

TEST REPORT

Reference No..... : WTX20X08052116W
FCC ID : 2AHRE- TZ01
Applicant : SHEN ZHEN HIDIN TECHNOLOGY CO., LTD
Address : 6th floor, No. 1301-59, Yinxing Industrial Park, Guanlan, Longhua District,
Shenzhen ,Guangdong China.
Product Name : Smart Gateway
Test Model. : TZ01
Standards : FCC Part 15.247
Date of Receipt sample : Jan.10, 2020
Date of Test..... : Jan.10, 2020 to Jan.15, 2020
Date of Issue : Jan.15, 2020
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.

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Report version

Version No.	Date of issue	Description
Rev.00	Aug.14, 2020	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: SHEN ZHEN HIDIN TECHNOLOGY CO., LTD
 Address of applicant: 6th floor, No. 1301-59, Yinxing Industrial Park, Guanlan,
 Longhua District, Shenzhen ,Guangdong China.

Manufacturer: SHEN ZHEN HIDIN TECHNOLOGY CO., LTD
 Address of manufacturer: 6th floor, No. 1301-59, Yinxing Industrial Park, Guanlan,
 Longhua District, Shenzhen ,Guangdong China.

General Description of EUT	
Product Name:	Smart Gateway
Trade Name:	/
Model No.:	TZ01
Adding Model(s):	/
Rated Voltage:	DC 5V/1A
Software Version:	1.3.8
Hardware Version:	V1
<i>Note: The test data is gathered from a production sample provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Support Standards:	IEEE802.15.4
Frequency Range:	2405-2475MHz
RF Output Power:	8.886dBm (Conducted)
Type of Modulation:	OQPSK
Quantity of Channels:	15
Channel Separation:	5MHz
Type of Antenna:	PCB Antenna
Antenna Gain:	2.5dBi

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 DTS Meas Guidance v05r02: GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247.

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 DTS Meas Guidance v05r02.

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	Low	2405MHz
TM2	Middle	2440MHz
TM3	High	2475MHz

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
USB Cable	1.06	Unshielded	Without Ferrite
WAN Cable	0.52	Unshielded	Without Ferrite

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

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E445	EB12648265
Adapter	/	KA1517-0502000CNU	/

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 $\pm 3.84\text{dB}$
		6-18GHz $\pm 3.92\text{dB}$

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	2019-04-30	2020-04-29
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2019-04-30	2020-04-29
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2019-04-30	2020-04-29
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
§ 2.1091	RF Exposure	Compliant
§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)	6 dB 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. RF Exposure

3.1 Standard Applicable

According to §1.1307 and §2.1091, the mobile transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 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.

4.2 Evaluation Information

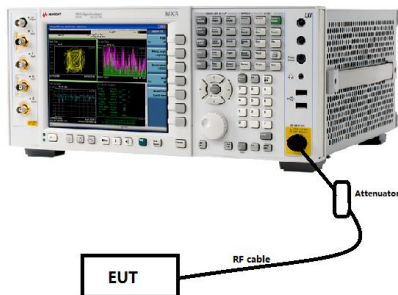
This product has a PCB antenna, fulfill the requirement of this section.

5. Power Spectral Density

5.1 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.

5.2 Test Setup Block Diagram



5.3 Test Procedure

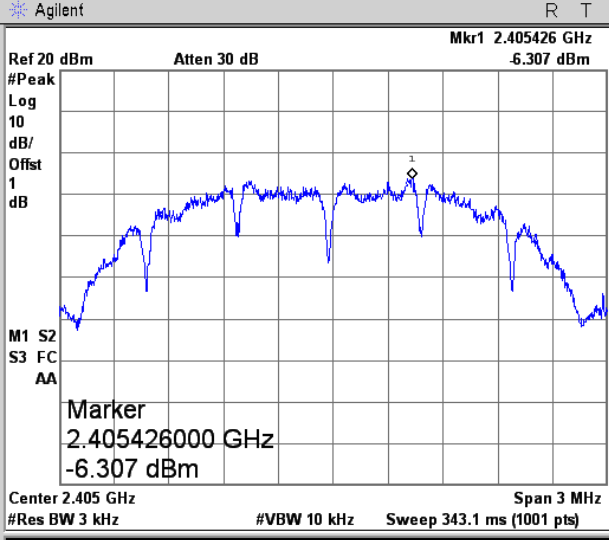
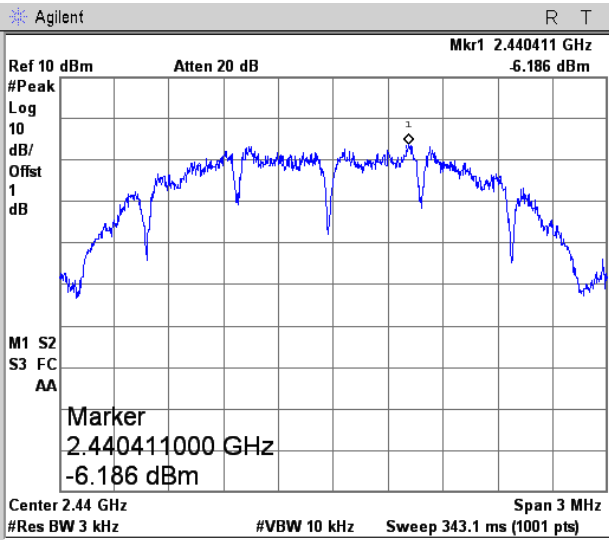
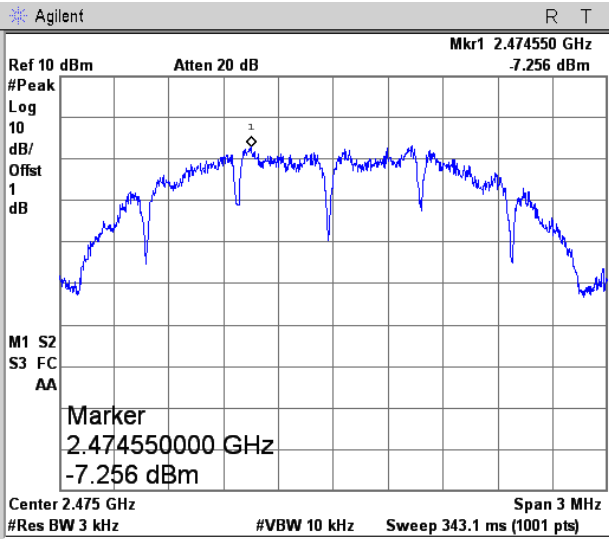
According to the KDB 558074, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

- 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).

5.4 Summary of Test Results/Plots

Test Mode	Test Channel	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
ZigBee	Low	-6.307	8
	Middle	-6.186	8
	High	-7.256	8

Please refer to the following test plots:

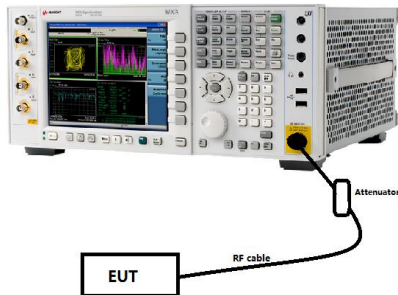
<p>Low</p>	 <p>Agilent R T</p> <p>Ref 20 dBm Atten 30 dB Mkr1 2.405426 GHz -6.307 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.405426000 GHz -6.307 dBm</p> <p>Center 2.405 GHz Span 3 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 343.1 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>
<p>Middle</p>	 <p>Agilent R T</p> <p>Ref 10 dBm Atten 20 dB Mkr1 2.440411 GHz -6.186 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.440411000 GHz -6.186 dBm</p> <p>Center 2.44 GHz Span 3 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 343.1 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>
<p>High</p>	 <p>Agilent R T</p> <p>Ref 10 dBm Atten 20 dB Mkr1 2.474550 GHz -7.256 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.474550000 GHz -7.256 dBm</p> <p>Center 2.475 GHz Span 3 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 343.1 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>

6. 6dB Bandwidth

6.1 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.

6.2 Test Setup Block Diagram



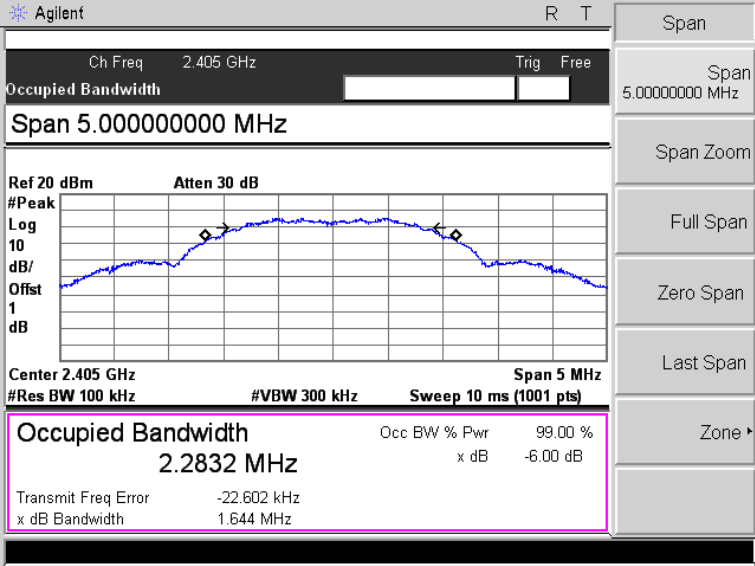
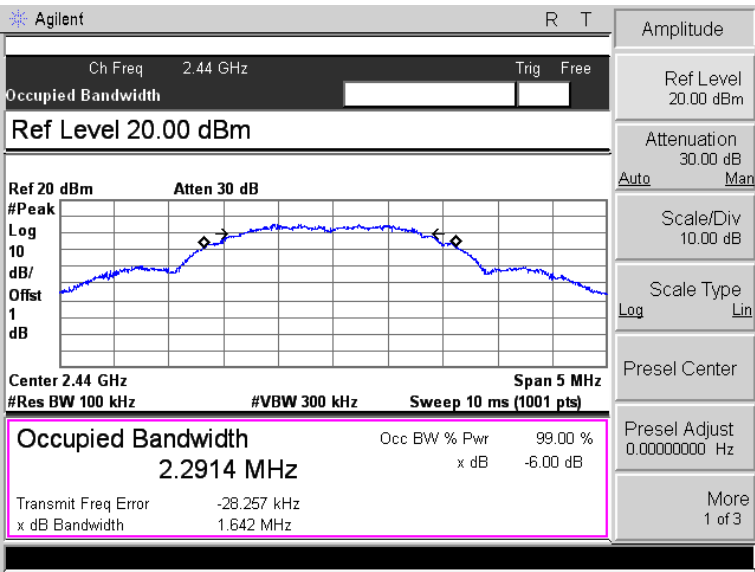
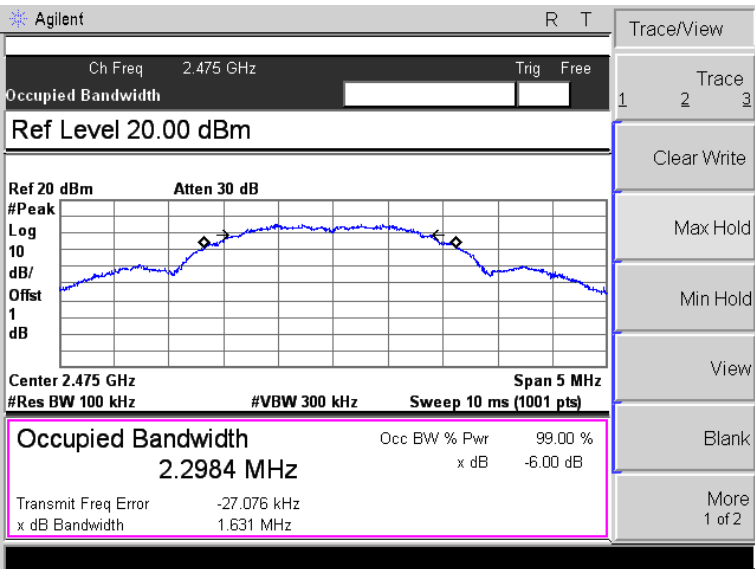
6.3 Test Procedure

- 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.

6.4 Summary of Test Results/Plots

Test Mode	Test Channel	6 dB Bandwidth MHz	Limit kHz
ZigBee	Low	1.644	≥ 500
	Middle	1.642	≥ 500
	High	1.631	≥ 500

Please refer to the following test plots:

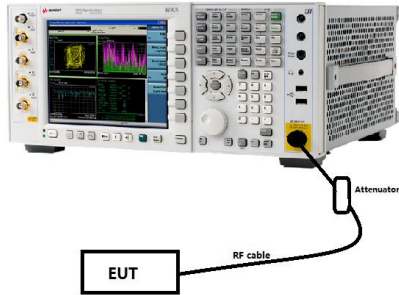
<p>Low</p>	 <p>Agilent R T</p> <p>Ch Freq 2.405 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Span 5.00000000 MHz</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/Offst 1 dB</p> <p>Center 2.405 GHz Span 5 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Occ BW % Pwr</td> <td>99.00 %</td> </tr> <tr> <td>2.2832 MHz</td> <td>x dB</td> <td>-6.00 dB</td> </tr> <tr> <td>Transmit Freq Error</td> <td></td> <td></td> </tr> <tr> <td>x dB Bandwidth</td> <td></td> <td></td> </tr> </table> <p>Span</p> <p>Span 5.00000000 MHz</p> <p>Span Zoom</p> <p>Full Span</p> <p>Zero Span</p> <p>Last Span</p> <p>Zone ▶</p>	Occupied Bandwidth	Occ BW % Pwr	99.00 %	2.2832 MHz	x dB	-6.00 dB	Transmit Freq Error			x dB Bandwidth		
Occupied Bandwidth	Occ BW % Pwr	99.00 %											
2.2832 MHz	x dB	-6.00 dB											
Transmit Freq Error													
x dB Bandwidth													
<p>Middle</p>	 <p>Agilent R T</p> <p>Ch Freq 2.44 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Ref Level 20.00 dBm</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/Offst 1 dB</p> <p>Center 2.44 GHz Span 5 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Occ BW % Pwr</td> <td>99.00 %</td> </tr> <tr> <td>2.2914 MHz</td> <td>x dB</td> <td>-6.00 dB</td> </tr> <tr> <td>Transmit Freq Error</td> <td></td> <td></td> </tr> <tr> <td>x dB Bandwidth</td> <td></td> <td></td> </tr> </table> <p>Amplitude</p> <p>Ref Level 20.00 dBm</p> <p>Attenuation 30.00 dB</p> <p>Auto Man</p> <p>Scale/Div 10.00 dB</p> <p>Scale Type Log Lin</p> <p>Presel Center</p> <p>Presel Adjust 0.00000000 Hz</p> <p>More 1 of 3</p>	Occupied Bandwidth	Occ BW % Pwr	99.00 %	2.2914 MHz	x dB	-6.00 dB	Transmit Freq Error			x dB Bandwidth		
Occupied Bandwidth	Occ BW % Pwr	99.00 %											
2.2914 MHz	x dB	-6.00 dB											
Transmit Freq Error													
x dB Bandwidth													
<p>High</p>	 <p>Agilent R T</p> <p>Ch Freq 2.475 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Ref Level 20.00 dBm</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/Offst 1 dB</p> <p>Center 2.475 GHz Span 5 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Occ BW % Pwr</td> <td>99.00 %</td> </tr> <tr> <td>2.2984 MHz</td> <td>x dB</td> <td>-6.00 dB</td> </tr> <tr> <td>Transmit Freq Error</td> <td></td> <td></td> </tr> <tr> <td>x dB Bandwidth</td> <td></td> <td></td> </tr> </table> <p>Trace/View</p> <p>Trace 1 2 3</p> <p>Clear Write</p> <p>Max Hold</p> <p>Min Hold</p> <p>View</p> <p>Blank</p> <p>More 1 of 2</p>	Occupied Bandwidth	Occ BW % Pwr	99.00 %	2.2984 MHz	x dB	-6.00 dB	Transmit Freq Error			x dB Bandwidth		
Occupied Bandwidth	Occ BW % Pwr	99.00 %											
2.2984 MHz	x dB	-6.00 dB											
Transmit Freq Error													
x dB Bandwidth													

7. RF Output Power

7.1 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.

7.2 Test Setup Block Diagram

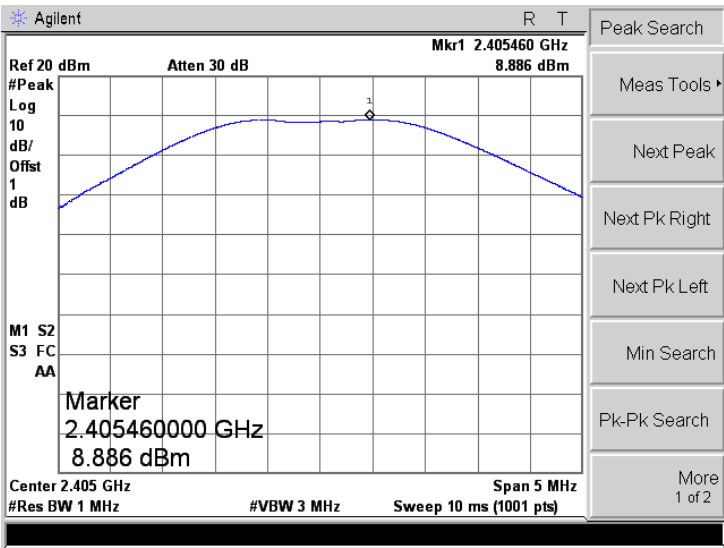
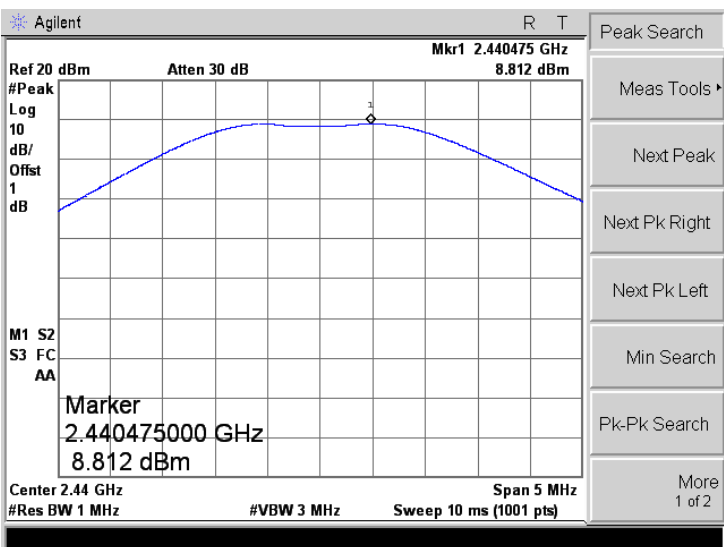
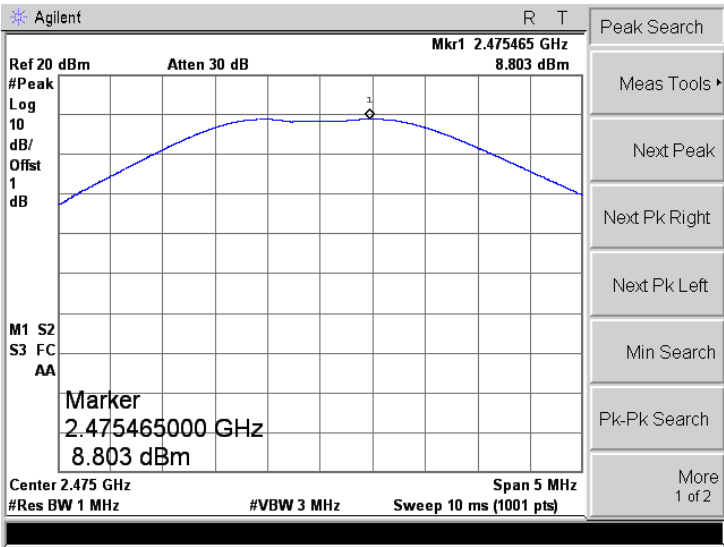


7.3 Test Procedure

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW \geq 3 RBW.
- c) Set span \geq 3 RBW.
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

7.4 Summary of Test Results/Plots

Test Mode	Test Channel	Reading dBm	Output Power mW	Limit mW
ZigBee	Low	8.886	7.74	1000
	Middle	8.812	7.61	1000
	High	8.803	7.59	1000

<p>Low</p>	 <p>Agilent R T Ref 20 dBm Atten 30 dB Mkr1 2.405460 GHz 8.886 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.405460000 GHz 8.886 dBm Center 2.405 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p>
<p>Middle</p>	 <p>Agilent R T Ref 20 dBm Atten 30 dB Mkr1 2.440475 GHz 8.812 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.440475000 GHz 8.812 dBm Center 2.44 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p>
<p>High</p>	 <p>Agilent R T Ref 20 dBm Atten 30 dB Mkr1 2.475465 GHz 8.803 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.475465000 GHz 8.803 dBm Center 2.475 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p>

8. Field Strength of Spurious 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).

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.

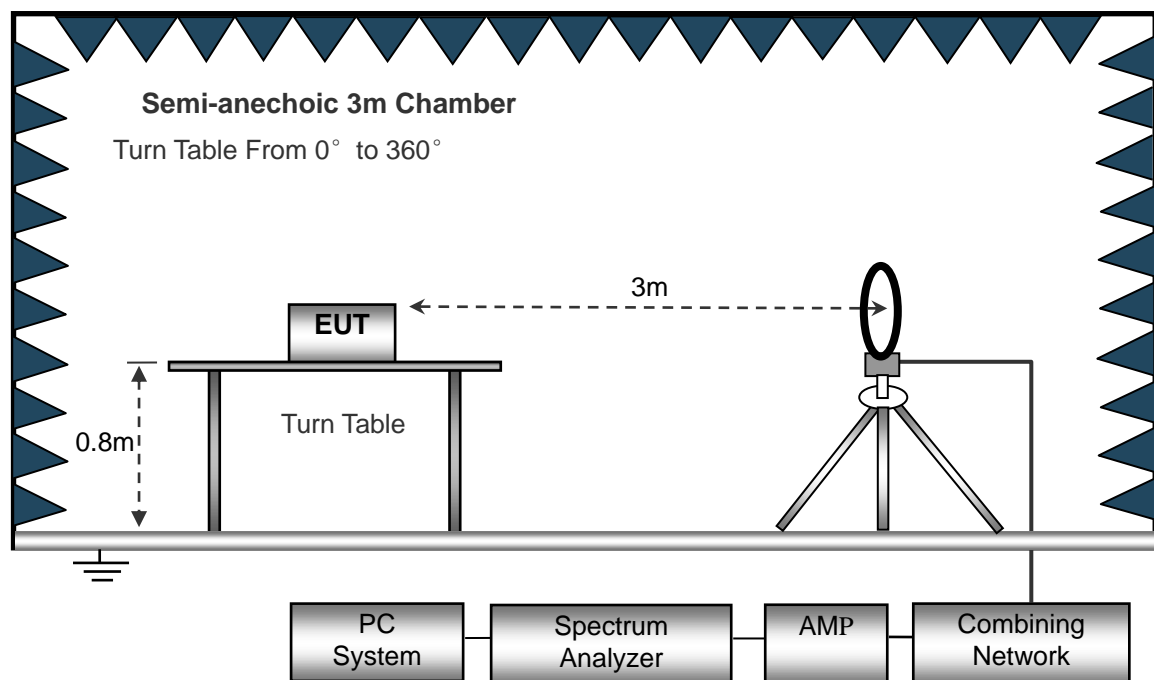
8.2 Test Procedure

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.

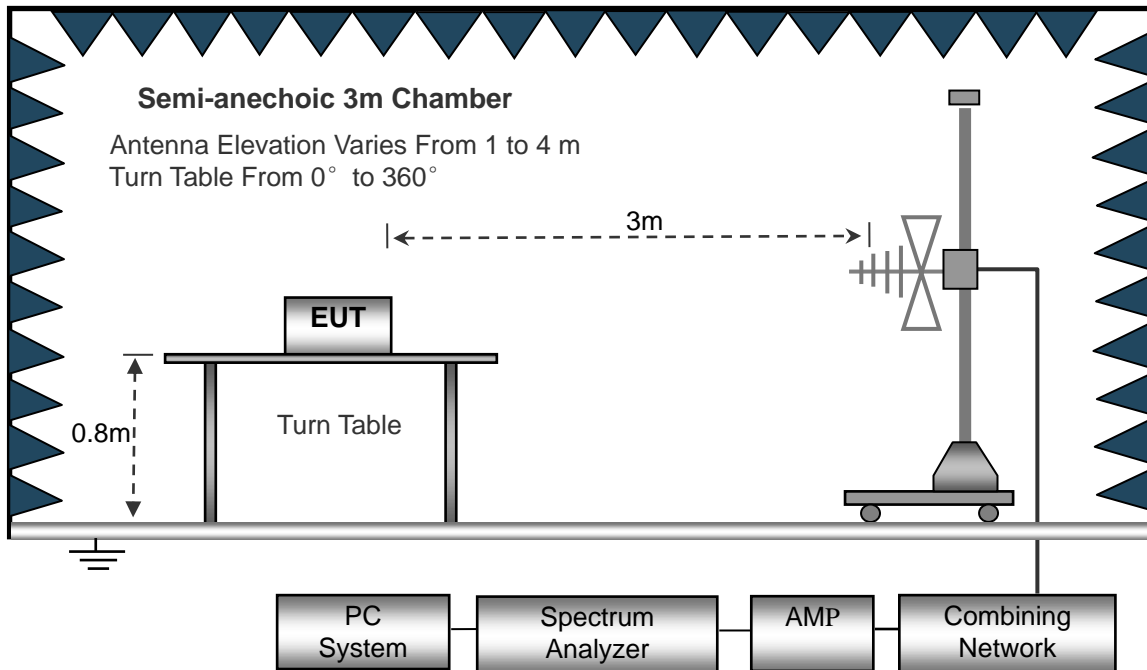
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

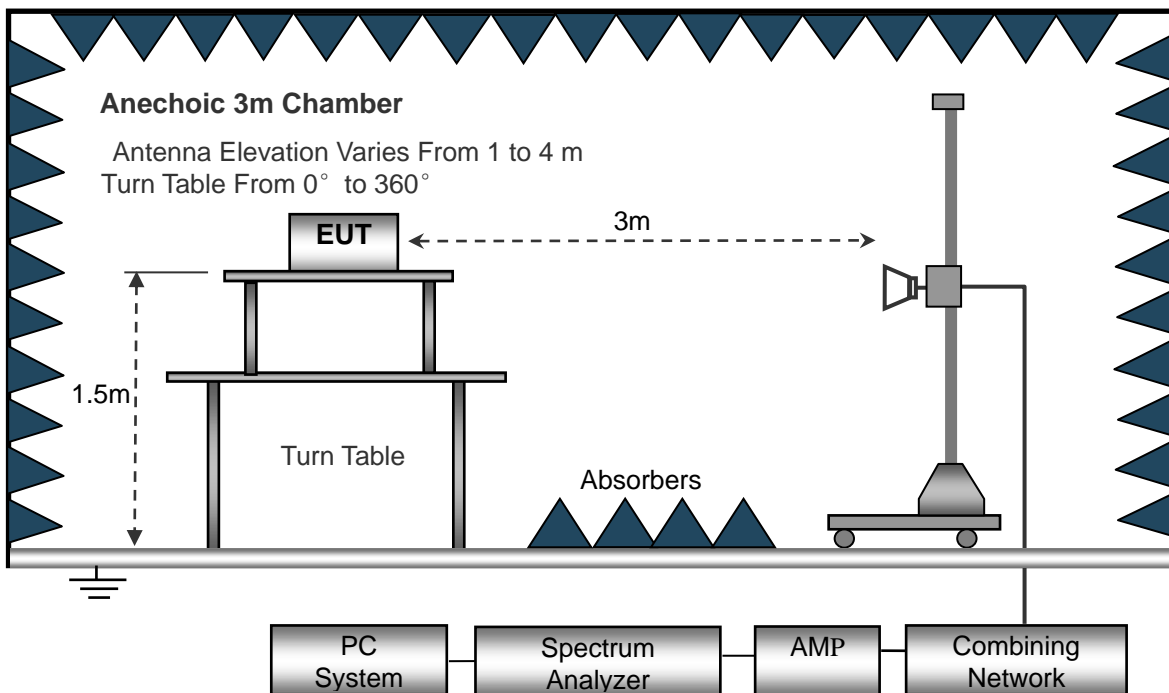
The test setup for emission measurement below 30MHz..



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



The test setup for emission measurement above 1 GHz..



Frequency :9kHz-30MHz

RBW=10KHz,

VBW =30KHz

Sweep time= Auto

Trace = max hold

Detector function = peak

Frequency :30MHz-1GHz

RBW=120KHz,

VBW=300KHz

Sweep time= Auto

Trace = max hold

Detector function = peak, QP

Frequency :Above 1GHz

RBW=1MHz,

VBW=3MHz(Peak), 10Hz(AV)

Sweep time= Auto

Trace = max hold

Detector function = peak, AV

8.3 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:

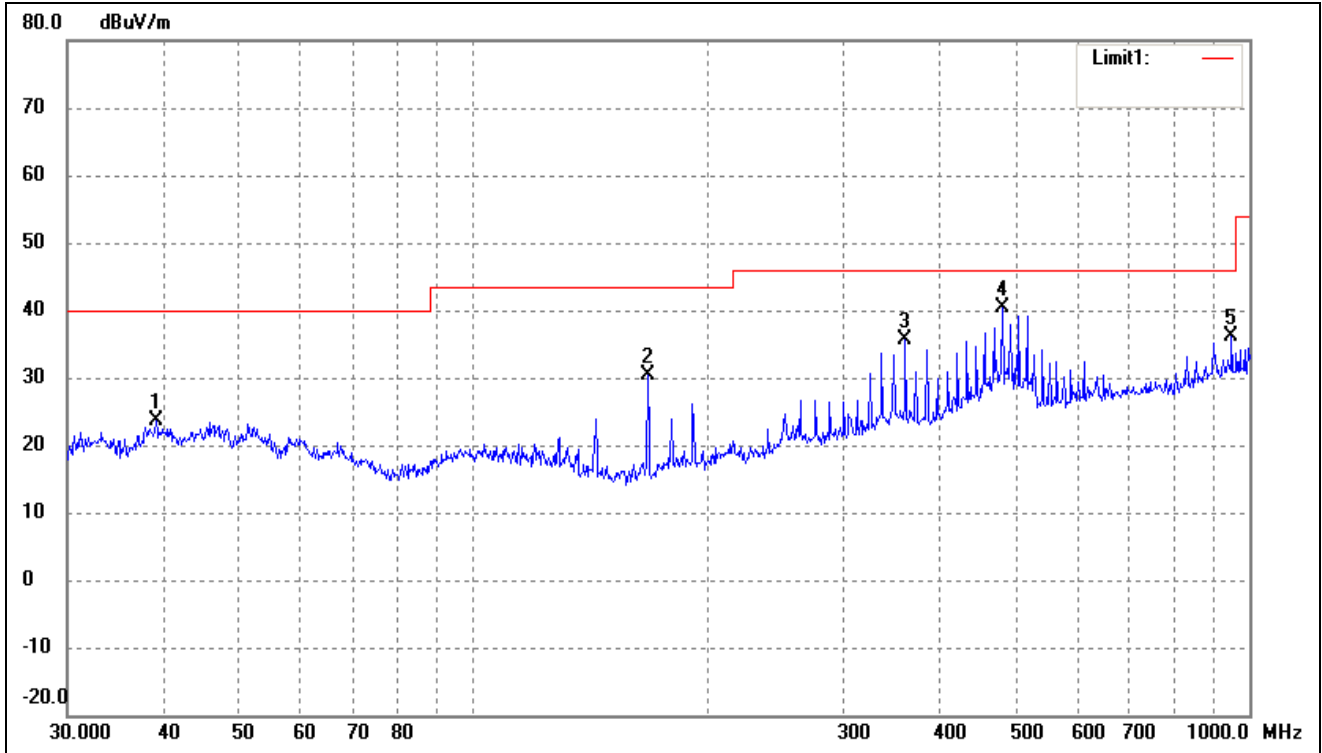
$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

8.4 Summary of Test Results/Plots

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

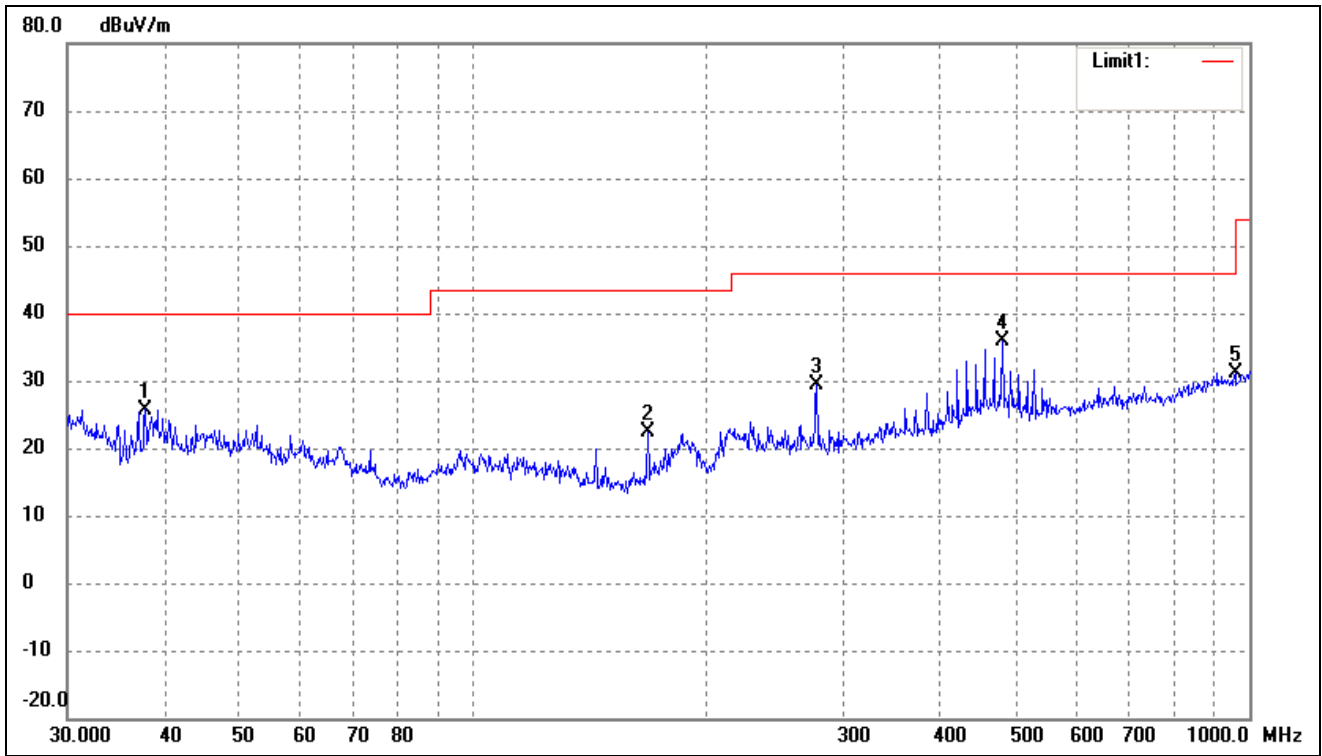
➤ Spurious Emissions Below 1GHz

Test Channel	Low	Polarity:	Horizontal
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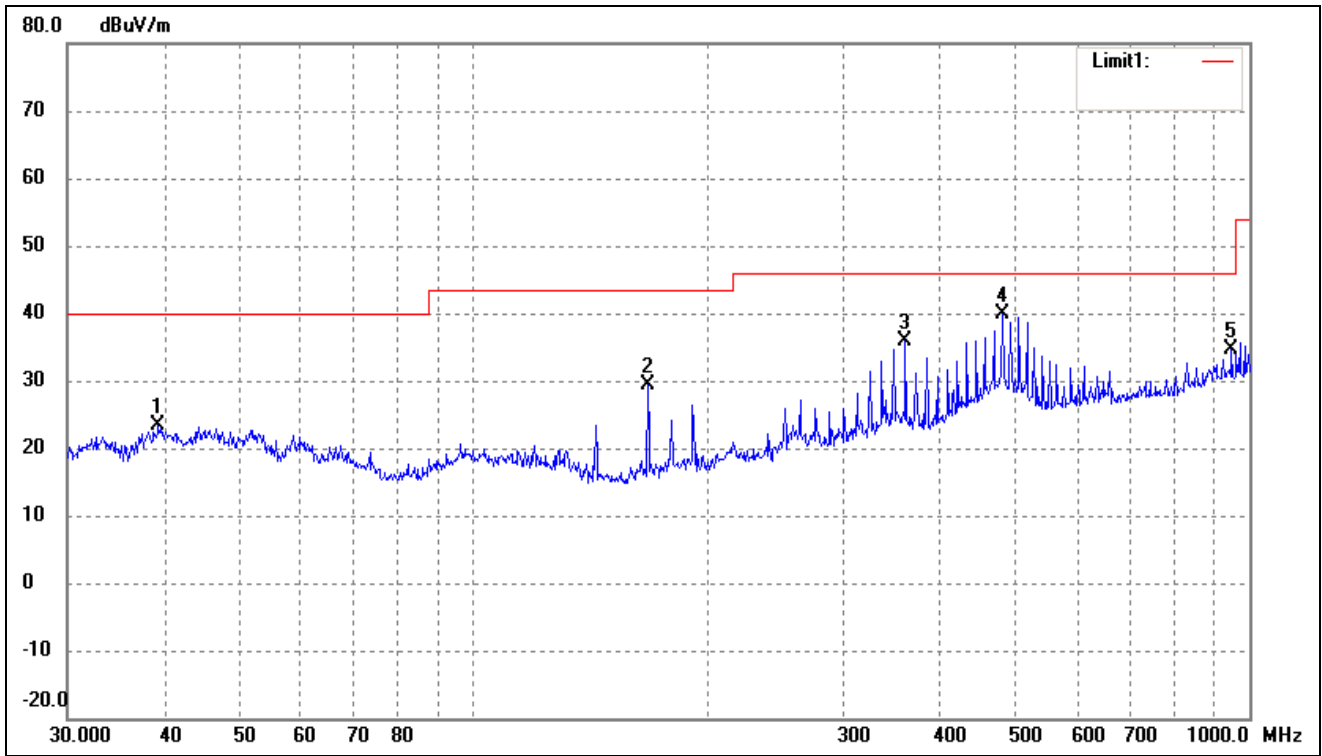
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.0245	36.04	-12.35	23.69	40.00	-16.31	-	-	peak
2	167.8243	45.56	-15.14	30.42	43.50	-13.08	-	-	peak
3	360.4477	43.04	-7.34	35.70	46.00	-10.30	-	-	peak
4	480.5276	44.92	-4.64	40.28	46.00	-5.72	-	-	peak
5	948.7610	34.85	1.39	36.24	46.00	-9.76	-	-	peak

Test Channel	Low	Polarity:	Vertical
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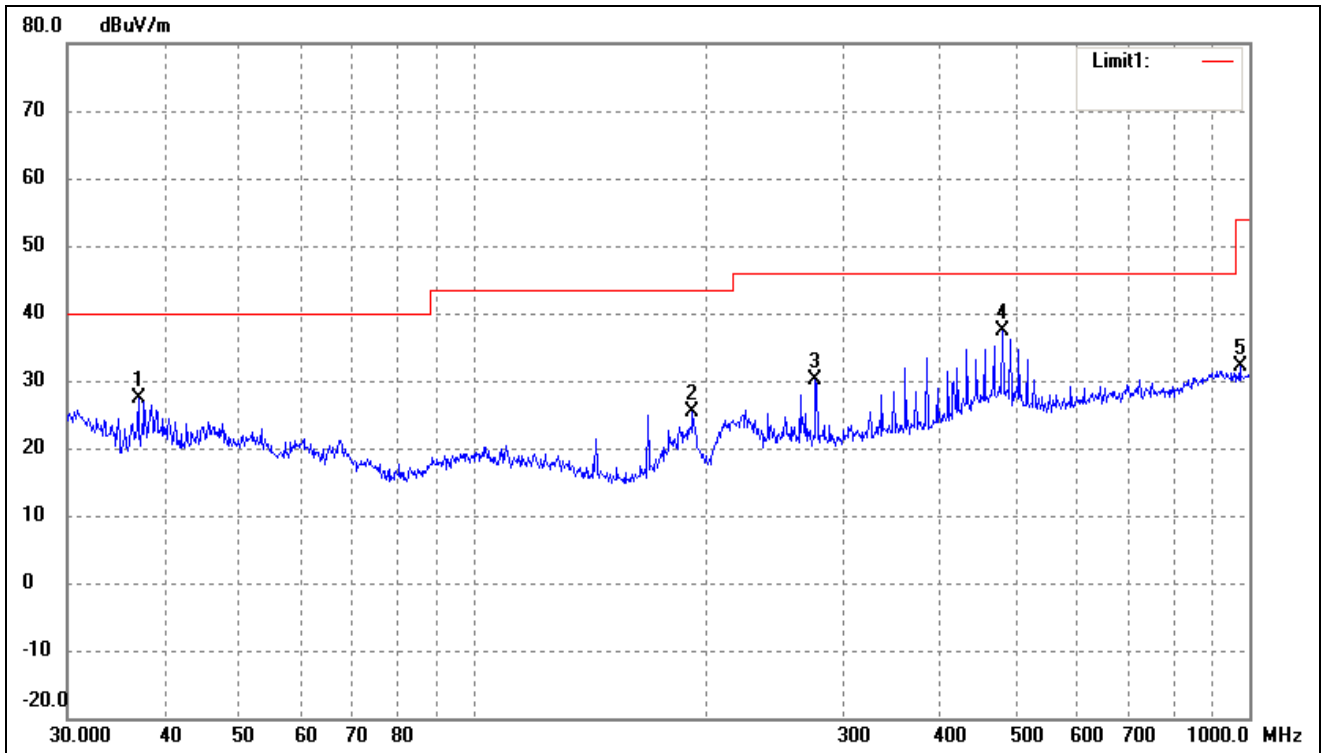
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	37.8121	38.56	-12.81	25.75	40.00	-14.25	-	-	peak
2	167.8243	37.51	-15.14	22.37	43.50	-21.13	-	-	peak
3	277.0935	40.06	-10.61	29.45	46.00	-16.55	-	-	peak
4	480.5276	40.54	-4.64	35.90	46.00	-10.10	-	-	peak
5	958.7943	29.61	1.40	31.01	46.00	-14.99	-	-	peak

Test Channel	Middle	Polarity:	Horizontal
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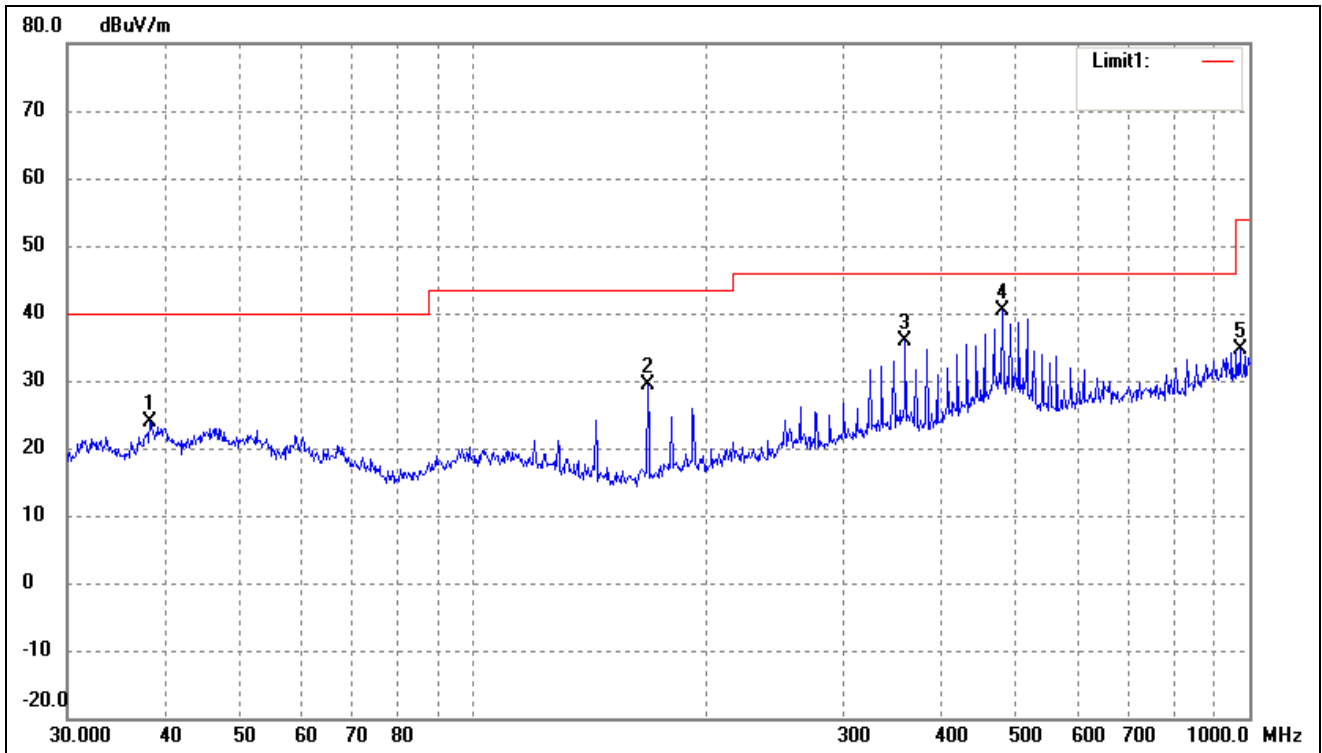
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.2991	35.55	-12.24	23.31	40.00	-16.69	-	-	peak
2	167.8243	44.60	-15.14	29.46	43.50	-14.04	-	-	peak
3	360.4477	43.30	-7.34	35.96	46.00	-10.04	-	-	peak
4	480.5276	44.63	-4.64	39.99	46.00	-6.01	-	-	peak
5	948.7610	33.22	1.39	34.61	46.00	-11.39	-	-	peak

Test Channel	Middle	Polarity:	Vertical
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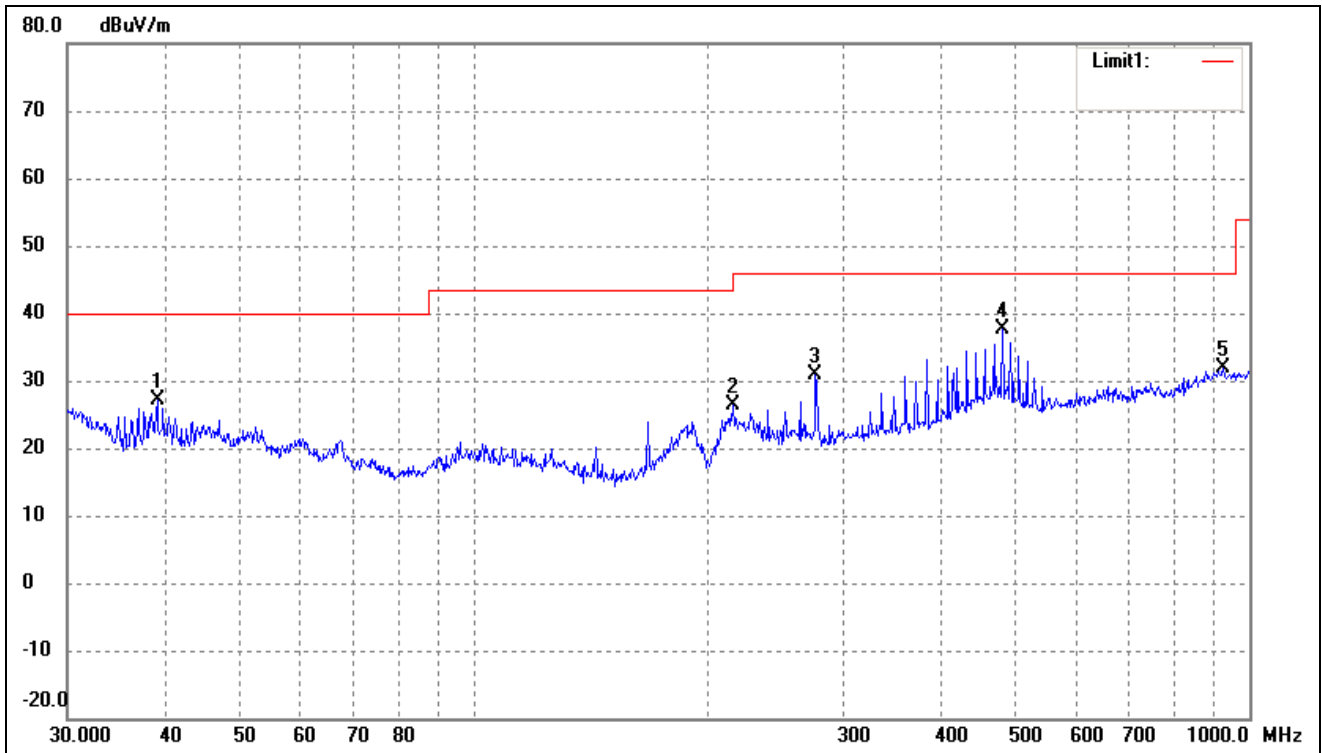
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	37.0249	40.39	-13.11	27.28	40.00	-12.72	-	-	peak
2	191.7450	38.40	-12.99	25.41	43.50	-18.09	-	-	peak
3	276.1236	40.89	-10.68	30.21	46.00	-15.79	-	-	peak
4	480.5276	41.92	-4.64	37.28	46.00	-8.72	-	-	peak
5	972.3374	30.60	1.46	32.06	54.00	-21.94	-	-	peak

Test Channel	High	Polarity:	Horizontal
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	38.3462	36.48	-12.61	23.87	40.00	-16.13	-	-	peak
2	167.8243	44.56	-15.14	29.42	43.50	-14.08	-	-	peak
3	360.4477	43.23	-7.34	35.89	46.00	-10.11	-	-	peak
4	480.5276	45.06	-4.64	40.42	46.00	-5.58	-	-	peak
5	972.3374	33.28	1.46	34.74	54.00	-19.26	-	-	peak

Test Channel	High	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.1616	39.38	-12.30	27.08	40.00	-12.92	-	-	peak
2	216.0240	38.55	-12.24	26.31	46.00	-19.69	-	-	peak
3	276.1236	41.67	-10.68	30.99	46.00	-15.01	-	-	peak
4	480.5276	42.16	-4.64	37.52	46.00	-8.48	-	-	peak
5	925.7563	29.99	1.84	31.83	46.00	-14.17	-	-	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

Frequency (MHz)	Reading (dBuV/m)	Correct dB	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar H/V	Detector
Low Channel-2405MHz							
4664.807	51.81	-4.60	47.21	74.00	-26.79	H	PK
6494.564	51.75	-2.28	49.47	74.00	-24.53	H	PK
9157.857	50.62	1.07	51.69	74.00	-22.31	H	PK
4223.950	52.85	-5.83	47.02	74.00	-26.98	V	PK
6594.518	51.62	-2.27	49.35	74.00	-24.65	V	PK
8637.084	52.20	0.04	52.24	74.00	-21.76	V	PK
Middle Channel-2445MHz							
3419.491	52.99	-7.44	45.55	74.00	-28.45	H	PK
5646.079	51.45	-3.81	47.64	74.00	-26.36	H	PK
8859.765	51.46	0.52	51.98	74.00	-22.02	H	PK
4256.330	52.01	-5.70	46.31	74.00	-27.69	V	PK
6251.257	51.51	-2.63	48.88	74.00	-25.12	V	PK
8334.700	52.40	-0.33	52.07	74.00	-21.93	V	PK
High Channel-2480MHz							
4946.072	54.54	-4.42	50.12	74.00	-23.88	H	PK
6561.030	51.80	-2.28	49.52	74.00	-24.48	H	PK
10139.447	50.39	2.64	53.03	74.00	-20.97	H	PK
4267.178	53.39	-5.66	47.73	74.00	-26.27	V	PK
6156.506	52.43	-2.77	49.66	74.00	-24.34	V	PK
8770.012	51.58	0.33	51.91	74.00	-22.09	V	PK

Note: 1. 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.

2. Average measurement was not performed if peak level is lower than average limit(54 dBuV/m) for above 1GHz.

9. Out of Band Emissions

9.1 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).

9.2 Test Procedure

According to the KDB 558074, the band-edge radiated test method as follows:

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.

According to the KDB 558074, the conducted spurious emissions test method as follows:

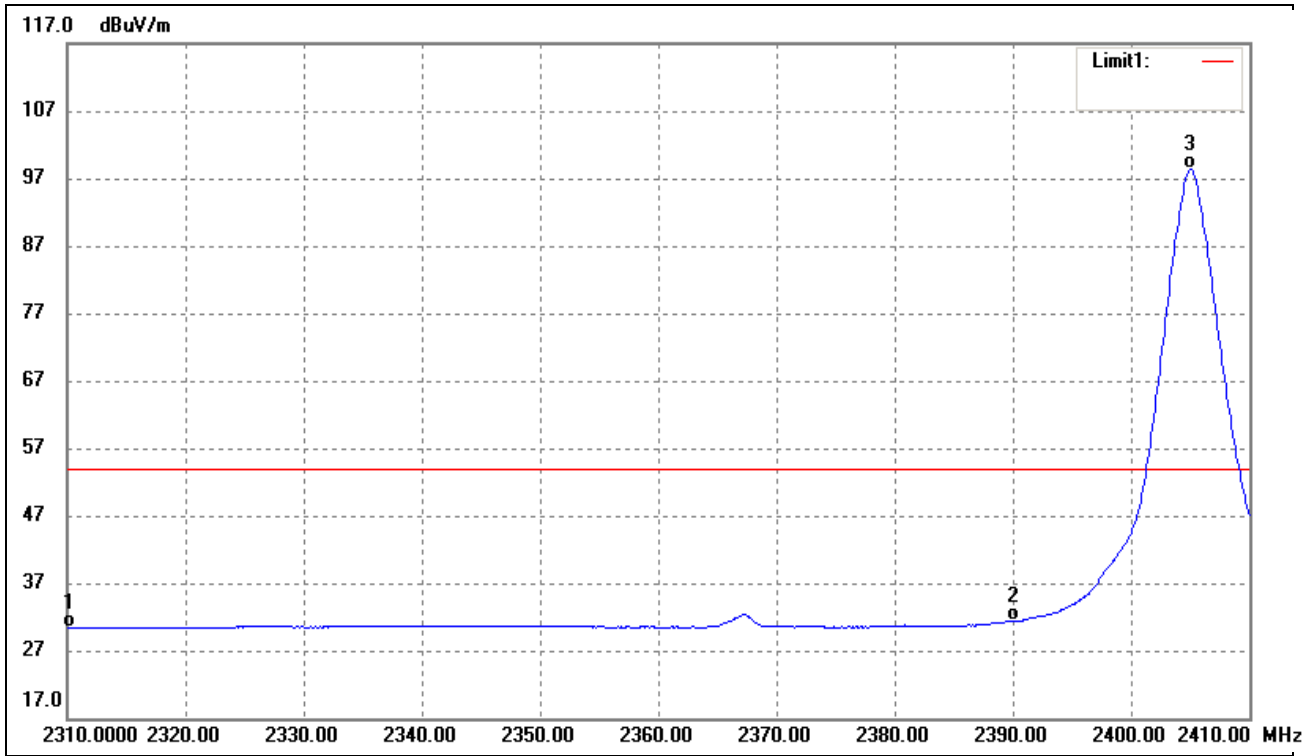
1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100 kHz.
4. Set VBW \geq 300 kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

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.

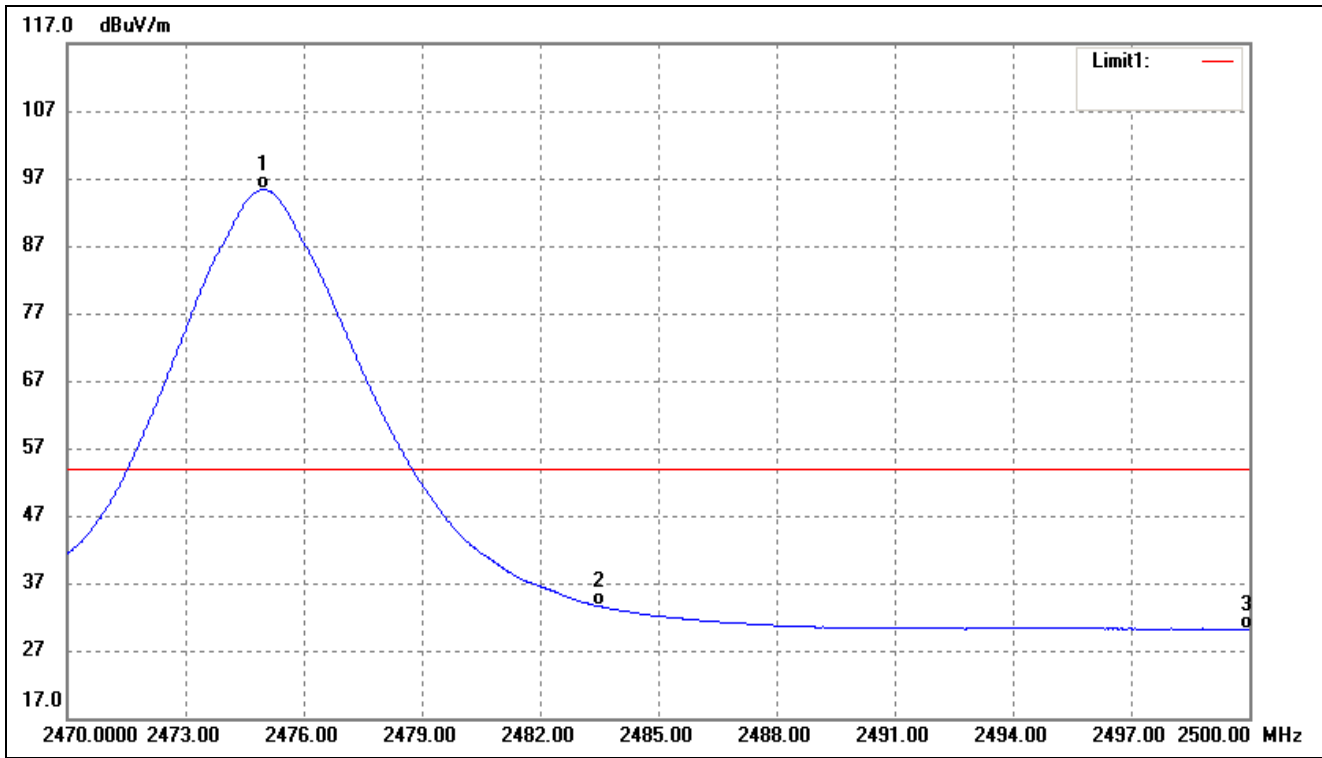
9.3 Summary of Test Results/Plots

Test Channel	Low	Polarity:	Horizontal (worst case)
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	40.01	-9.66	30.35	54.00	-23.65	Average Detector
	2310.000	51.37	-9.66	41.71	74.00	-32.29	Peak Detector
2	2390.000	40.88	-9.50	31.38	54.00	-22.62	Average Detector
	2390.000	52.77	-9.50	43.27	74.00	-30.73	Peak Detector
3	2405.000	107.79	-9.48	98.31			Average Detector
	2404.500	110.44	-9.48	100.96			Peak Detector

Test Channel	High	Polarity:	Horizontal (worst case)
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2474.980	104.69	-9.34	95.35	/	/	Average Detector
	2474.470	107.29	-9.34	97.95	/	/	Peak Detector
2	2483.500	42.91	-9.31	33.60	54.00	-20.40	Average Detector
	2483.500	55.77	-9.31	46.46	74.00	-27.54	Peak Detector
3	2500.000	39.38	-9.28	30.10	54.00	-23.90	Average Detector
	2500.000	52.61	-9.28	43.33	74.00	-30.67	Peak Detector

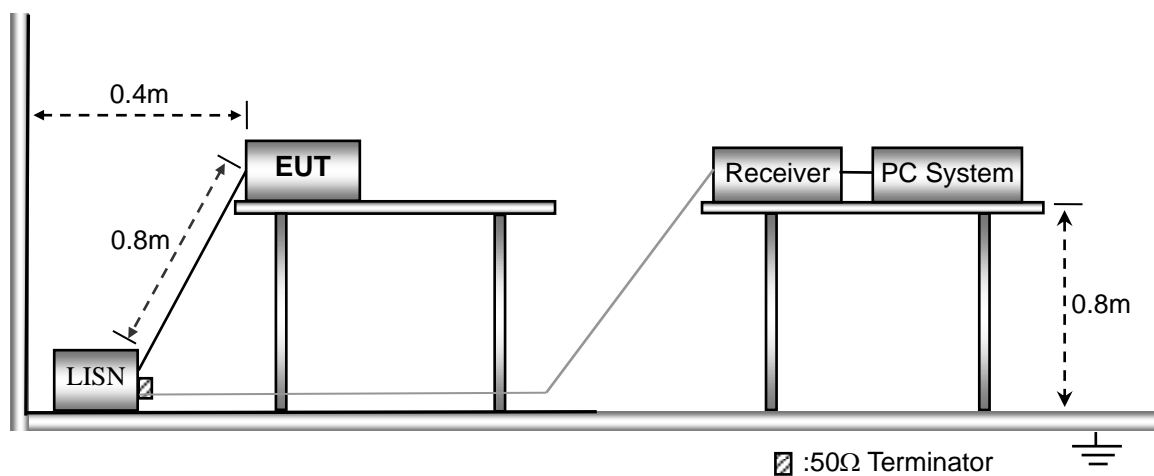
10. Conducted Emissions

10.1 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.

10.2 Basic Test Setup Block Diagram



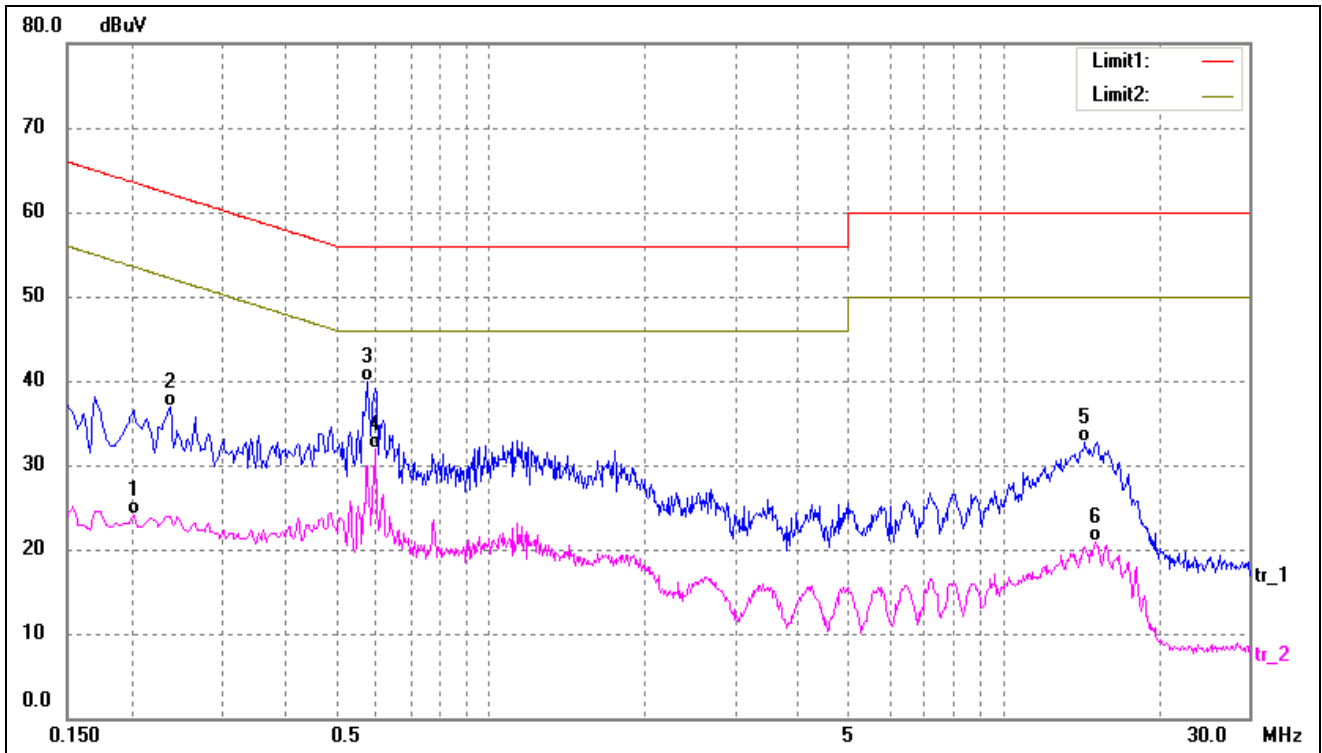
10.3 Test Receiver Setup

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

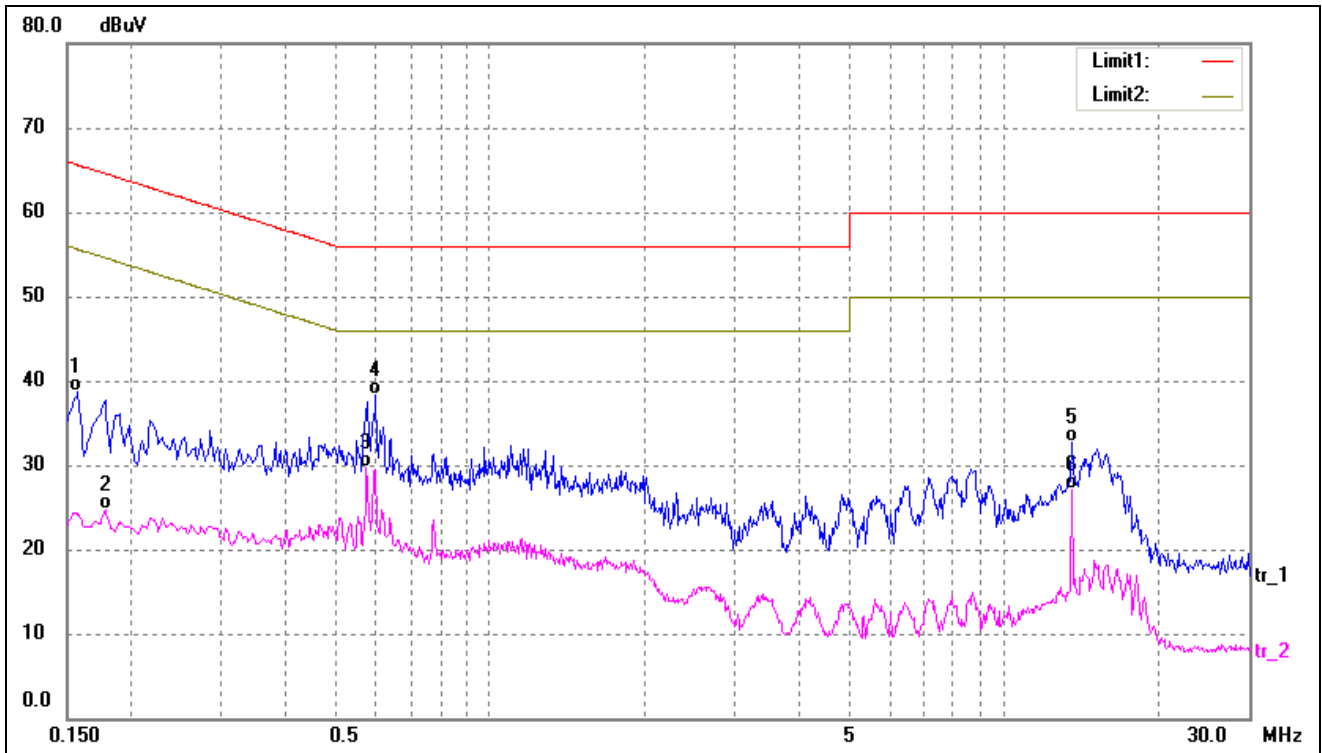
10.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.2020	13.89	10.27	24.16	53.52	-29.36	AVG
2	0.2380	26.57	10.26	36.83	62.16	-25.33	QP
3	0.5780	29.61	10.21	39.82	56.00	-16.18	QP
4*	0.5980	21.78	10.21	31.99	46.00	-14.01	AVG
5	14.3900	22.19	10.54	32.73	60.00	-27.27	QP
6	15.0860	10.31	10.58	20.89	50.00	-29.11	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1580	28.39	10.25	38.64	65.56	-26.92	QP
2	0.1780	14.44	10.26	24.70	54.57	-29.87	AVG
3*	0.5740	19.44	10.21	29.65	46.00	-16.35	AVG
4	0.5980	28.09	10.21	38.30	56.00	-17.70	QP
5	13.5620	22.22	10.50	32.72	60.00	-27.28	QP
6	13.5620	16.64	10.50	27.14	50.00	-22.86	AVG

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