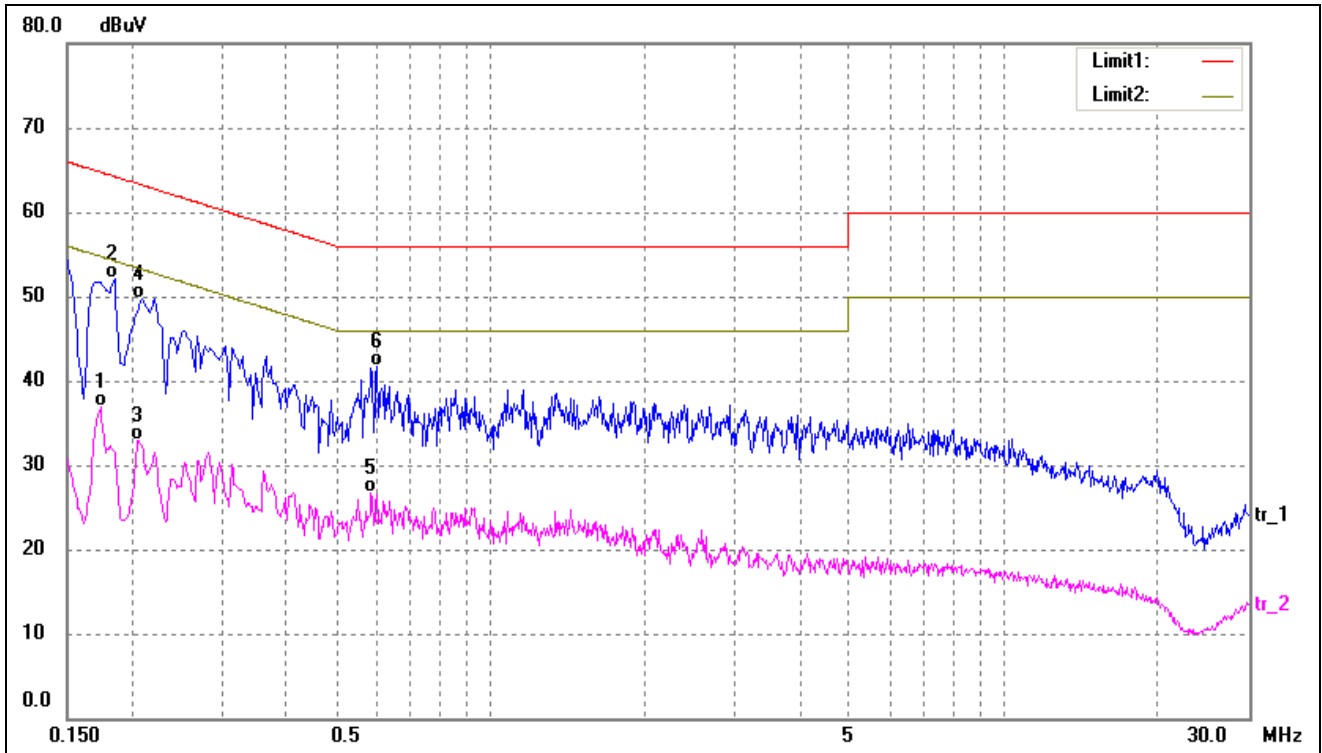
9.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency	150 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth.....	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

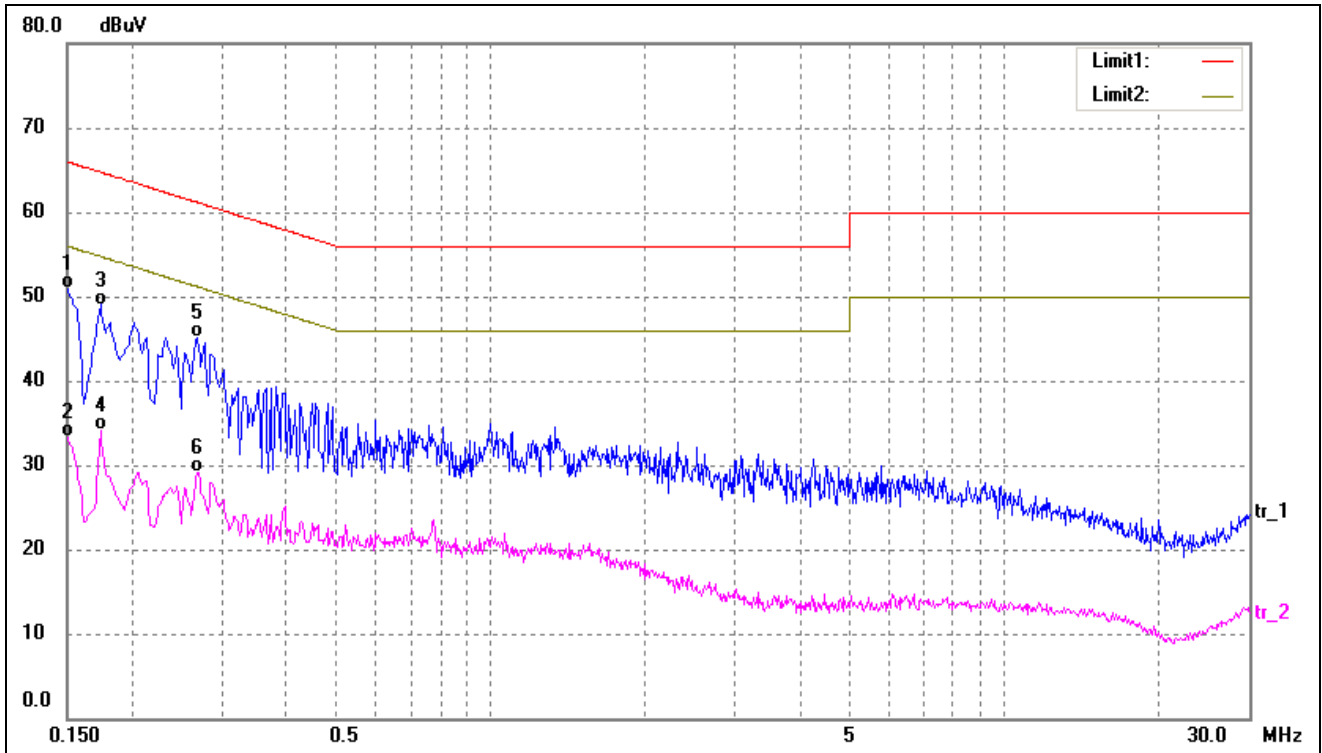
9.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral
-----------	---------------	-------------	-----------	---------



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1740	26.64	10.25	36.89	54.76	-17.87	AVG
2*	0.1860	41.92	10.26	52.18	64.21	-12.03	QP
3	0.2060	22.60	10.27	32.87	53.36	-20.49	AVG
4	0.2100	39.51	10.27	49.78	63.20	-13.42	QP
5	0.5860	16.55	10.21	26.76	46.00	-19.24	AVG
6	0.6020	31.46	10.21	41.67	56.00	-14.33	QP

Test Mode	Communication	AC120V 60Hz	Polarity:	Line
-----------	---------------	-------------	-----------	------



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1*	0.1499	40.75	10.25	51.00	66.00	-15.00	QP
2	0.1499	23.11	10.25	33.36	56.00	-22.64	AVG
3	0.1740	38.75	10.25	49.00	64.76	-15.76	QP
4	0.1740	23.91	10.25	34.16	54.76	-20.60	AVG
5	0.2700	34.82	10.25	45.07	61.12	-16.05	QP
6	0.2700	18.90	10.25	29.15	51.12	-21.97	AVG

APPENDIX SUMMARY

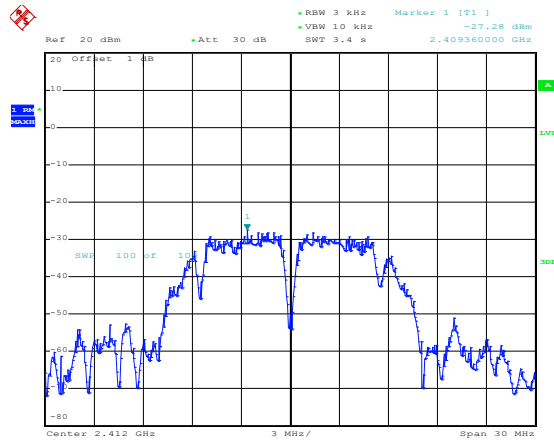
Project No.	WTH20X12103639W	Test Engineer	Moon
Start date	2021/01/06	Finish date	2021/01/06
Temperature	24.3℃	Humidity	46%
RF specifications	WIFI-2.4G		

APPENDIX	Description of Test Item	Result
A	Power Spectral Density	Compliant
B	DTS Bandwidth	Compliant
C	RF Output Power	Compliant
D	Conducted Out of Band Emissions	Compliant

APPENDIX A

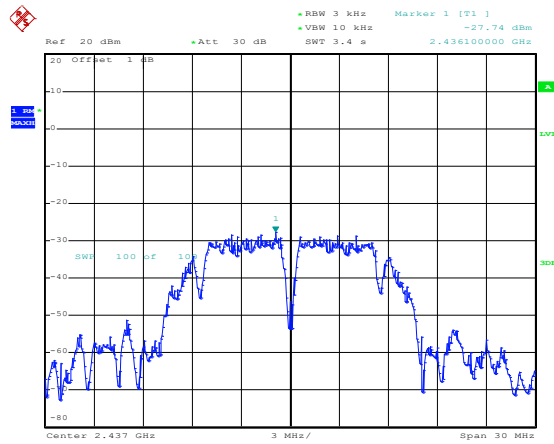
Power Spectral Density			
Test Mode	Test Channel MHz	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
802.11b_1Mbps	2412	-27.28	8
	2437	-27.74	8
	2462	-28.10	8

802.11b-Low



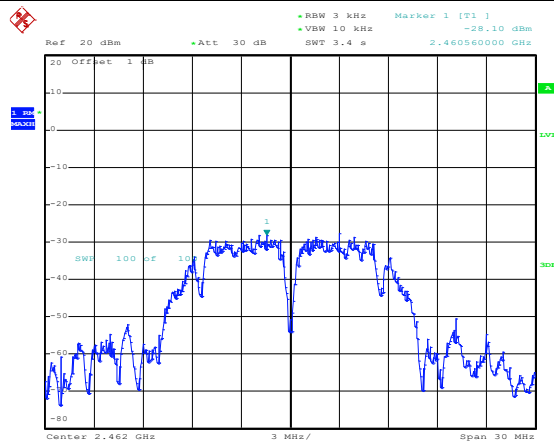
Date: 6.JAN.2021 14:52:09

802.11b-Middle



Date: 6.JAN.2021 14:58:37

802.11b-High

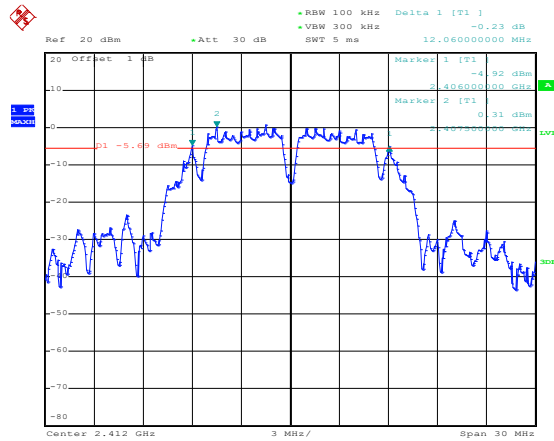


Date: 6.JAN.2021 15:04:48

APPENDIX B

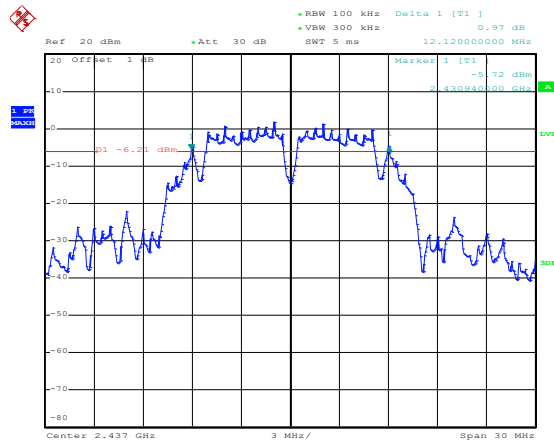
DTS Bandwidth			
Test Mode	Test Channel MHz	6 dB Bandwidth MHz	Limit kHz
802.11b_1Mbps	2412	12.06	≥500
	2437	12.12	≥500
	2462	10.26	≥500

802.11b-Low



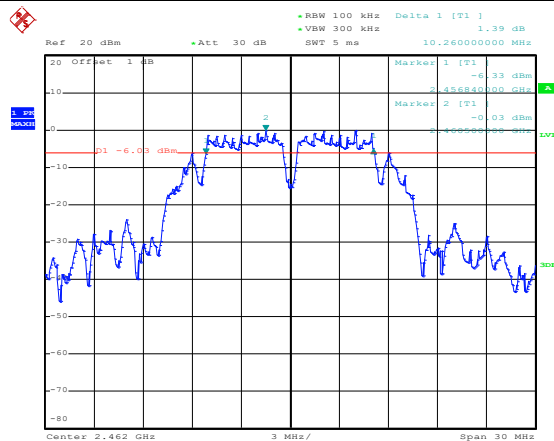
Date: 6.JAN.2021 15:16:31

802.11b-Middle



Date: 6.JAN.2021 15:14:45

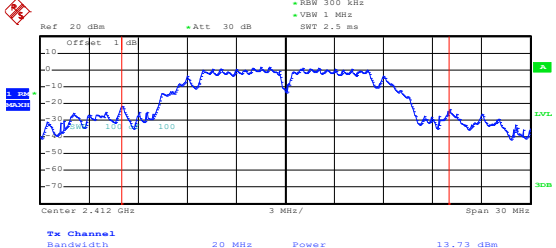
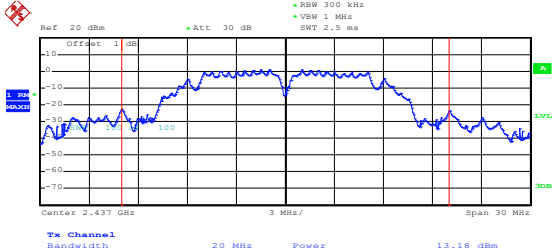
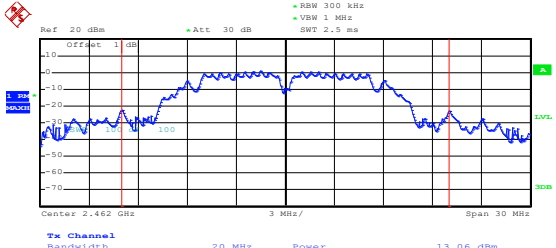
802.11b-High



Date: 6.JAN.2021 15:06:40

APPENDIX C

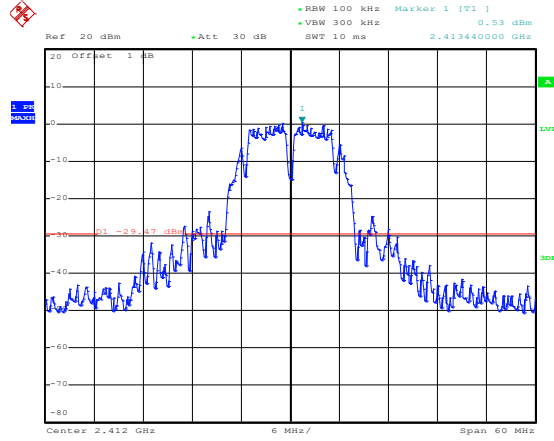
Test Mode	Frequency MHz	Reading dBm	Limit dBm
802.11b _ 1Mbps	2412	13.73	30.00
	2437	13.18	30.00
	2462	13.06	30.00

<p>802.11b-Low</p>	 <p>Ref 20 dBm Offset 1 dB Att 30 dB RBW 300 kHz VSW 1 MHz SWT 2.5 ms</p> <p>Center 2.412 GHz Span 30 MHz</p> <p>Tx Channel Bandwidth 20 MHz Power 13.73 dBm</p> <p>Date: 6.JAN.2021 14:41:07</p>
<p>802.11b-Middle</p>	 <p>Ref 20 dBm Offset 1 dB Att 30 dB RBW 300 kHz VSW 1 MHz SWT 2.5 ms</p> <p>Center 2.437 GHz Span 30 MHz</p> <p>Tx Channel Bandwidth 20 MHz Power 13.18 dBm</p> <p>Date: 6.JAN.2021 14:42:27</p>
<p>802.11b-High</p>	 <p>Ref 20 dBm Offset 1 dB Att 30 dB RBW 300 kHz VSW 1 MHz SWT 2.5 ms</p> <p>Center 2.462 GHz Span 30 MHz</p> <p>Tx Channel Bandwidth 20 MHz Power 13.06 dBm</p> <p>Date: 6.JAN.2021 14:45:25</p>

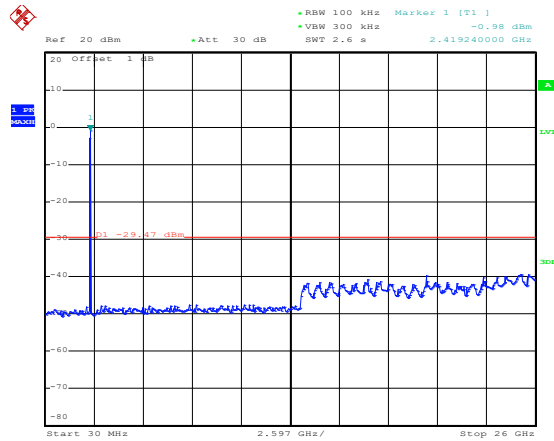
APPENDIX D

Conducted Out of Band Emissions

802.11b-Low

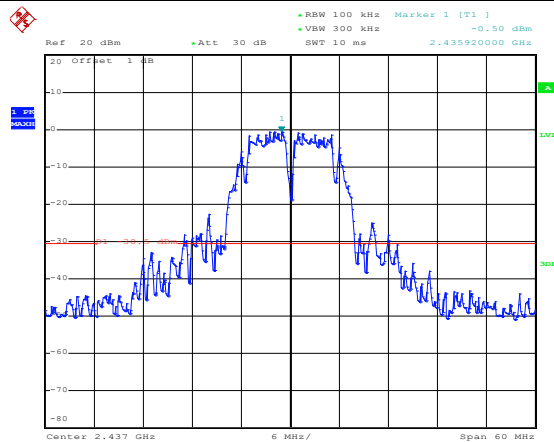


Date: 6.JAN.2021 15:18:09

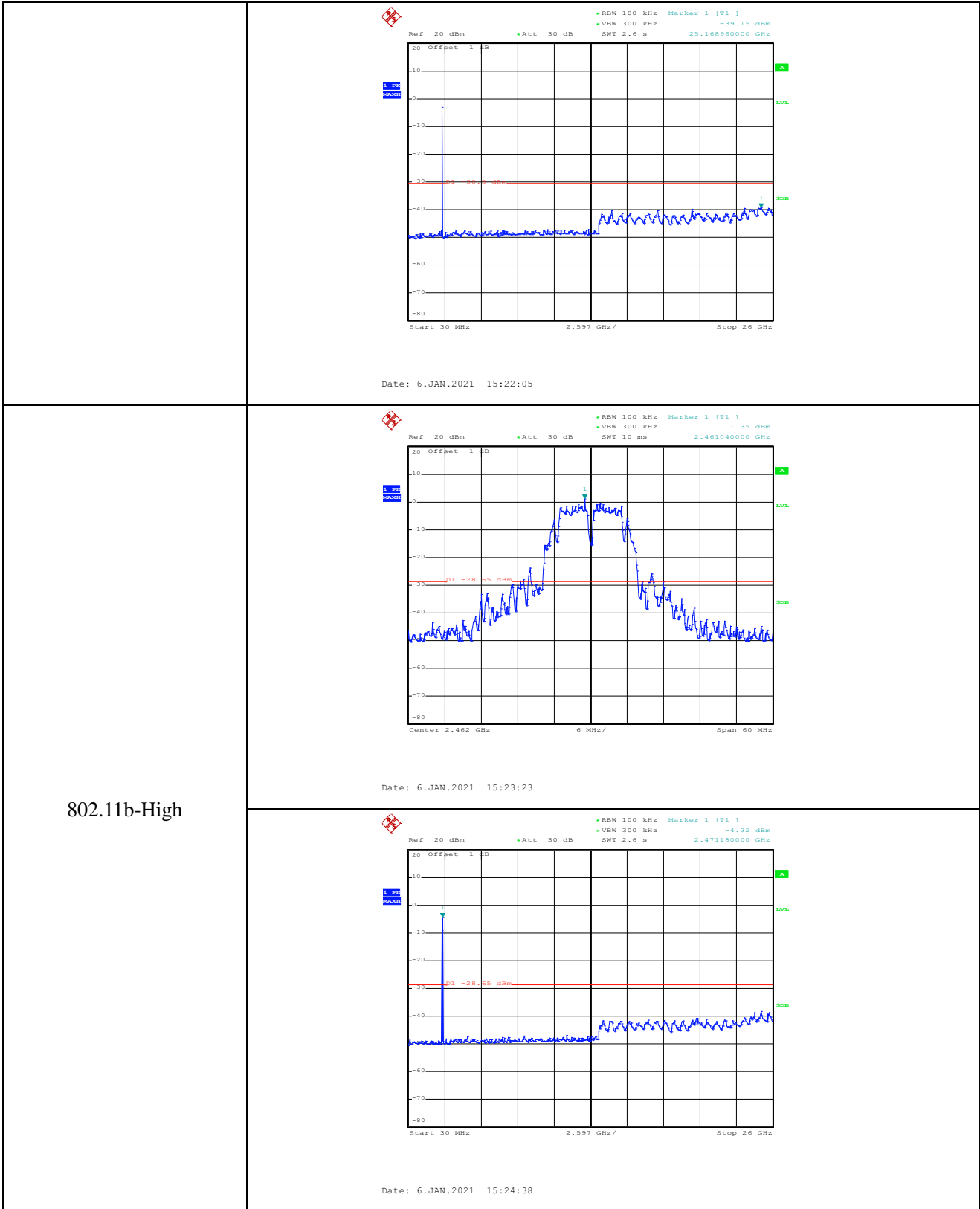


Date: 6.JAN.2021 15:19:12

802.11b-Middle



Date: 6.JAN.2021 15:20:22



APPENDIX PHOTOGRAPHS

Please refer to “ANNEX”

******* END OF REPORT *******