

FCC Part 15C Measurement and Test Report

For

Lumi United Technology Co., Ltd

8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan

Residential District, Nanshan District, Shenzhen, China.

FCC ID: 2AKIT-BR-USH01

FCC Rule(s):	<u>FCC Part 15.247</u>
Product Description:	<u>Smart Plug</u>
Tested Model:	<u>BR-USH01</u>
Report No.:	<u>WTX19X12086595W-3</u>
Sample Receipt Date:	<u>2019-12-12</u>
Tested Date:	<u>2019-12-12 to 2019-12-30</u>
Issued Date:	<u>2019-12-30</u>
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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen SEM Test Technology Co., Ltd.

TABLE OF CONTENTS

1. GENERAL INFORMATION.....4

 1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....4

 1.2 TEST STANDARDS.....6

 1.3 TEST METHODOLOGY6

 1.4 TEST FACILITY6

 1.5 EUT SETUP AND TEST MODE.....7

 1.6 MEASUREMENT UNCERTAINTY8

 1.7 TEST EQUIPMENT LIST AND DETAILS9

2. SUMMARY OF TEST RESULTS11

3. RF EXPOSURE12

 3.1 STANDARD APPLICABLE.....12

 3.2 TEST RESULT.....12

4. ANTENNA REQUIREMENT13

 4.1 STANDARD APPLICABLE.....13

 4.2 EVALUATION INFORMATION13

5. POWER SPECTRAL DENSITY14

 5.1 STANDARD APPLICABLE.....14

 5.2 TEST PROCEDURE.....14

 5.3 SUMMARY OF TEST RESULTS/PLOTS14

6. DTS BANDWIDTH.....16

 6.1 STANDARD APPLICABLE.....16

 6.2 TEST PROCEDURE.....16

 6.3 SUMMARY OF TEST RESULTS/PLOTS16

7. RF OUTPUT POWER18

 7.1 STANDARD APPLICABLE.....18

 7.2 TEST PROCEDURE.....18

 7.3 SUMMARY OF TEST RESULTS/PLOTS18

8. FIELD STRENGTH OF SPURIOUS EMISSIONS20

 8.1 STANDARD APPLICABLE.....20

 8.2 TEST PROCEDURE.....20

 8.3 CORRECTED AMPLITUDE & MARGIN CALCULATION.....21

 8.4 SUMMARY OF TEST RESULTS/PLOTS21

9. OUT OF BAND EMISSIONS.....29

 9.1 STANDARD APPLICABLE.....29

 9.2 TEST PROCEDURE.....29

 9.3 SUMMARY OF TEST RESULTS/PLOTS30

10. CONDUCTED EMISSIONS36

 10.1 TEST PROCEDURE.....36

 10.2 BASIC TEST SETUP BLOCK DIAGRAM.....36

 10.3 TEST RECEIVER SETUP36

 10.4 SUMMARY OF TEST RESULTS/PLOTS36

Report version

Version No.	Date of issue	Description
Rev.00	2019-12-30	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Lumi United Technology Co., Ltd
Address of applicant: 8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China.

Manufacturer: Lumi United Technology Co., Ltd
Address of manufacturer: 8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China.

General Description of EUT	
Product Name:	Smart Plug
Brand Name:	AQara
Model No.:	BR-USH01
Adding Model(s):	/
Rated Voltage:	AC120V/60Hz
Power Adapter:	/
Software Version:	1.8D24
Hardware Version:	LM19-GBR-B-T1, LM19-GBR-C-T1, LM19-GBR-A_X3
<i>Note: The test data is gathered from a production sample, provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Frequency Range:	2405-2475MHz
RF Output Power:	21.89dBm (Conducted)
Modulation:	O-QPSK
Quantity of Channels:	15 (ch11~ch25)
Type of Antenna:	Built-in steel plate Antenna
Antenna Gain:	2.0dBi

➤ Center Frequency of Each of Channel:

Channel	Frequency (MHz)
11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
25	2475

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

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.

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: Shenzhen SEM Test Technology Co., Ltd.

Address: 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C. (518101)

FCC – Registration No.: 125990

Shenzhen SEM Test Technology 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 Shenzhen SEM Test Technology 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
/	/	/	/

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

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Smart Plug	Lumi	BR-USH01	/
Smart Plug	Lumi	BR-USH01	/
Smart Plug	Lumi	BR-USH01	/
TP-LINK-D714	PULIAN	TL-WR842N	/
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 $\pm 3.84\text{dB}$
		6-18GHz $\pm 3.92\text{dB}$

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2019-04-30	2020-04-29
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2019-04-30	2020-04-29
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2019-04-30	2020-04-29
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2019-04-30	2020-04-29
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2019-04-30	2020-04-29
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	2019-04-30	2020-04-29
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2019-04-30	2020-04-29
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2019-04-30	2020-04-29
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2019-04-30	2020-04-29
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2019-04-30	2020-04-29
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2019-04-30	2020-04-29
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)	/	2019-03-18	2020-03-17
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2019-03-18	2020-03-17
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2019-03-18	2020-03-17
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2019-03-18	2020-03-17
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2019-03-18	2020-03-17
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2019-03-18	2020-03-17

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)	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. 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 built-in steel plate 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 Procedure

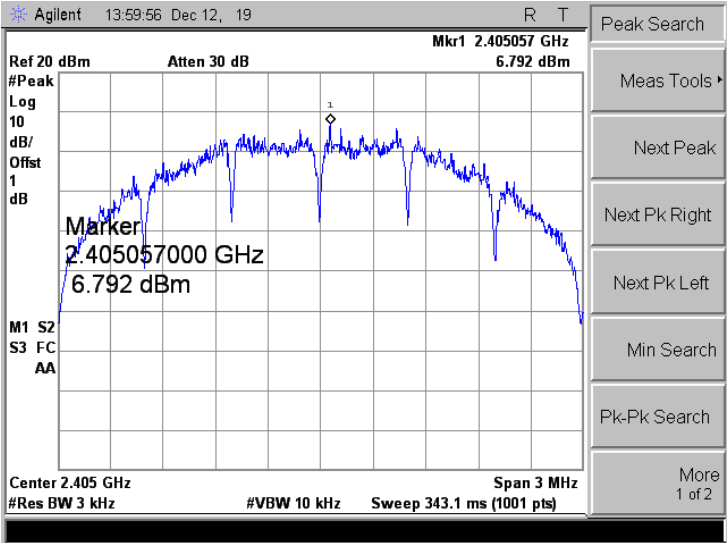
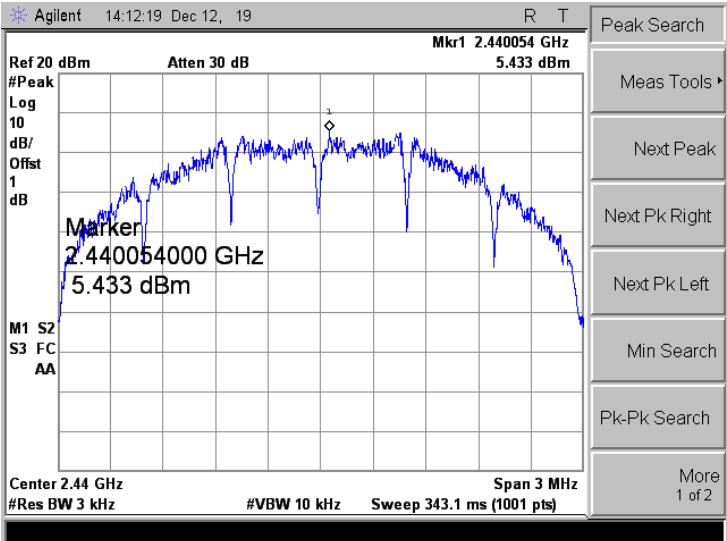
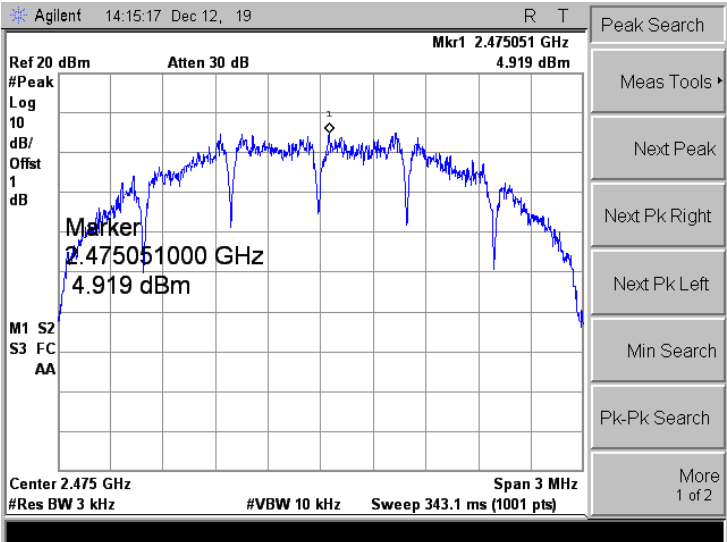
According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3 Summary of Test Results/Plots

Test Mode	Test Channel	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
O-QPSK	Low	6.792	8
	Middle	5.433	8
	High	4.919	8

Please refer to the following test plots:

<p>Low</p>	
<p>Middle</p>	
<p>High</p>	

6. DTS 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 Procedure

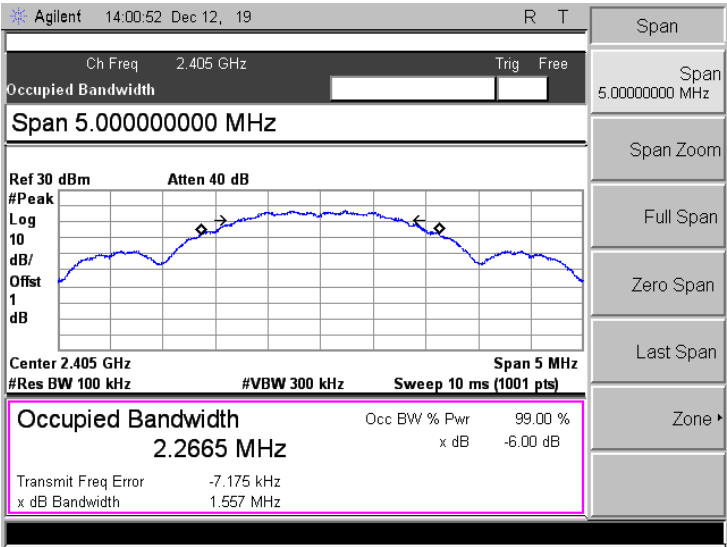
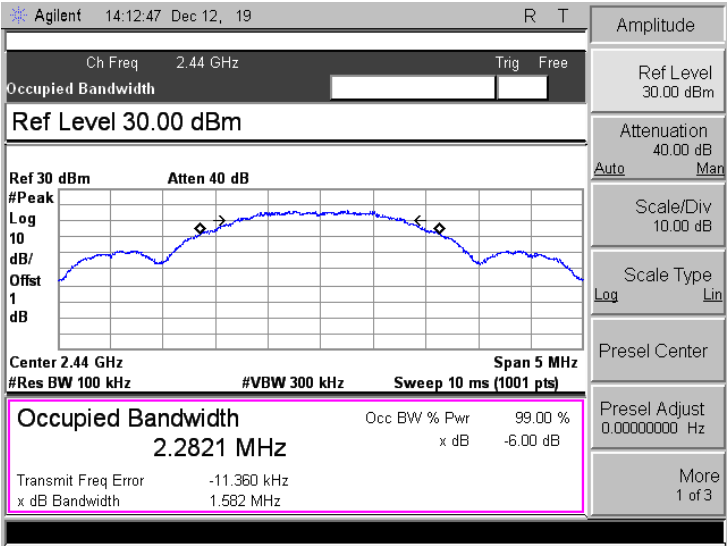
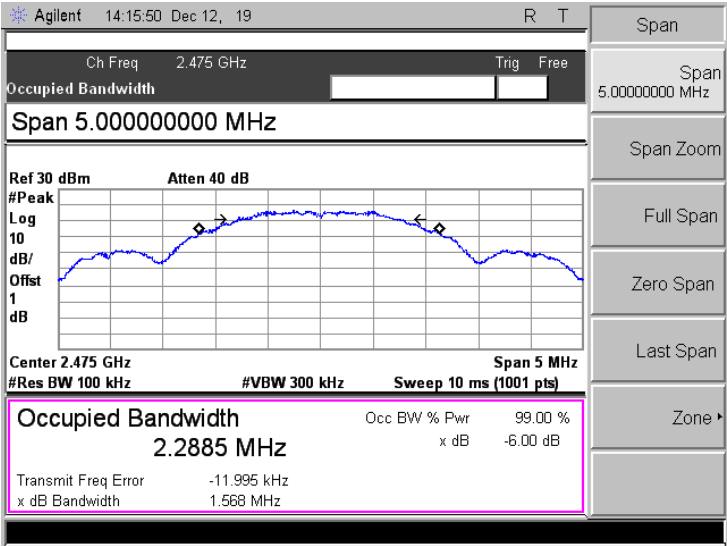
According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

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

6.3 Summary of Test Results/Plots

Test Mode	Test Channel	6 dB Bandwidth kHz	Limit kHz
O-QPSK	Low	1557	≥ 500
	Middle	1582	≥ 500
	High	1568	≥ 500

Please refer to the following test plots:

<p>Low</p>	 <p>Agilent 14:00:52 Dec 12, 19 R T</p> <p>Ch Freq 2.405 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Span 5.00000000 MHz</p> <p>Ref 30 dBm Atten 40 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> <p>Occupied Bandwidth 2.2665 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -6.00 dB</p> <p>Transmit Freq Error -7.175 kHz x dB Bandwidth 1.567 MHz</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>
<p>Middle</p>	 <p>Agilent 14:12:47 Dec 12, 19 R T</p> <p>Ch Freq 2.44 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Ref Level 30.00 dBm</p> <p>Ref 30 dBm Atten 40 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> <p>Occupied Bandwidth 2.2821 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -6.00 dB</p> <p>Transmit Freq Error -11.360 kHz x dB Bandwidth 1.582 MHz</p> <p>Amplitude</p> <p>Ref Level 30.00 dBm</p> <p>Attenuation 40.00 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>
<p>High</p>	 <p>Agilent 14:15:50 Dec 12, 19 R T</p> <p>Ch Freq 2.475 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Span 5.00000000 MHz</p> <p>Ref 30 dBm Atten 40 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> <p>Occupied Bandwidth 2.2885 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -6.00 dB</p> <p>Transmit Freq Error -11.995 kHz x dB Bandwidth 1.568 MHz</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>

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.

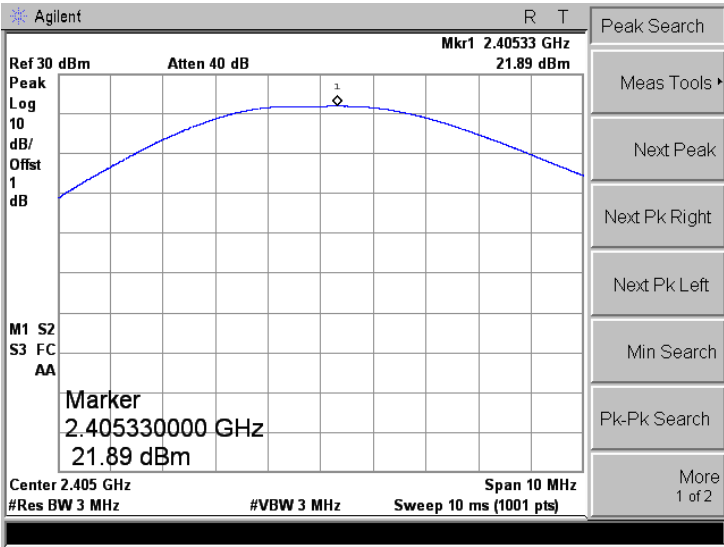
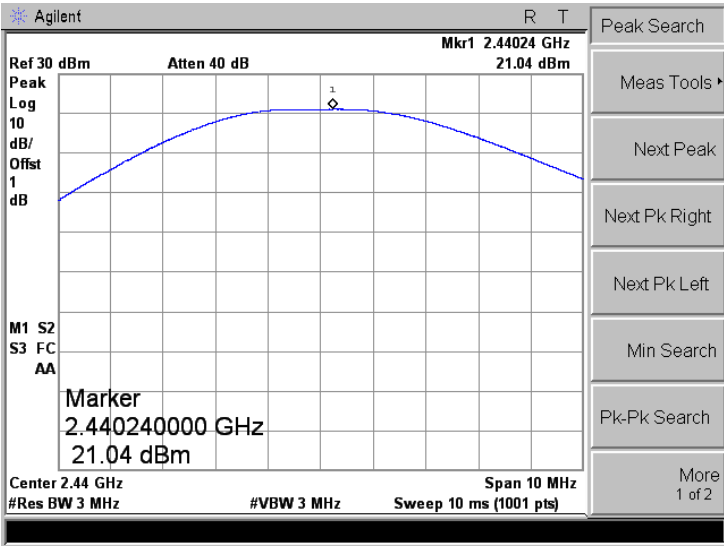
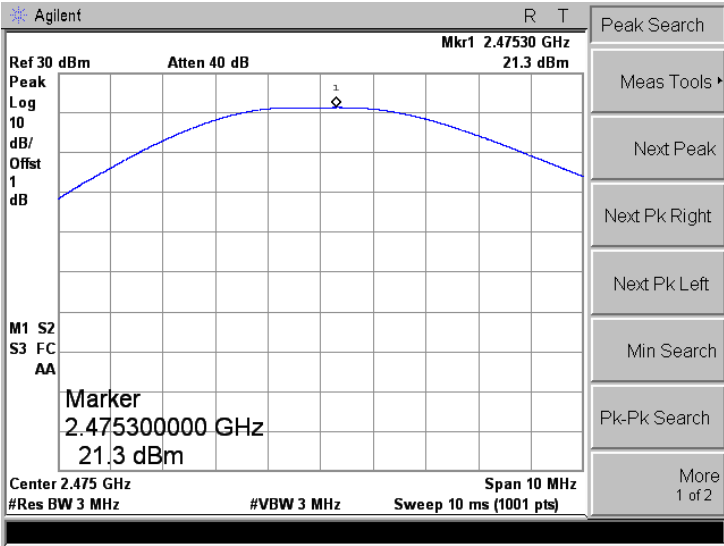
7.2 Test Procedure

According to the KDB-558074 D01 v05r02 Subclause 8.3.1.1 and ANSI C63.10-2013 Subclause 11.9.1.1, this procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW $\geq 3 \times$ RBW.
- c) Set span $\geq 3 \times$ 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.

7.3 Summary of Test Results/Plots

Test Mode	Test Channel	Reading dBm	Output Power mW	Limit mW
O-QPSK	Low	21.89	154.53	1000
	Middle	21.04	127.06	1000
	High	21.30	134.90	1000

<p>Low</p>	 <p>Agilent R T Ref 30 dBm Atten 40 dB Mkr1 2.40533 GHz 21.89 dBm Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p> <p>Marker 2.405330000 GHz 21.89 dBm</p> <p>Center 2.405 GHz Span 10 MHz #Res BW 3 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p>
<p>Middle</p>	 <p>Agilent R T Ref 30 dBm Atten 40 dB Mkr1 2.44024 GHz 21.04 dBm Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p> <p>Marker 2.440240000 GHz 21.04 dBm</p> <p>Center 2.44 GHz Span 10 MHz #Res BW 3 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p>
<p>High</p>	 <p>Agilent R T Ref 30 dBm Atten 40 dB Mkr1 2.47530 GHz 21.3 dBm Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p> <p>Marker 2.475300000 GHz 21.3 dBm</p> <p>Center 2.475 GHz Span 10 MHz #Res BW 3 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p>

8. Field Strength of Spurious Emissions

8.1 Standard Applicable

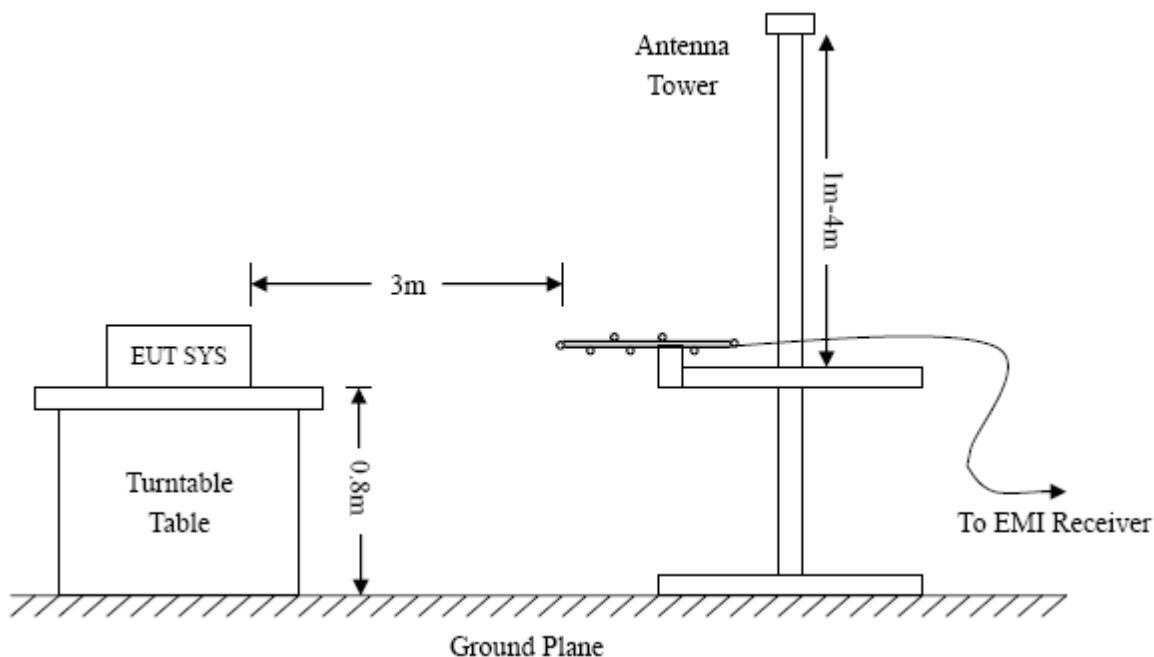
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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).

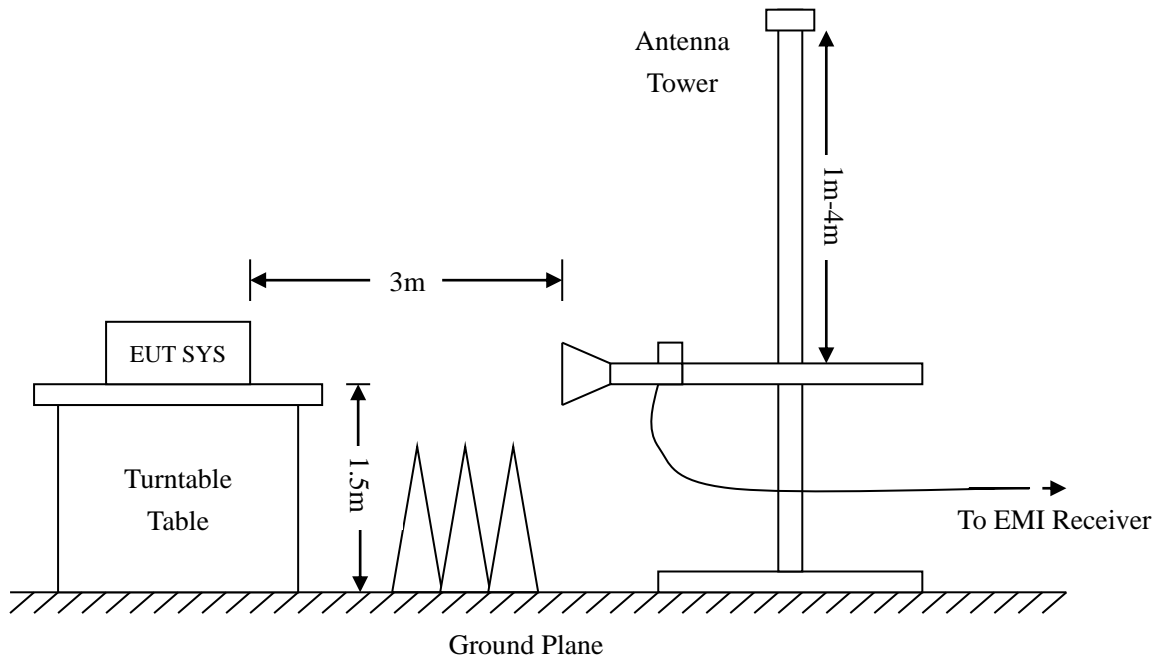
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

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.





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 $-6\text{dB}\mu\text{V}$ means the emission is $6\text{dB}\mu\text{V}$ below the maximum limit. The equation for margin calculation is as follows:

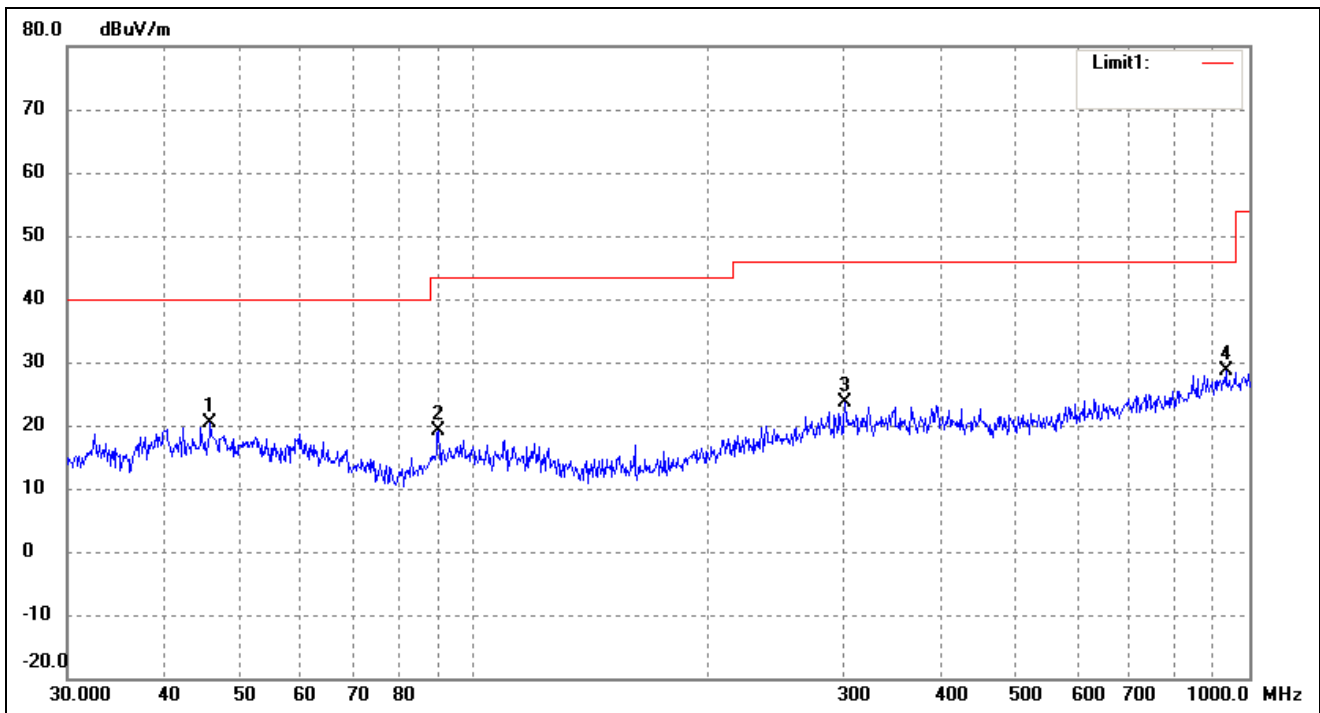
$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

8.4 Summary of Test Results/Plots

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

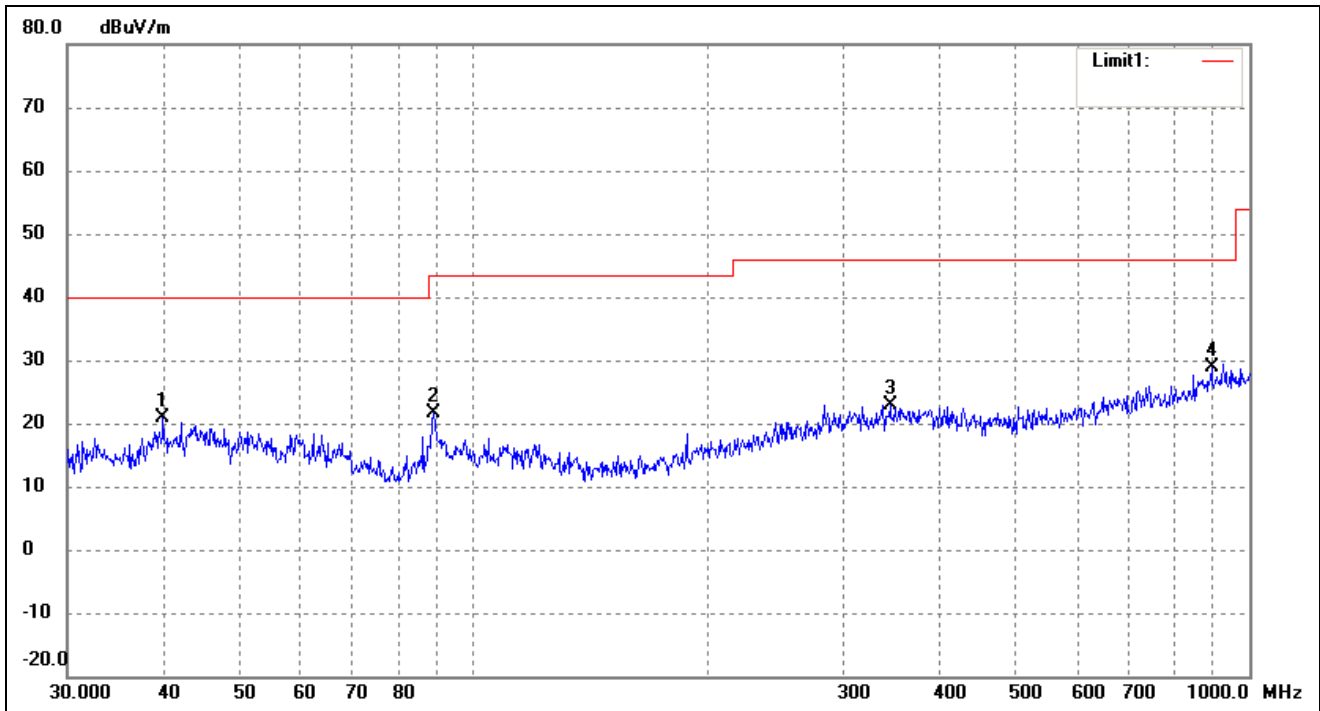
➤ Spurious Emissions Below 1GHz

Test Channel	Low	Polarity:	Horizontal
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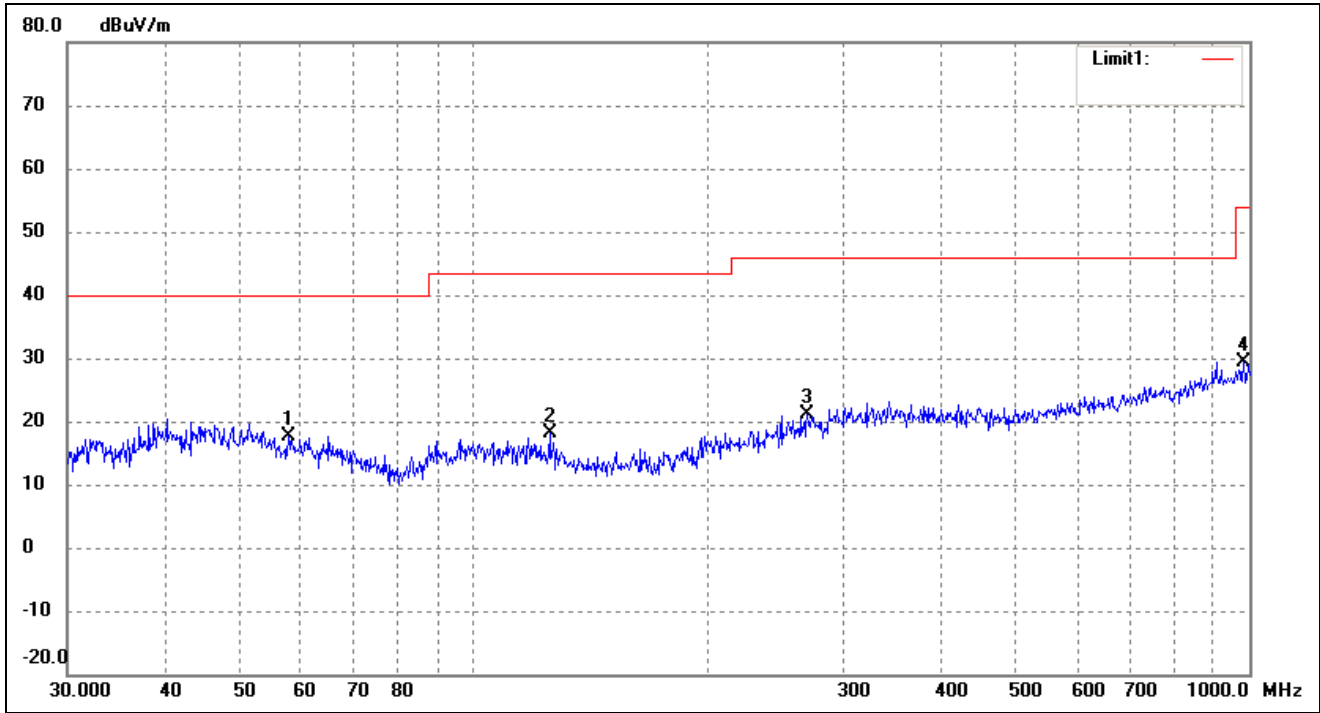
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	45.8553	34.16	-13.88	20.28	40.00	-19.72	319	100	peak
2	90.2205	35.91	-16.86	19.05	43.50	-24.45	145	100	peak
3	301.4224	31.49	-7.86	23.63	46.00	-22.37	82	100	peak
4	932.2715	29.58	-0.89	28.69	46.00	-17.31	126	100	peak

Test Channel	Low	Polarity:	Vertical
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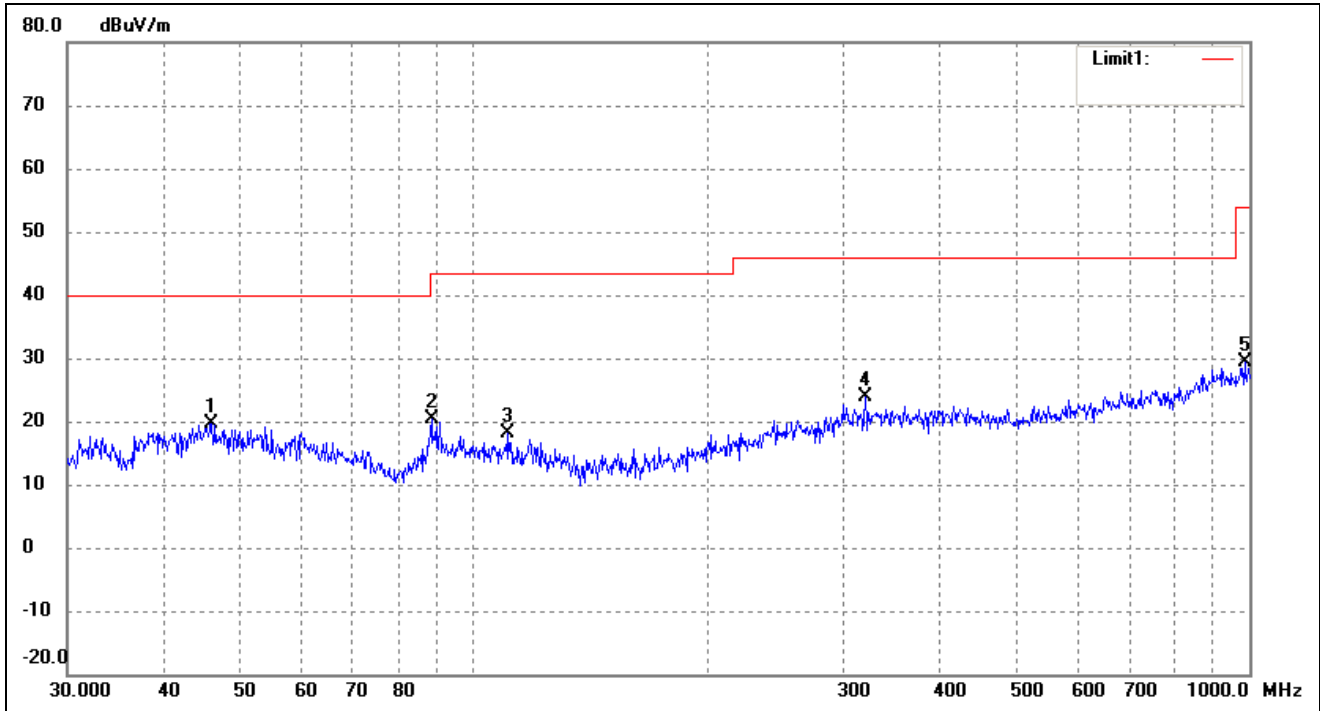
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.8542	35.15	-14.21	20.94	40.00	-19.06	317	100	peak
2	88.9639	38.83	-17.17	21.66	43.50	-21.84	95	100	peak
3	344.3855	30.77	-7.78	22.99	46.00	-23.01	353	100	peak
4	893.8567	30.31	-1.48	28.83	46.00	-17.17	112	100	peak

Test Channel	Middle	Polarity:	Horizontal
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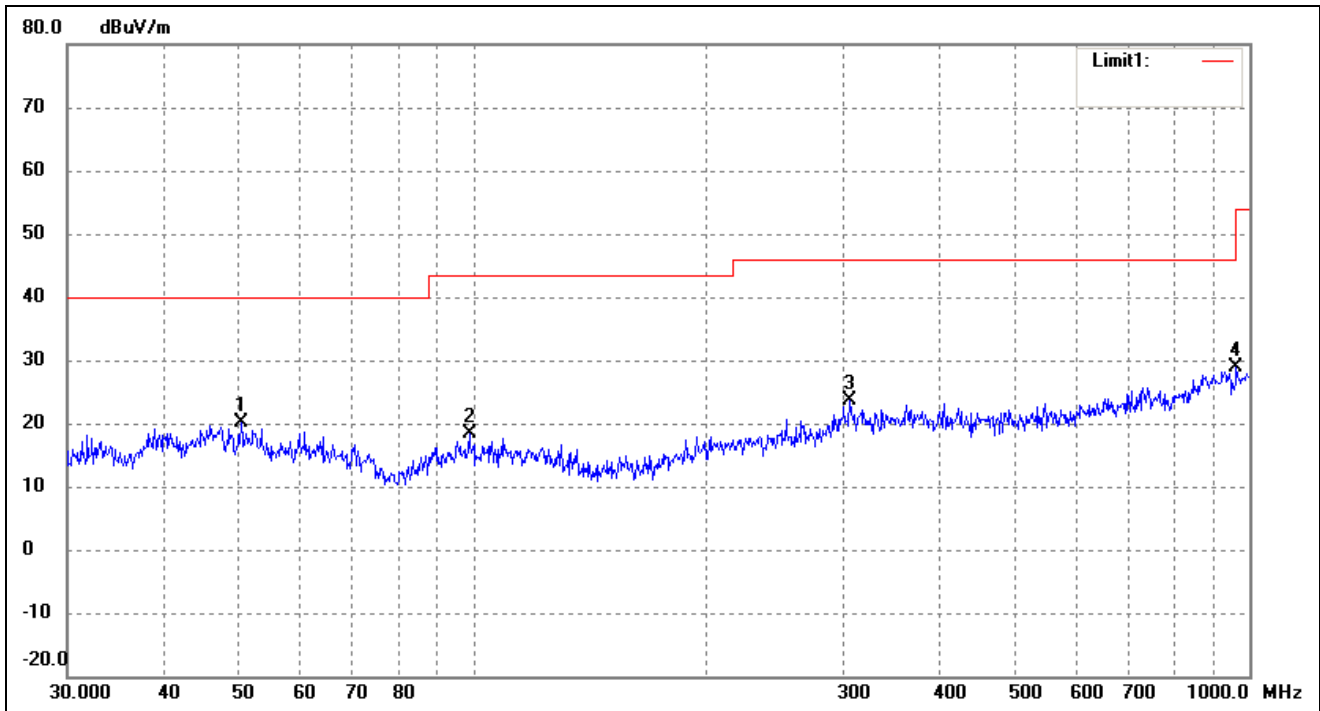
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	57.7962	32.74	-15.13	17.61	40.00	-22.39	56	100	peak
2	125.4457	35.01	-17.00	18.01	43.50	-25.49	158	100	peak
3	269.4284	31.28	-10.10	21.18	46.00	-24.82	85	100	peak
4	982.6200	30.05	-0.78	29.27	54.00	-24.73	150	100	peak

Test Channel	Middle	Polarity:	Vertical
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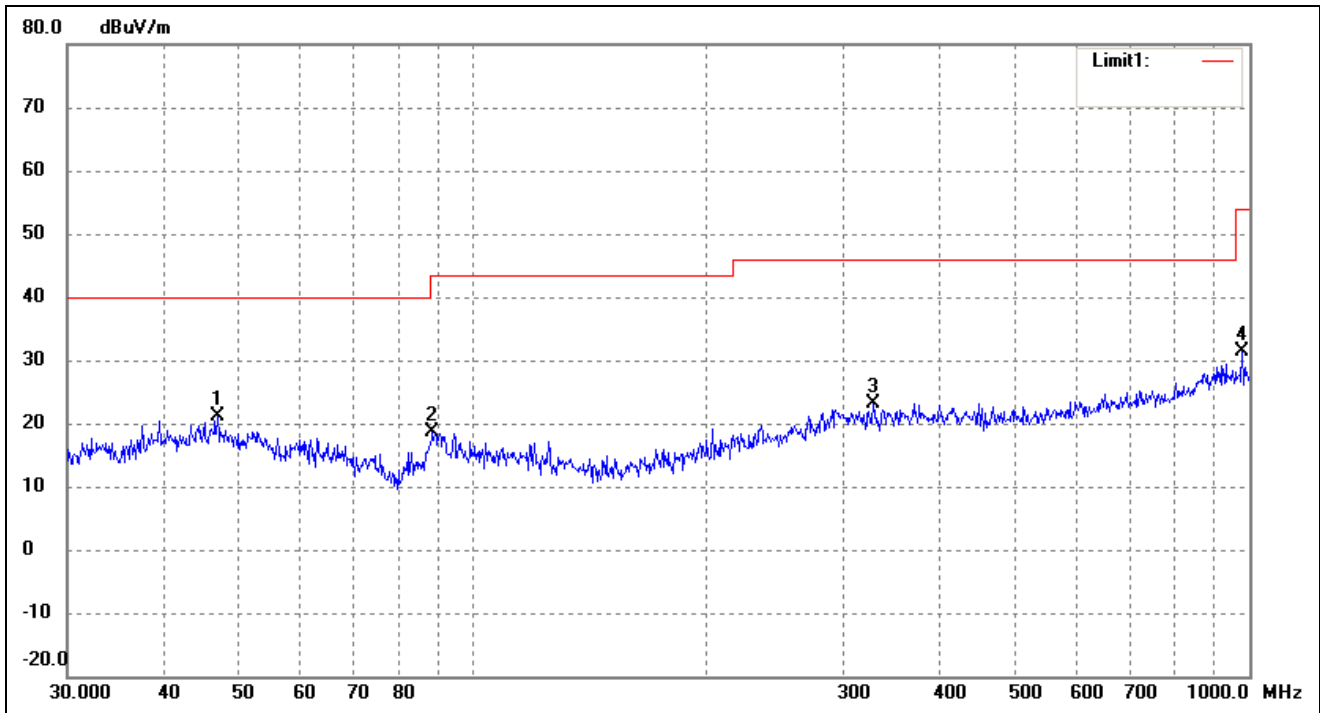
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	46.0164	33.60	-13.87	19.73	40.00	-20.27	243	100	peak
2	88.3421	37.80	-17.31	20.49	43.50	-23.01	99	100	peak
3	110.9571	33.07	-14.86	18.21	43.50	-25.29	314	100	peak
4	319.9370	32.17	-8.35	23.82	46.00	-22.18	115	100	peak
5	986.0717	29.98	-0.71	29.27	54.00	-24.73	87	100	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	50.2325	33.88	-13.70	20.18	40.00	-19.82	238	100	peak
2	98.8326	33.60	-15.16	18.44	43.50	-25.06	262	100	peak
3	305.6800	31.67	-7.97	23.70	46.00	-22.30	64	100	peak
4	962.1623	30.01	-1.06	28.95	54.00	-25.05	247	100	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	46.8303	35.00	-13.83	21.17	40.00	-18.83	159	100	peak
2	88.6525	35.93	-17.24	18.69	43.50	-24.81	328	100	peak
3	327.8873	31.57	-8.38	23.19	46.00	-22.81	55	100	peak
4	979.1804	32.22	-0.85	31.37	54.00	-22.63	178	100	peak

➤ 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-2402MHz							
4810	59.46	-3.59	55.87	74	-18.13	H	PK
4810	39.4	-3.59	35.81	54	-18.19	H	AV
7215	61.85	-0.52	61.33	74	-12.67	H	PK
7215	39.46	-0.52	38.94	54	-15.06	H	AV
4810	60.31	-3.59	56.72	74	-17.28	V	PK
4810	41.32	-3.59	37.73	54	-16.27	V	AV
7215	59.97	-0.52	59.45	74	-14.55	V	PK
7215	38.13	-0.52	37.61	54	-16.39	V	AV
Middle Channel-2440MHz							
4880	61.75	-3.49	58.26	74	-15.74	H	PK
4880	38.08	-3.49	34.59	54	-19.41	H	AV
7320	58.73	-0.47	58.26	74	-15.74	H	PK
7320	38.96	-0.47	38.49	54	-15.51	H	AV
4880	61.62	-3.49	58.13	74	-15.87	V	PK
4880	40.82	-3.49	37.33	54	-16.67	V	AV
7320	61.87	-0.47	61.4	74	-12.6	V	PK
7320	38.52	-0.47	38.05	54	-15.95	V	AV
High Channel-2480MHz							
4950	60.68	-3.41	57.27	74	-16.73	H	PK
4950	40.49	-3.41	37.08	54	-16.92	H	AV
7425	61.44	-0.42	61.02	74	-12.98	H	PK
7425	41.73	-0.42	41.31	54	-12.69	H	AV
4950	59.04	-3.41	55.63	74	-18.37	V	PK
4950	40.36	-3.41	36.95	54	-17.05	V	AV
7425	59.51	-0.42	59.09	74	-14.91	V	PK
7425	39.56	-0.42	39.14	54	-14.86	V	AV

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.

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 D01 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
9kHz to 150kHz	200Hz to 300Hz
0.15MHz to 30MHz	9kHz to 10kHz
30MHz to 1000MHz	100kHz to 120kHz
>1000MHz	1MHz

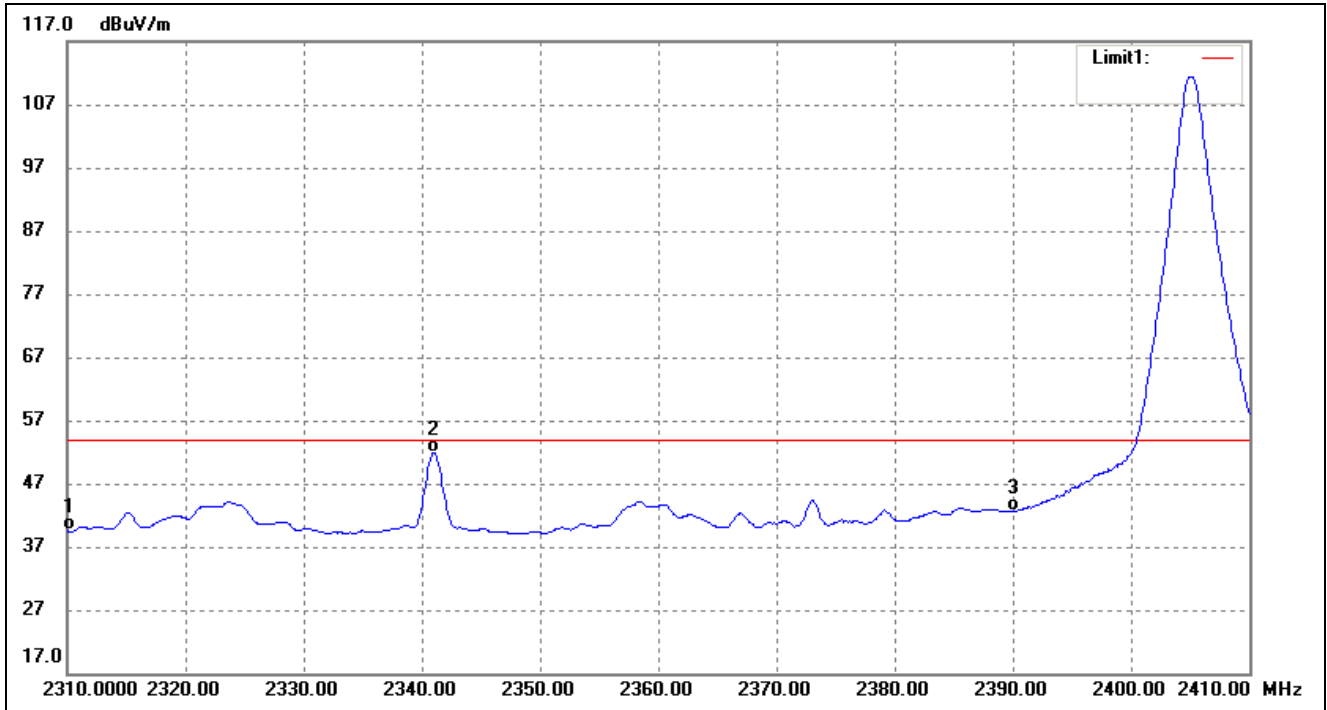
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

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.

9.3 Summary of Test Results/Plots

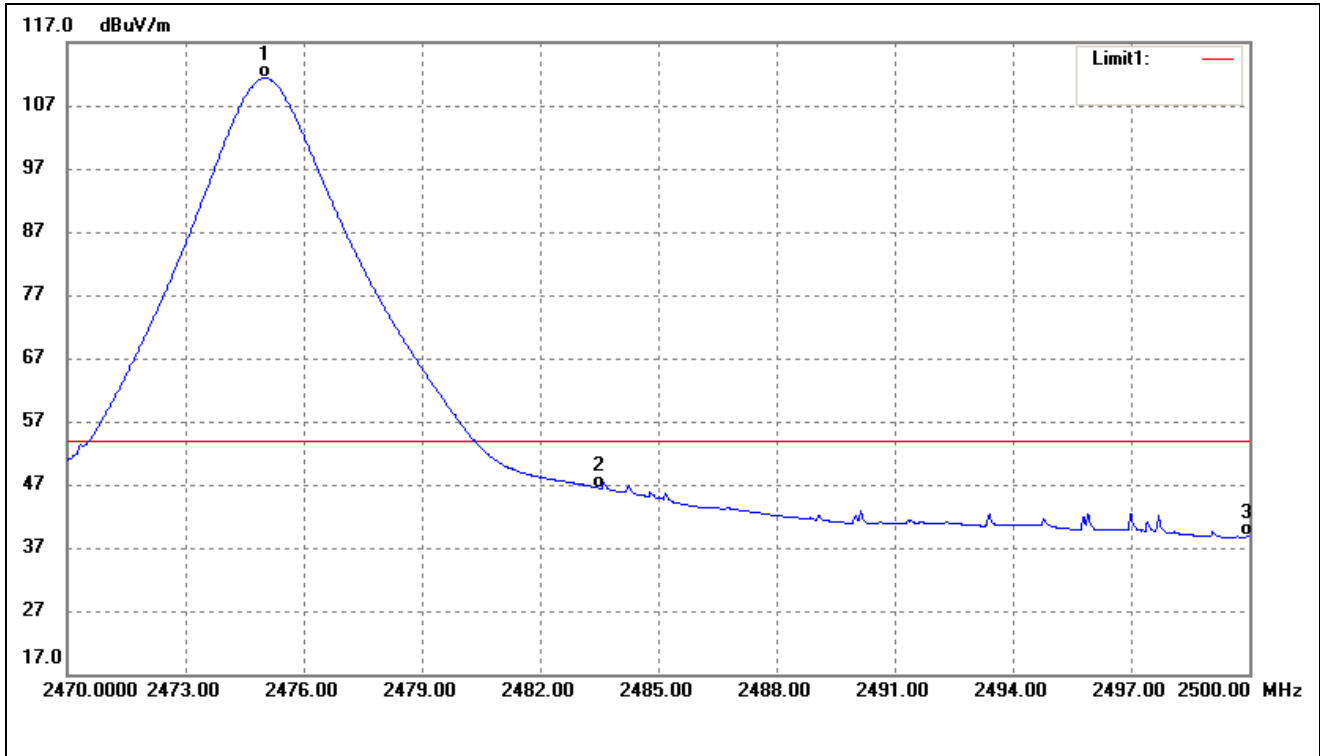
➤ Radiated test

Test Channel	Low	Polarity:	Vertical(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	2310.000	49.24	-9.66	39.58	54.00	-14.42	Average Detector
	2310.000	59.71	-9.66	50.05	74.00	-23.95	Peak Detector
2	2341.000	61.50	-9.60	51.90	54.00	-2.10	Average Detector
	2341.000	67.59	-9.60	57.99	74.00	-16.01	Peak Detector
3	2390.000	52.10	-9.50	42.60	54.00	-11.40	Average Detector
	2390.000	64.47	-9.50	54.97	74.00	-19.03	Peak Detector
4	2405.200	120.93	-9.48	111.45	/	/	Average Detector
	2405.300	121.03	-9.48	111.55	/	/	Peak Detector

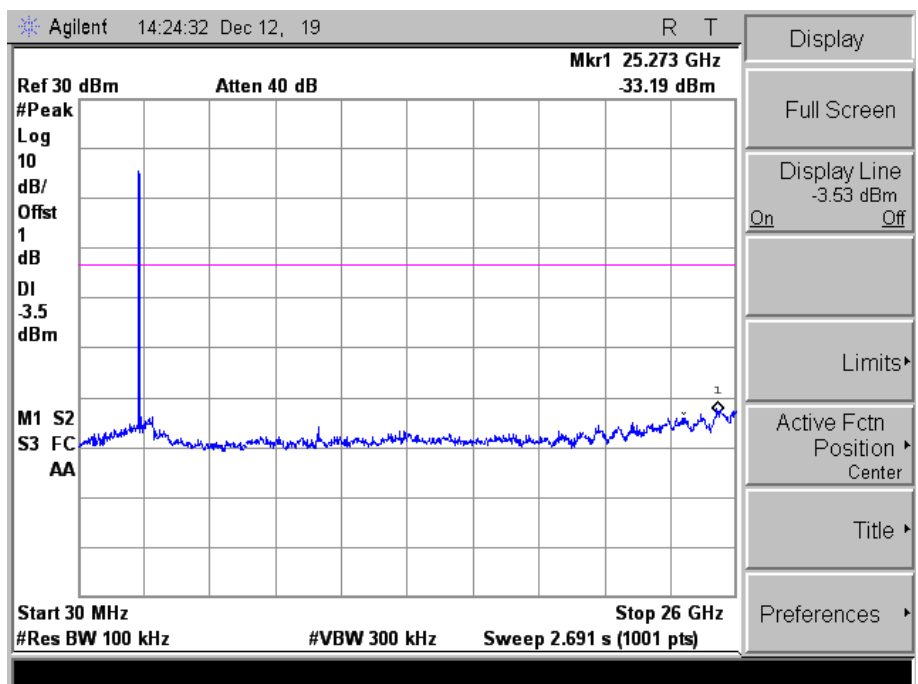
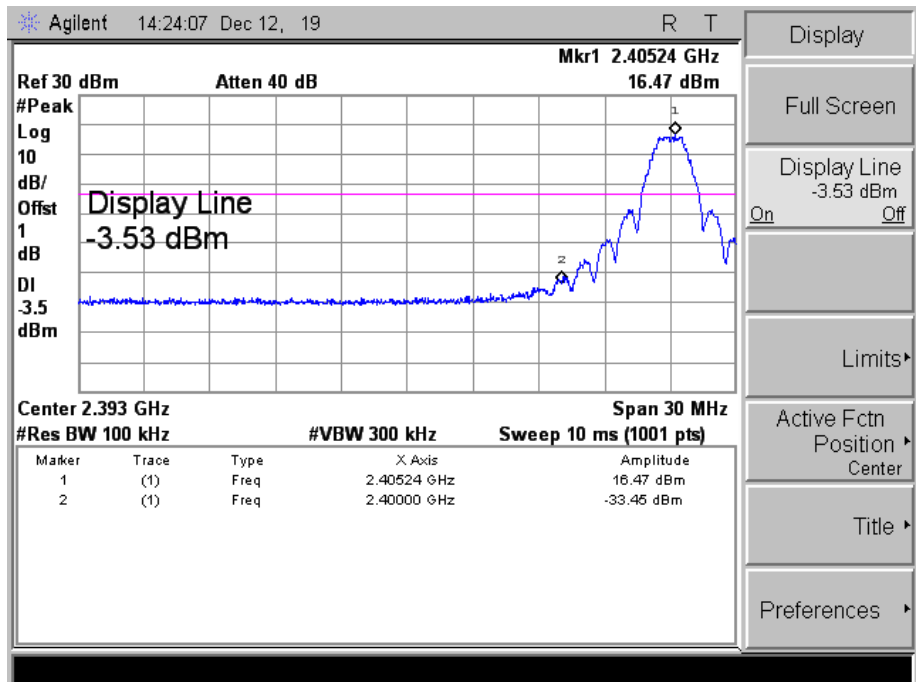
Test Channel	High	Polarity:	Vertical(worst case)
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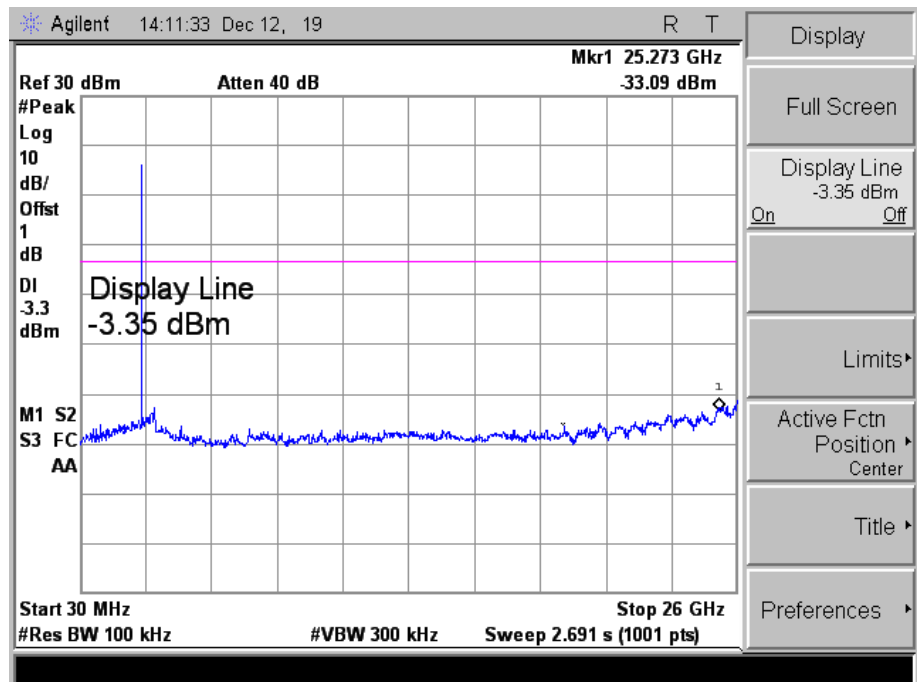
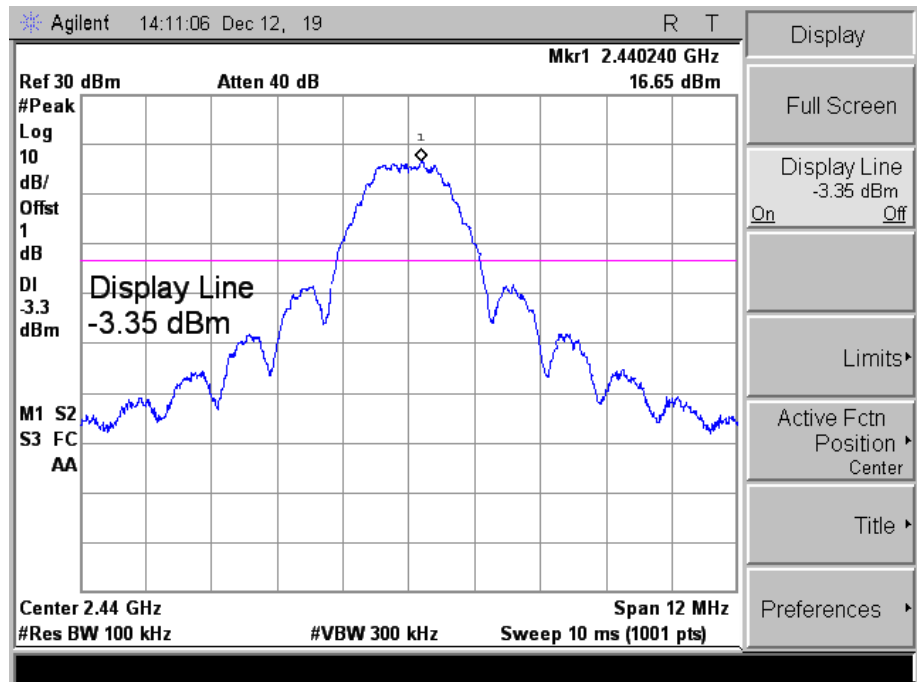
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2475.010	120.74	-9.33	111.41	/	/	Average Detector
	2474.980	121.00	-9.34	111.66	/	/	Peak Detector
2	2483.500	55.78	-9.31	46.47	54.00	-7.53	Average Detector
	2483.500	67.86	-9.31	58.55	74.00	-15.45	Peak Detector
3	2500.000	48.14	-9.28	38.86	54.00	-15.14	Average Detector
	2500.000	59.65	-9.28	50.37	74.00	-23.63	Peak Detector

➤ Conducted test

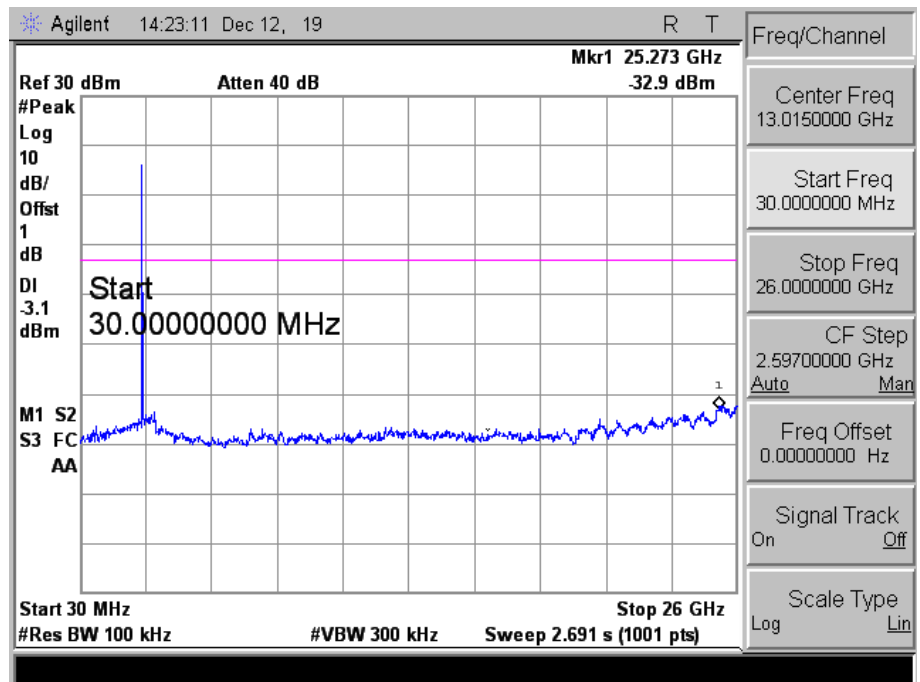
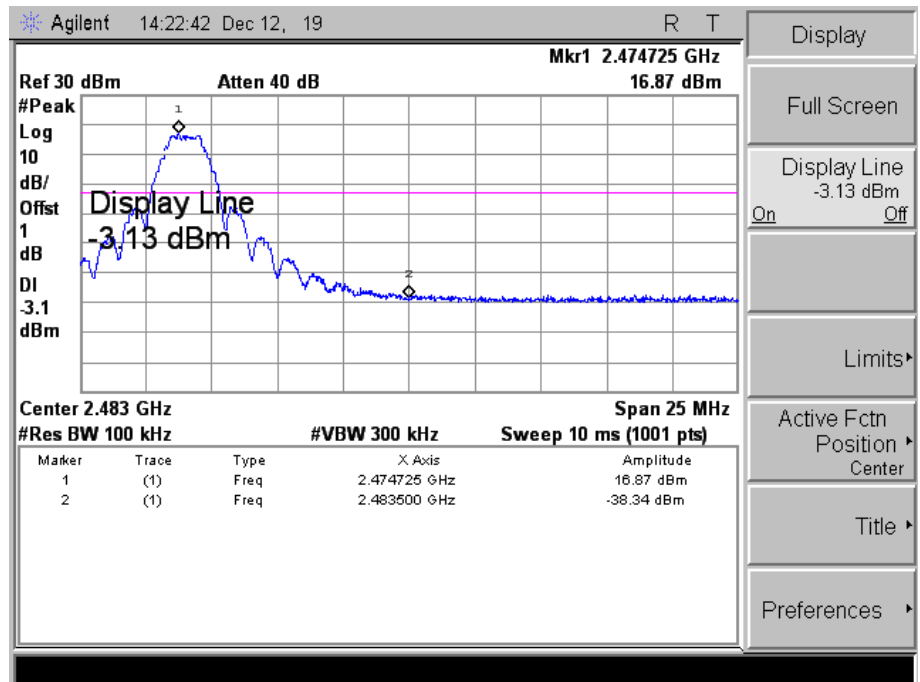
Low



Middle



High



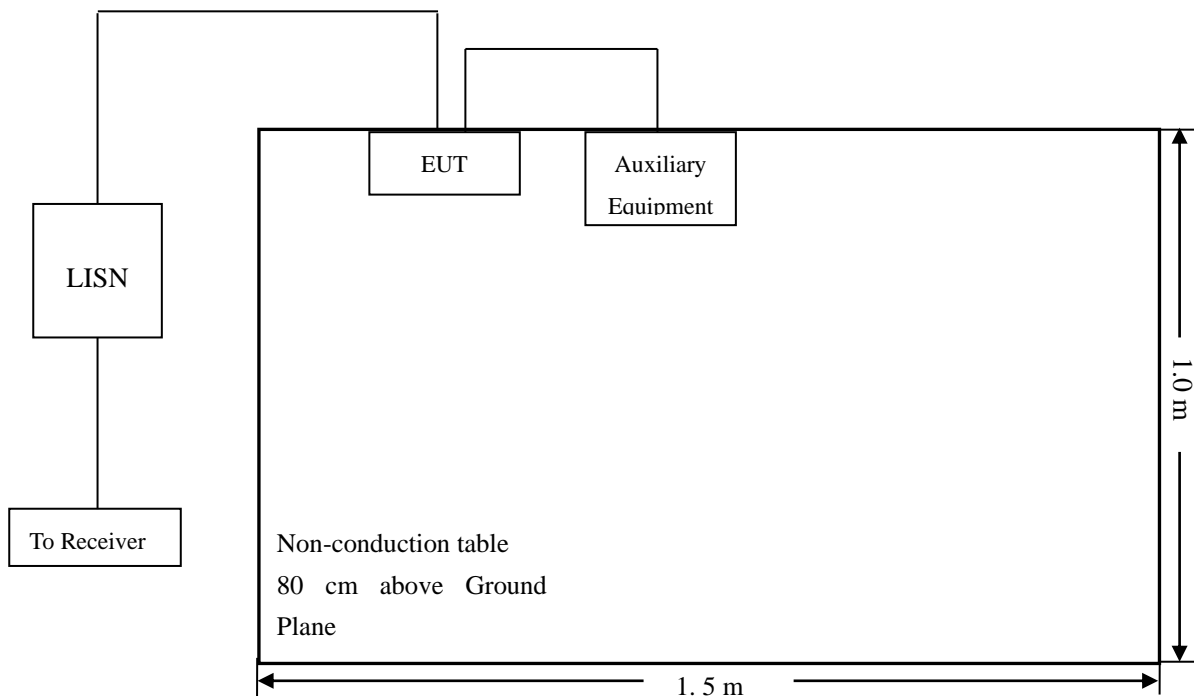
10. Conducted Emissions

10.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 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



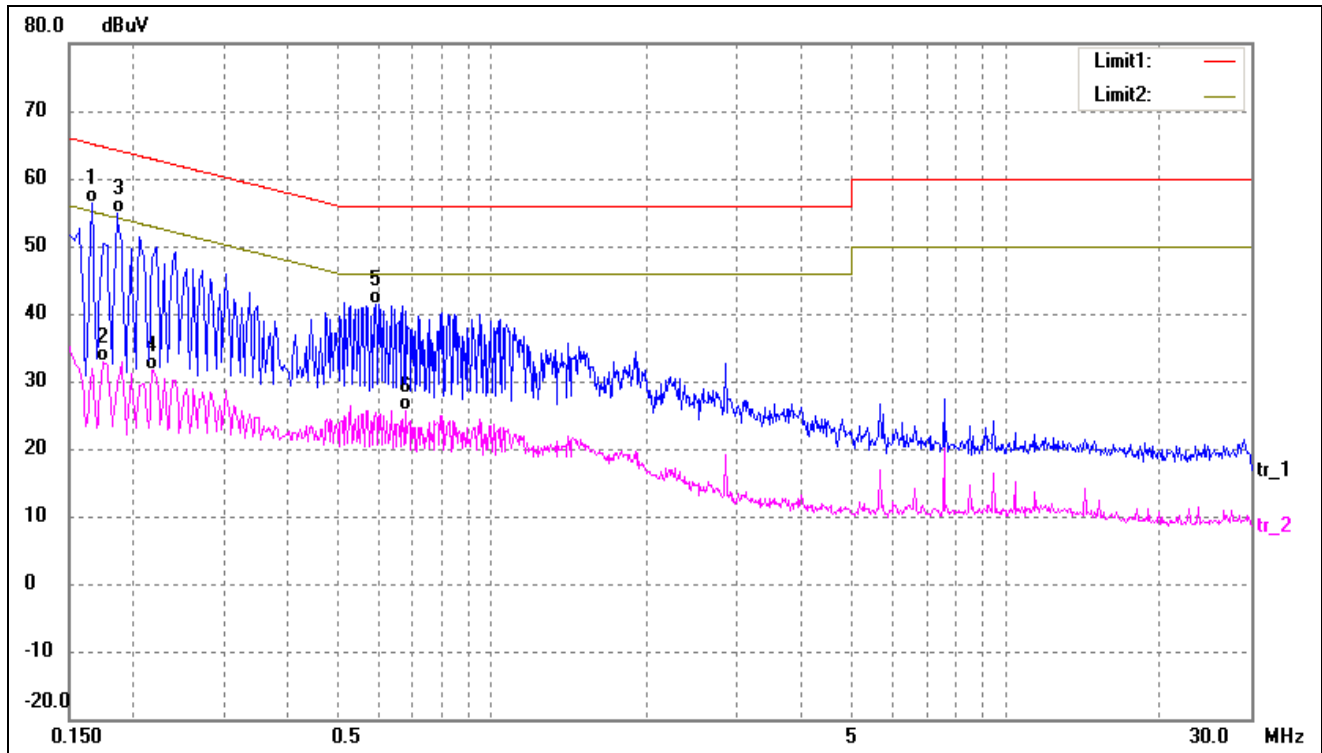
10.3 Test Receiver Setup

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

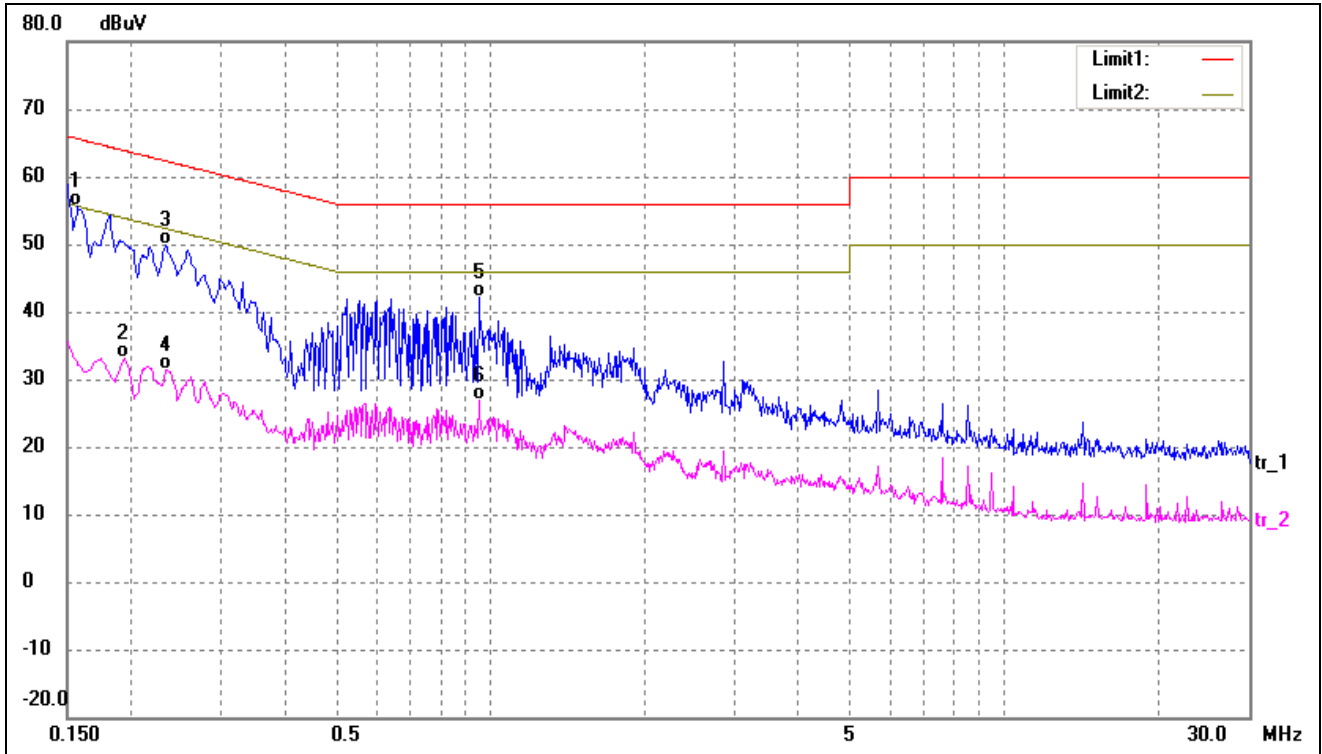
10.4 Summary of Test Results/Plots

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*	0.1660	46.35	9.95	56.30	65.15	-8.85	QP
2	0.1740	22.86	9.95	32.81	54.76	-21.95	AVG
3	0.1860	44.93	9.96	54.89	64.21	-9.32	QP
4	0.2180	21.76	9.98	31.74	52.89	-21.15	AVG
5	0.5940	31.44	10.05	41.49	56.00	-14.51	QP
6	0.6780	15.63	10.05	25.68	46.00	-20.32	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	45.56	9.95	55.51	65.56	-10.05	QP
2	0.1940	23.10	9.97	33.07	53.86	-20.79	AVG
3	0.2340	39.97	10.00	49.97	62.30	-12.33	QP
4	0.2340	21.40	10.00	31.40	52.30	-20.90	AVG
5	0.9500	31.86	10.31	42.17	56.00	-13.83	QP
6	0.9500	16.45	10.31	26.76	46.00	-19.24	AVG

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