FCC Part 15C
Measurement and Test Report

For

Ningbo Tonwel Audio Co.,LTD

No.28,Xiyi Road,Jiangshan Town ,Yinzhou, Ningbo,China

FCC ID: 2AIQW-V4112

FCC Rule(s):	FCC Part 15.247
Product Description:	ACTIVE SPEAKER
Tested Model:	V4112
Report No.:	WTX19X06043197W-3
Sample Receipt Date:	2019-06-28
Tested Date:	2019-06-28 to 2019-07-12
Issued Date:	2019-07-12
Tested By:	Mike Shi / Engineer
Reviewed By:	Silin Chen / EMC Manager
Approved & Authorized By:	Jandy So / PSQ Manager

Prepared By:

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Report version

Version No.	Date of issue	Description
Rev.00	2019-07-12	Original

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Ningbo Tonwel Audio Co.,LTD
Address of applicant: No.28,Xiyi Road,Jiangshan Town ,Yinzhou, Ningbo,China

Manufacturer: Ningbo Tonwel Audio Co.,LTD
Address of manufacturer: 500 Qihang North Road,Zhanqi Town, Ningbo,China

General Description of EUT	
Product Name:	ACTIVE SPEAKER
Brand Name:	/
Model No.:	V4112
Adding Model(s):	V4115
Rated Voltage:	AC110-120V 60Hz
Power Adapter:	/
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 V4112, but the circuit and the electronic construction do not change, declared by the manufacturer.	

Technical Characteristics of EUT	
Bluetooth Version:	V5.0 (BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	8.04dBm (Conducted)
Data Rate:	1Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	Integral
Antenna Gain:	2dBi

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

FCC – Registration No.: 125990
Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). 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	2402MHz
TM2	Middle	2440MHz
TM3	High	2480MHz

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	1.2	Unshielded	Without Ferrite
AUX CABLE	1.2	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Power Spectral Density	Conducted	±1.8dB
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	9-150kHz ±3.74dB
		0.15-30MHz ±3.34dB
Transmitter Spurious Emissions	Radiated	30-200MHz ±4.52dB
		0.2-1GHz ±5.56dB
		1-6GHz ±3.84dB
		6-18GHz ±3.92dB

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
§2.1093	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 integral 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

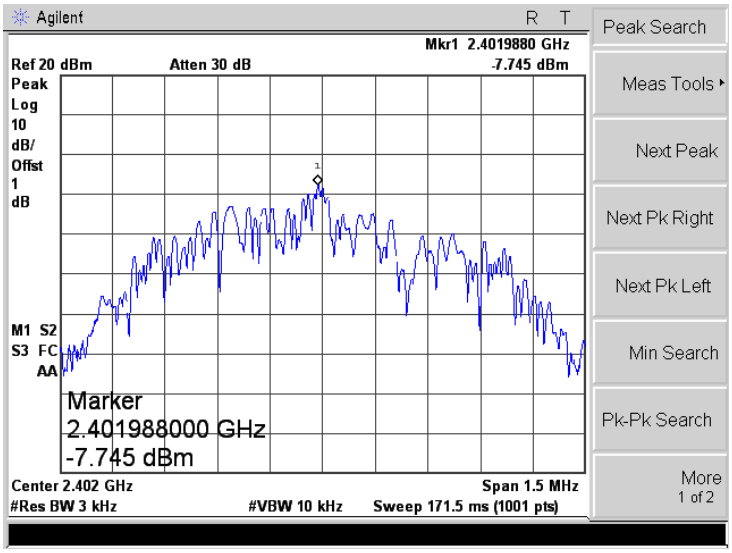
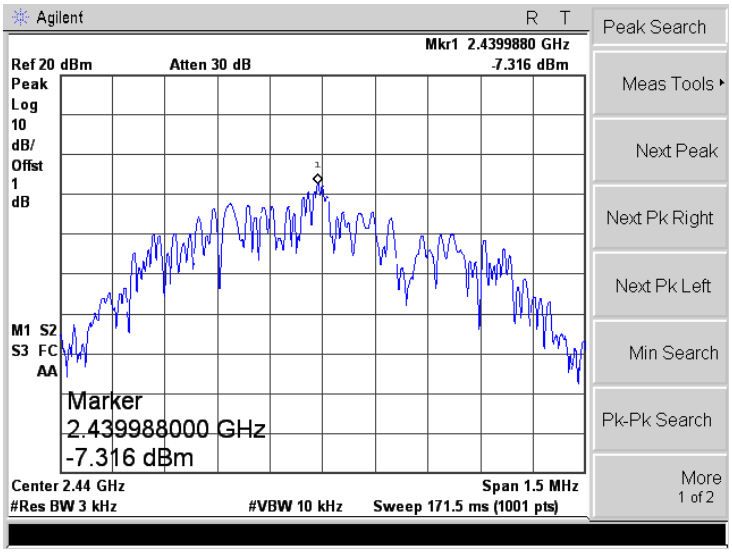
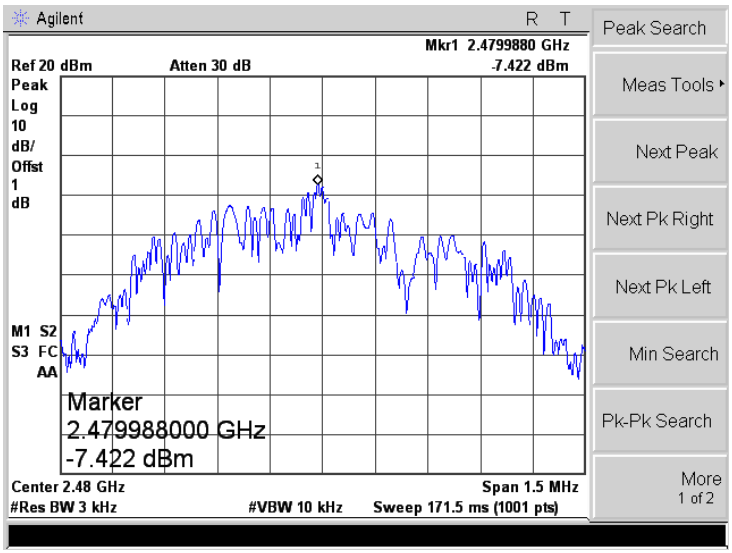
According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

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 kHz $\leqslant$ RBW $\leqslant$ 100 kHz.
d) Set the VBW $\geqslant$ 3 $\times$ 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
GFSK(BLE)	Low	-7.75	8
	Middle	-7.32	8
	High	-7.42	8

Please refer to the following test plots:

Low	
Middle	
High	

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

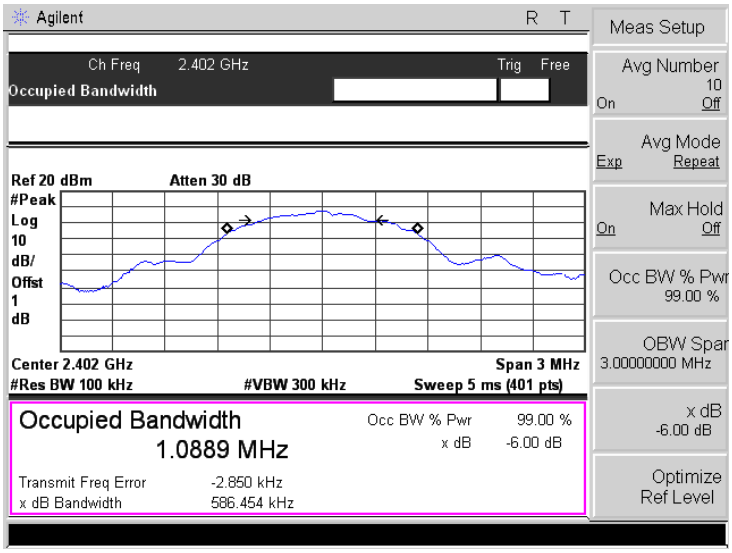
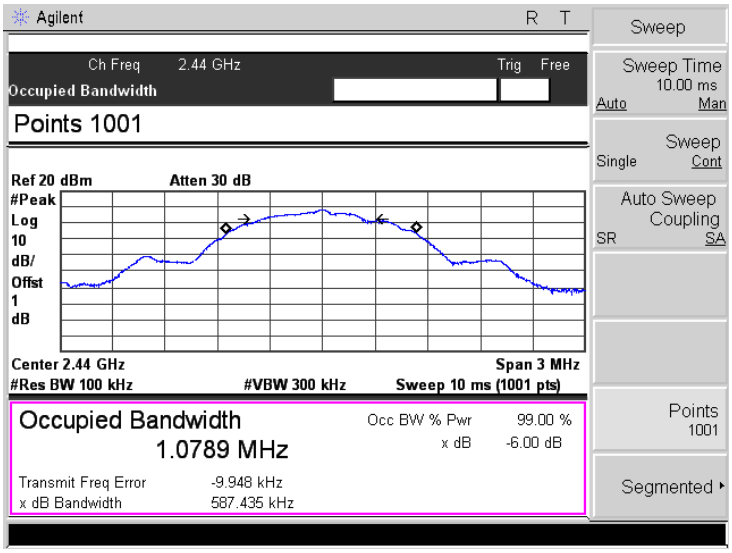
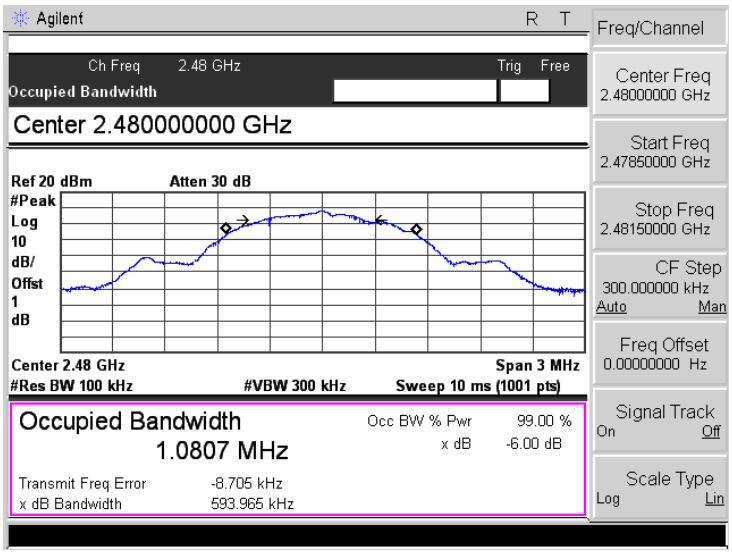
According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × 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
GFSK(BLE)	Low	586.454	≥500
	Middle	587.435	≥500
	High	593.965	≥500

Please refer to the following test plots:

Low	
Middle	
High	

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.

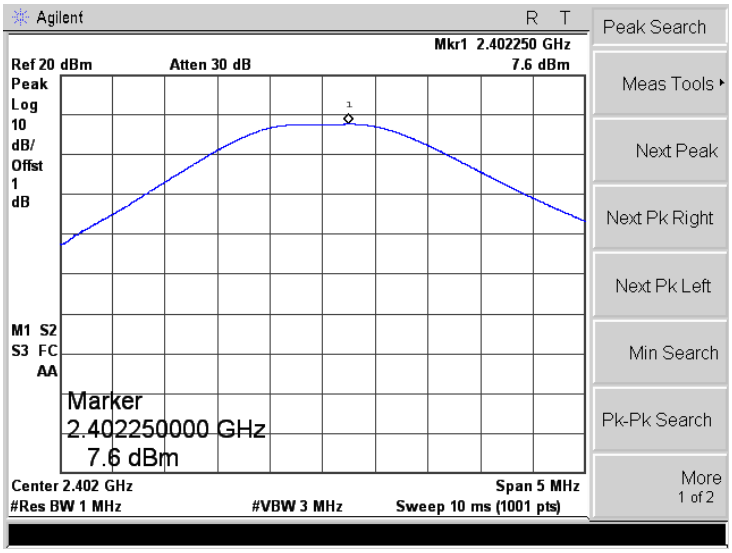
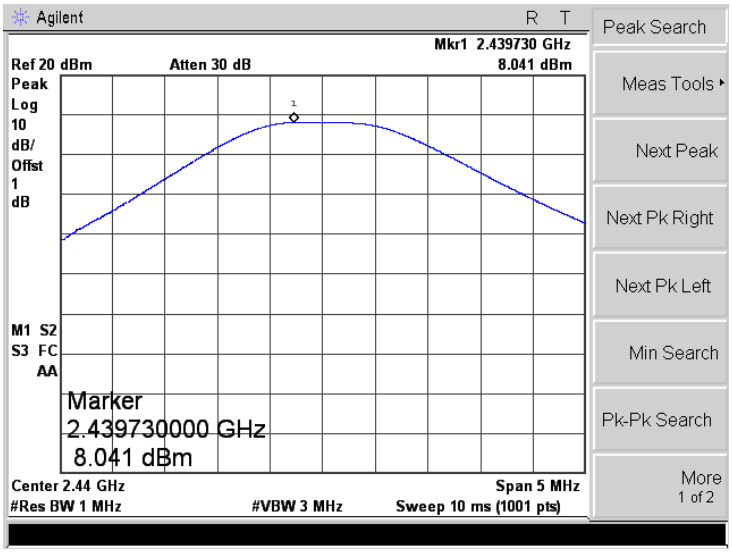
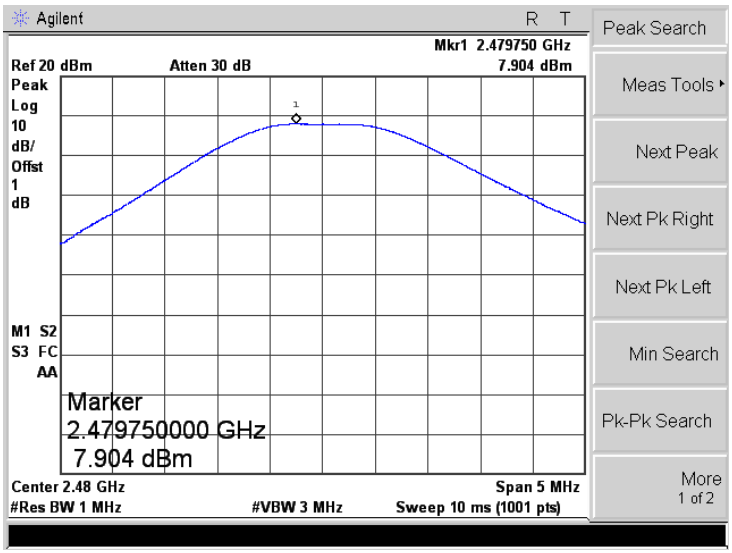
7.2 Test Procedure

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 ⩾ DTS bandwidth.
b) Set VBW ⩾ 3 × RBW.
c) Set span ⩾ 3 x 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
GFSK(BLE)	Low	7.60	5.7544	1000
	Middle	8.04	6.3680	1000
	High	7.90	6.1660	1000

Low	
Middle	
High	

8. Field Strength of Spurious Emissions

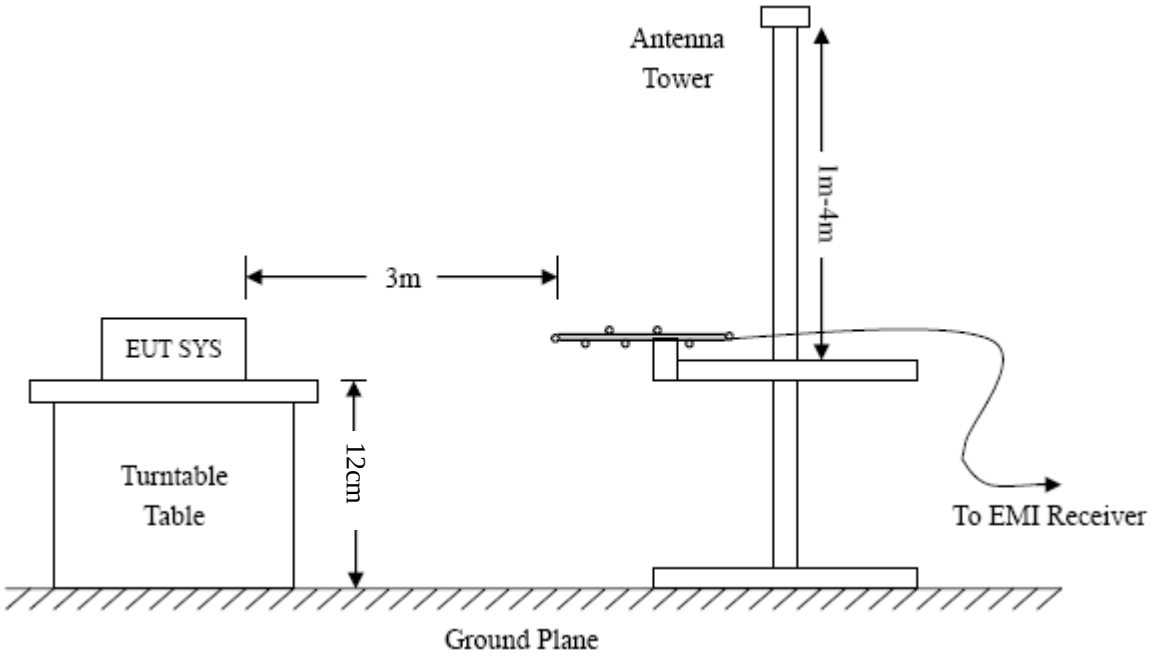
8.1 Standard Applicable

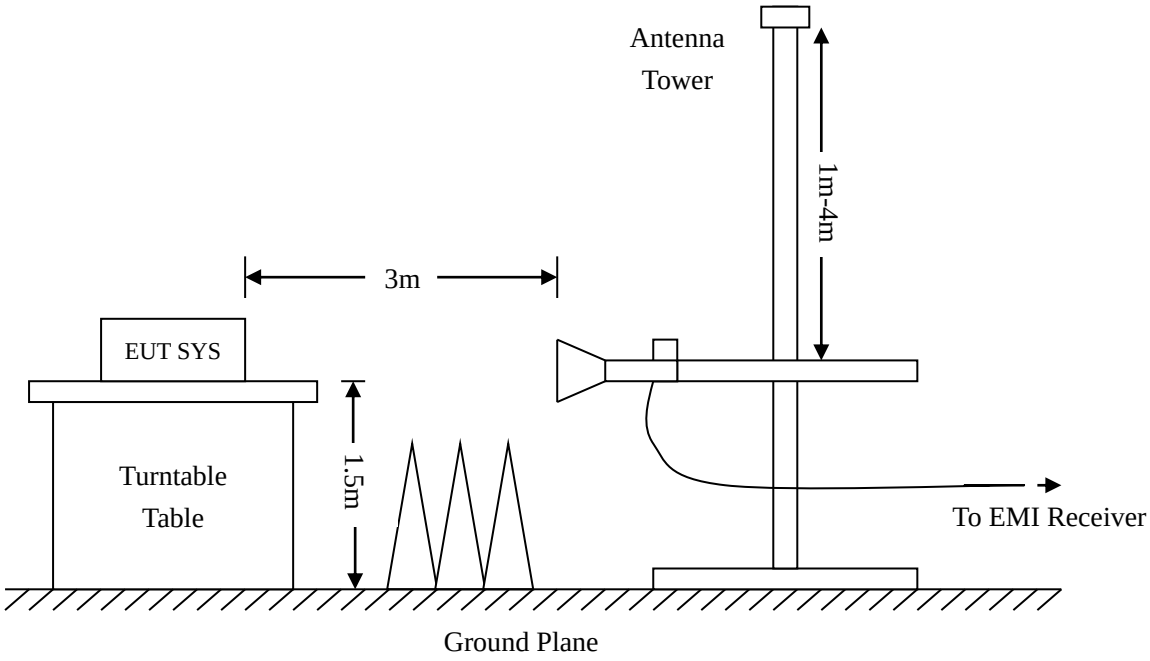
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within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

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:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

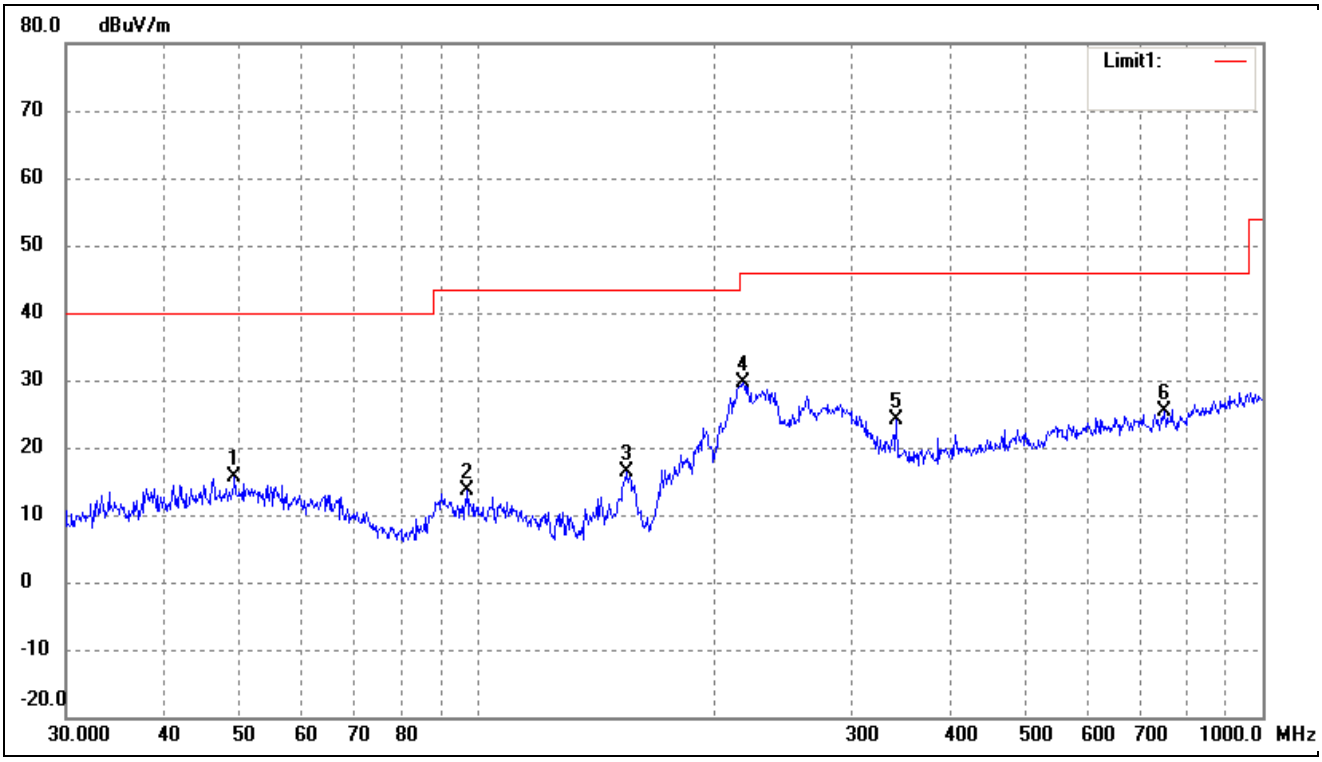
The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part 15 Limit

8.4 Summary of Test Results/Plots

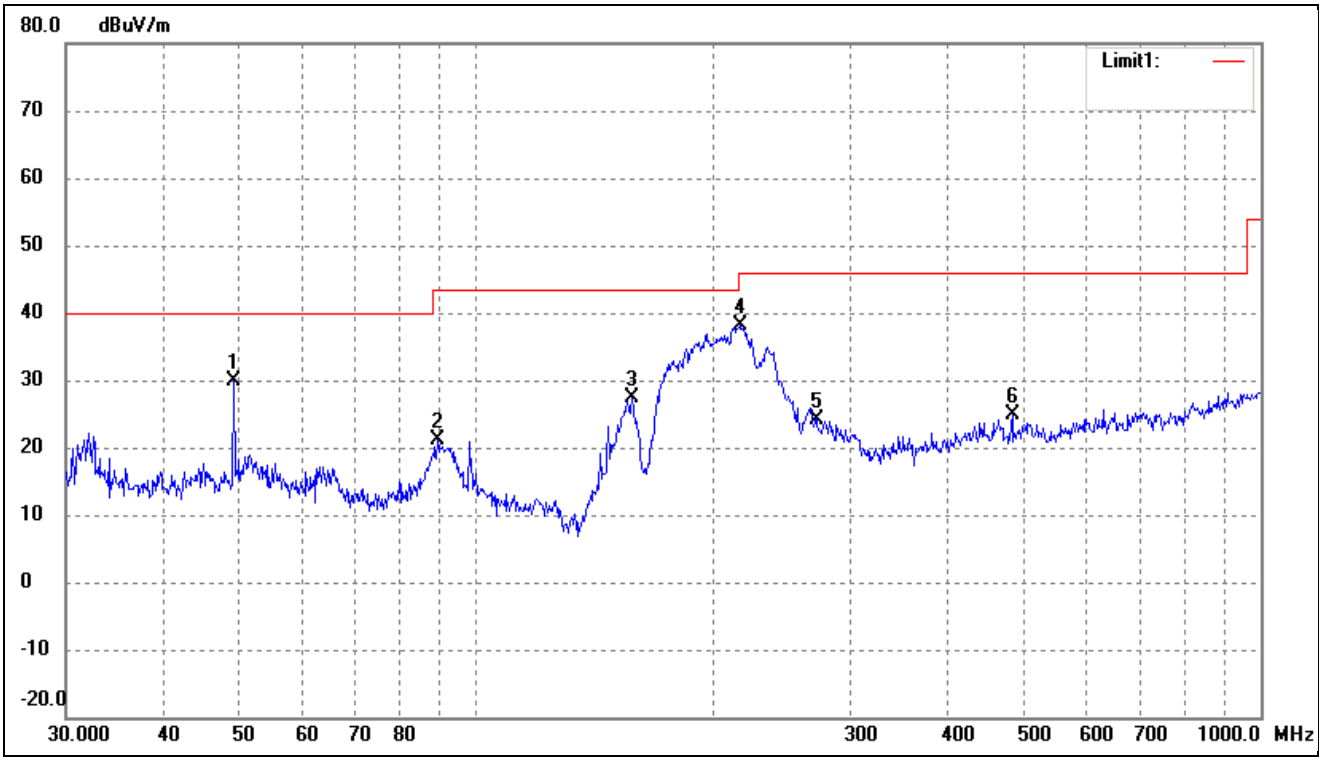
➢ Spurious Emissions Below 1GHz

Test Channel	Low	Polarity:	Horizontal



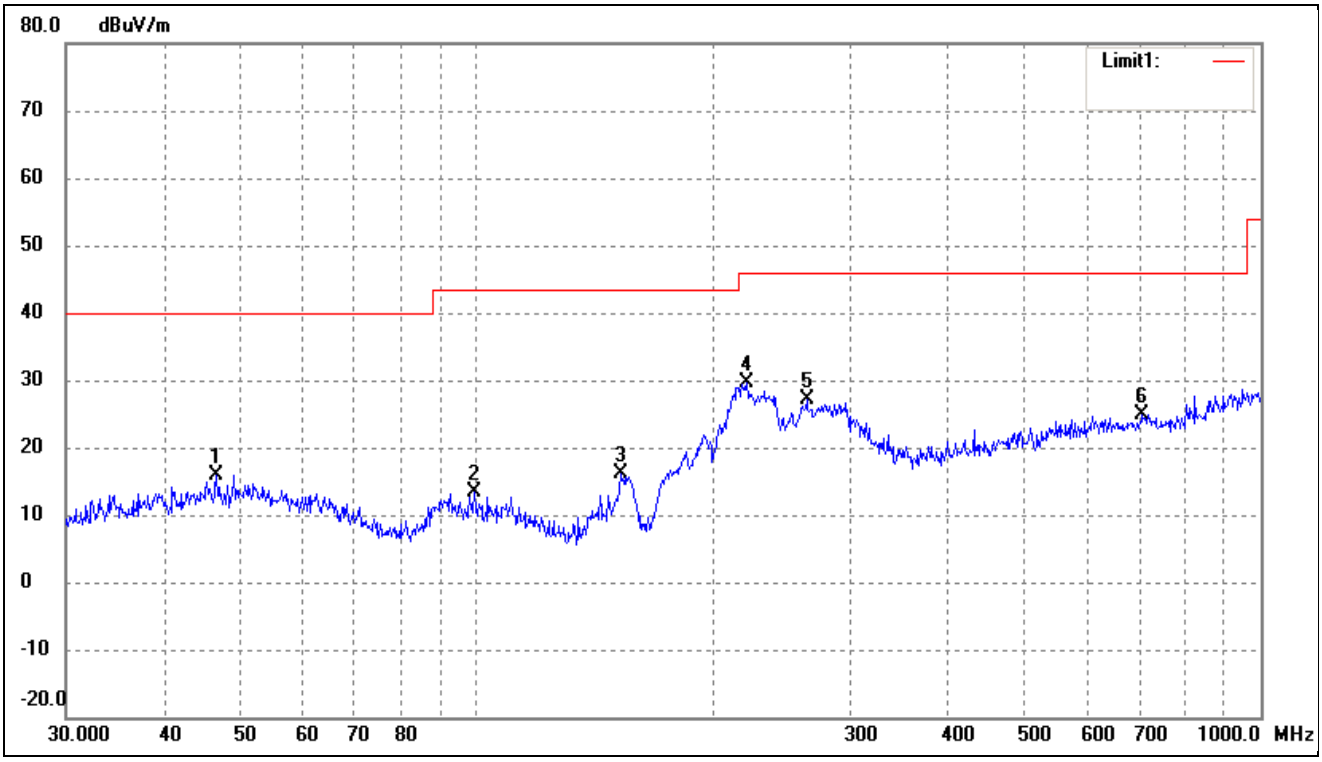
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	49.1866	27.28	-11.63	15.65	40.00	-24.35	344	100	peak
2	97.1148	27.76	-14.15	13.61	43.50	-29.89	91	100	peak
3	155.3644	33.12	-16.84	16.28	43.50	-27.22	198	100	peak
4	218.3085	41.91	-12.36	29.55	46.00	-16.45	101	100	peak
5	341.9787	31.36	-7.22	24.14	46.00	-21.86	236	100	peak
6	750.1083	27.41	-1.98	25.43	46.00	-20.57	181	100	peak

Test Channel	Low	Polarity:	Vertical



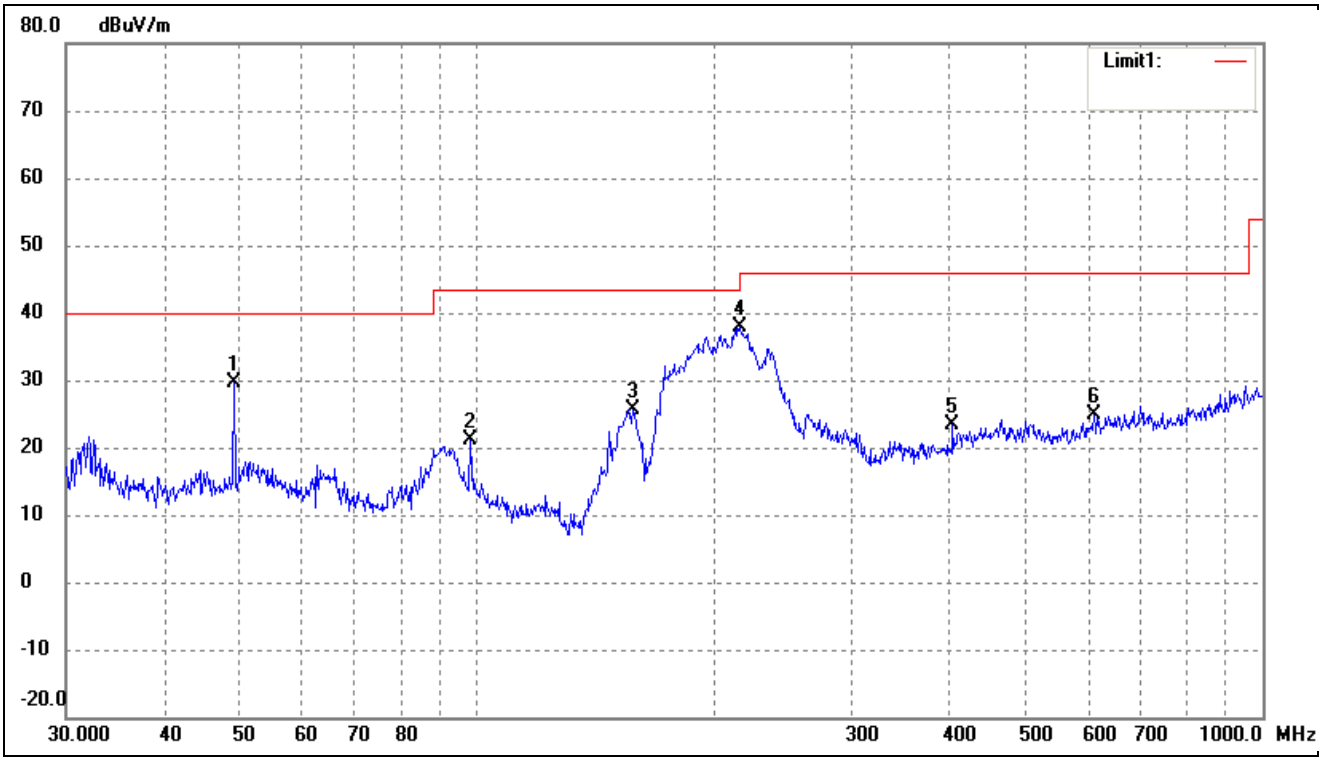
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	49.0145	41.46	-11.63	29.83	40.00	-10.17	242	100	peak
2	89.2764	35.01	-13.96	21.05	43.50	-22.45	93	100	peak
3	158.1123	44.15	-16.70	27.45	43.50	-16.05	159	100	peak
4	216.7828	50.60	-12.55	38.05	46.00	-7.95	98	100	peak
5	271.3246	33.31	-9.06	24.25	46.00	-21.75	343	100	peak
6	482.2156	30.58	-5.74	24.84	46.00	-21.16	283	100	peak

Test Channel	Middle	Polarity:	Horizontal



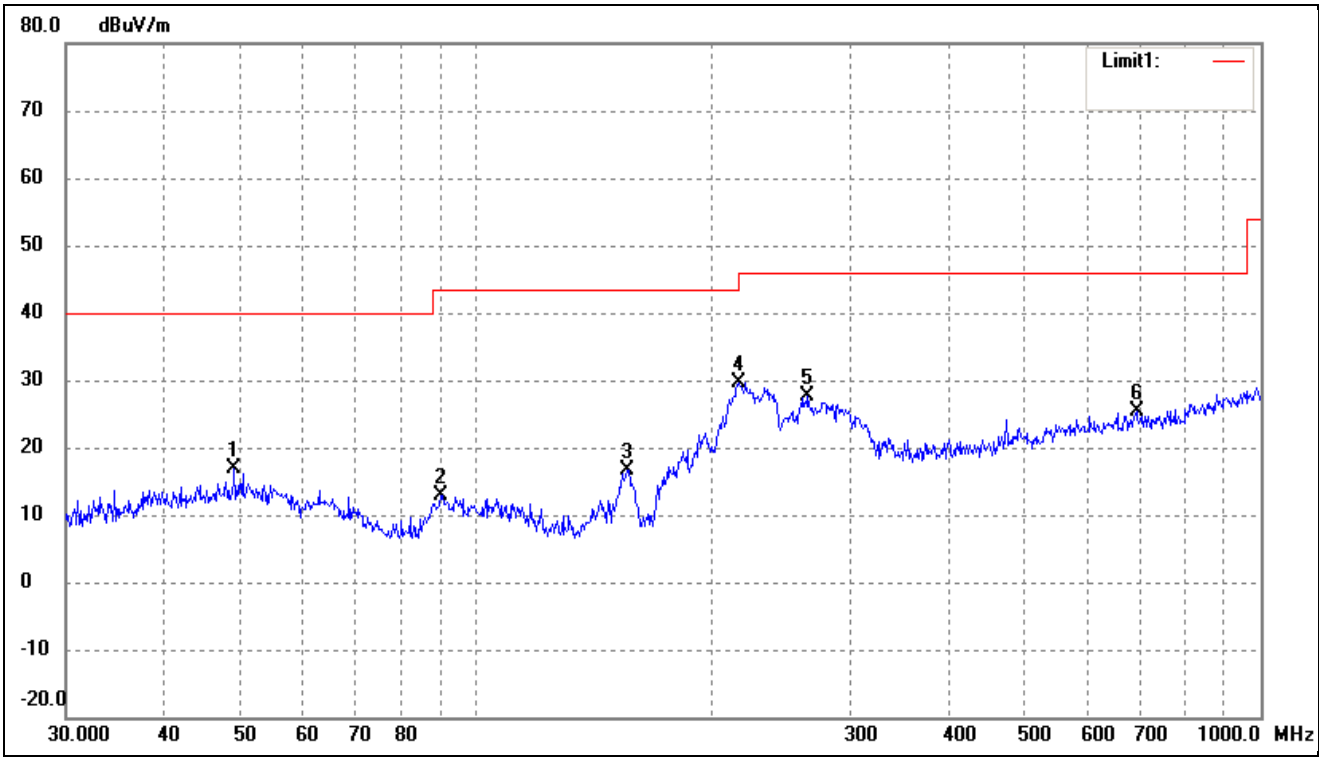
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	46.6664	27.66	-11.77	15.89	40.00	-24.11	168	100	peak
2	99.5281	27.16	-13.86	13.30	43.50	-30.20	120	100	peak
3	152.6641	33.17	-17.10	16.07	43.50	-27.43	68	100	peak
4	221.3921	41.61	-12.04	29.57	46.00	-16.43	172	100	peak
5	263.8190	36.22	-9.02	27.20	46.00	-18.80	104	100	peak
6	706.6999	26.80	-1.81	24.99	46.00	-21.01	92	100	peak

Test Channel	Middle	Polarity:	Vertical



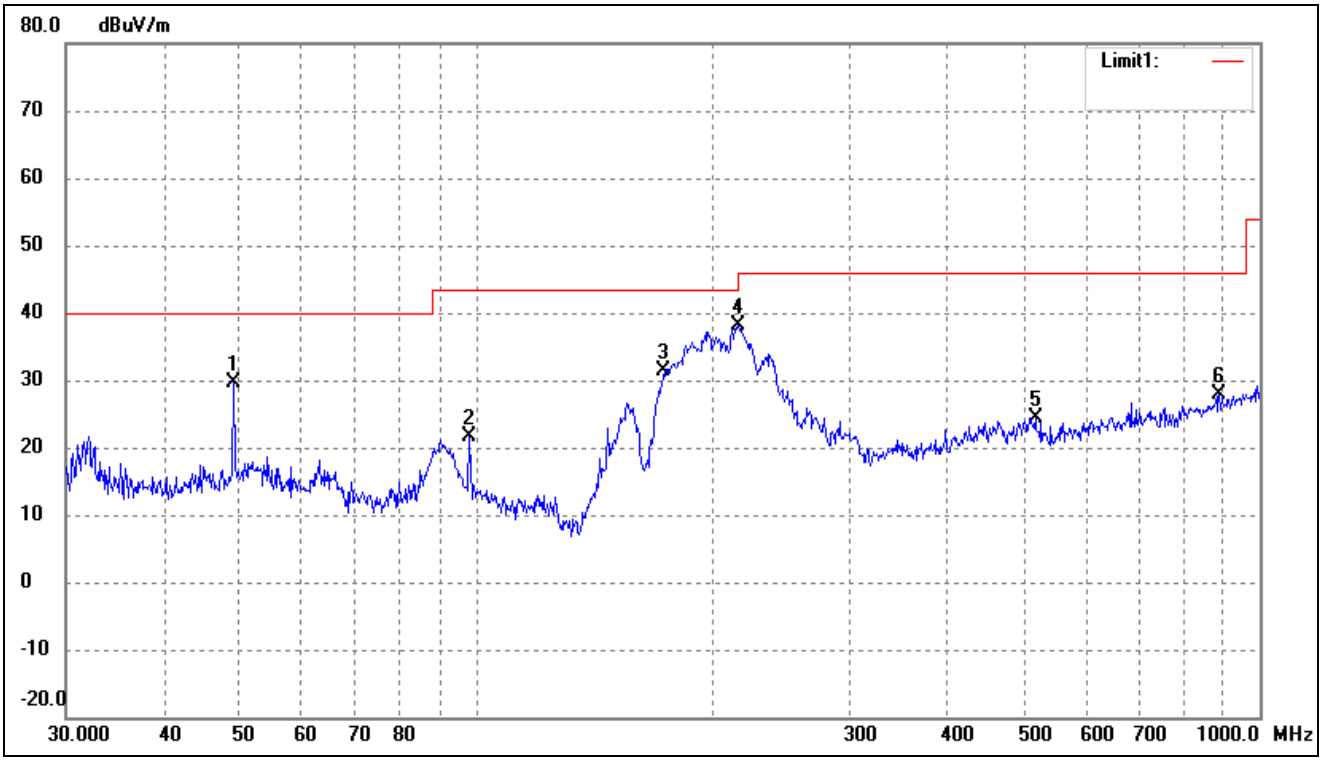
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	49.0145	41.34	-11.63	29.71	40.00	-10.29	298	100	peak
2	98.1419	35.06	-14.02	21.04	43.50	-22.46	311	100	peak
3	158.1123	42.33	-16.70	25.63	43.50	-17.87	97	100	peak
4	216.0240	50.50	-12.65	37.85	46.00	-8.15	160	100	peak
5	403.2500	30.07	-6.66	23.41	46.00	-22.59	179	100	peak
6	609.9217	28.20	-3.20	25.00	46.00	-21.00	350	100	peak

Test Channel	High	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	49.1866	28.42	-11.63	16.79	40.00	-23.21	115	100	peak
2	90.2205	26.41	-13.44	12.97	43.50	-30.53	113	100	peak
3	155.9101	33.53	-16.80	16.73	43.50	-26.77	56	100	peak
4	216.0240	42.37	-12.65	29.72	46.00	-16.28	122	100	peak
5	264.7457	36.58	-8.95	27.63	46.00	-18.37	358	100	peak
6	694.4174	27.26	-1.90	25.36	46.00	-20.64	102	100	peak

Test Channel	High	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	49.0145	41.32	-11.63	29.69	40.00	-10.31	86	100	peak
2	98.1419	35.68	-14.02	21.66	43.50	-21.84	151	100	peak
3	173.8135	47.45	-16.01	31.44	43.50	-12.06	89	100	peak
4	216.0240	50.82	-12.65	38.17	46.00	-7.83	122	100	peak
5	517.2480	29.85	-5.40	24.45	46.00	-21.55	355	100	peak
6	887.6099	27.22	0.64	27.86	46.00	-18.14	274	100	peak

➢ Spurious Emissions Below 1GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
4804	63.50	-3.59	59.91	74	-14.09	H	PK
4804	41.71	-3.59	35.12	54	-15.88	H	AV
7206	57.53	-0.52	57.01	74	-16.99	H	PK
7206	36.67	-0.52	36.15	54	-17.85	H	AV
4804	61.22	-3.59	57.63	74	-16.37	V	PK
4804	38.94	-3.59	35.35	54	-18.65	V	AV
7206	60.62	-0.52	60.10	74	-13.90	V	PK
7206	41.69	-0.52	41.17	54	-12.83	V	AV
Middle Channel-2440MHz							
4880	62.45	-3.49	58.96	74	-15.04	H	PK
4880	62.14	-3.49	58.65	74	-15.35	H	AV
7320	45.24	-3.49	41.75	54	-12.25	H	PK
7320	56.39	-0.47	55.92	74	-18.08	H	AV
4880	36.15	-0.47	35.68	54	-18.32	V	PK
4880	59.26	-3.49	55.77	74	-18.23	V	AV
7320	40.86	-3.49	37.37	54	-16.63	V	PK
7320	62.41	-0.47	61.94	74	-12.06	V	AV
High Channel-2480MHz							
4960	63.16	-3.49	59.67	74	-14.33	H	PK
4960	43.69	-3.49	40.20	54	-13.80	H	AV
7440	62.39	-3.49	58.90	74	-15.10	H	PK
7440	35.90	-0.47	35.43	54	-18.57	H	AV
4960	59.75	-0.47	59.28	74	-14.72	V	PK
4960	40.86	-3.49	37.37	54	-16.63	V	AV
7440	61.57	-3.49	58.08	74	-15.92	V	PK
7440	39.92	-0.47	39.45	54	-14.55	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 ≥ [3 × 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 ≥ [3 × 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

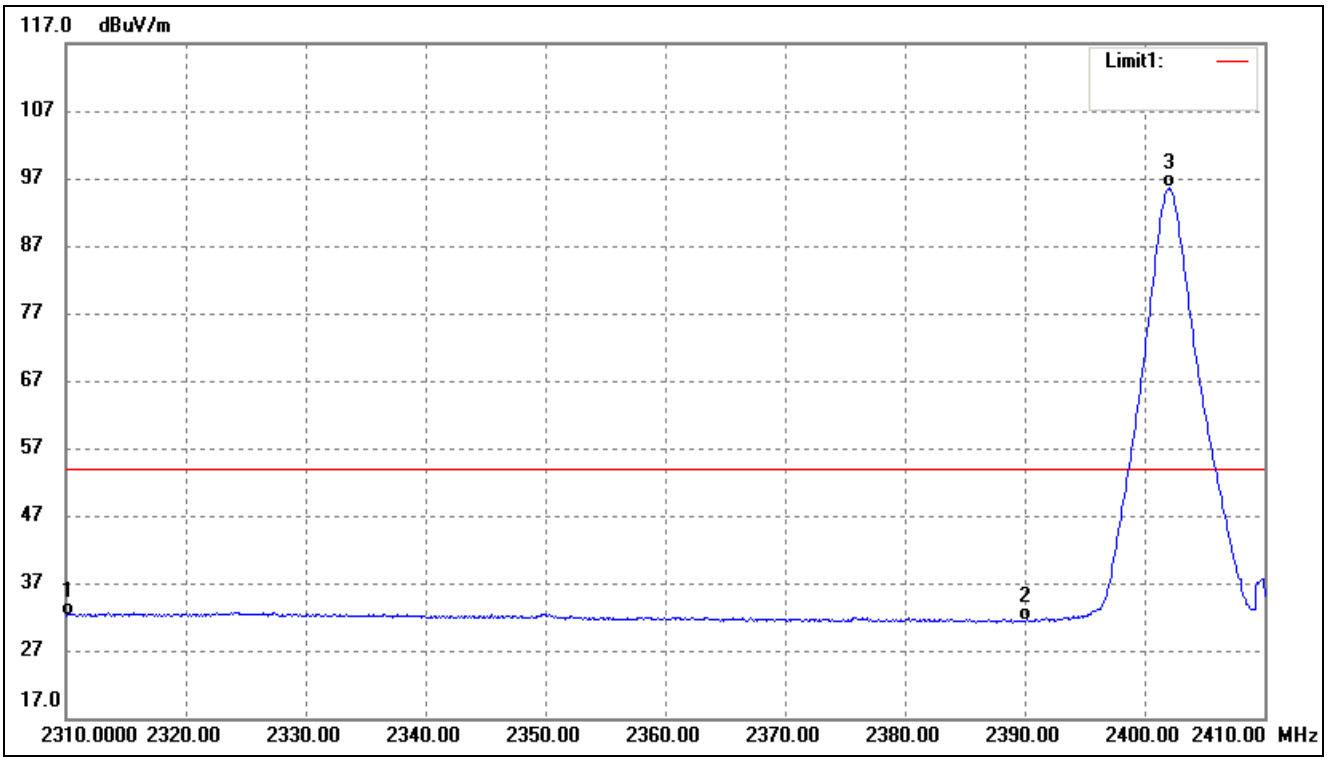
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

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.

9.3 Summary of Test Results/Plots

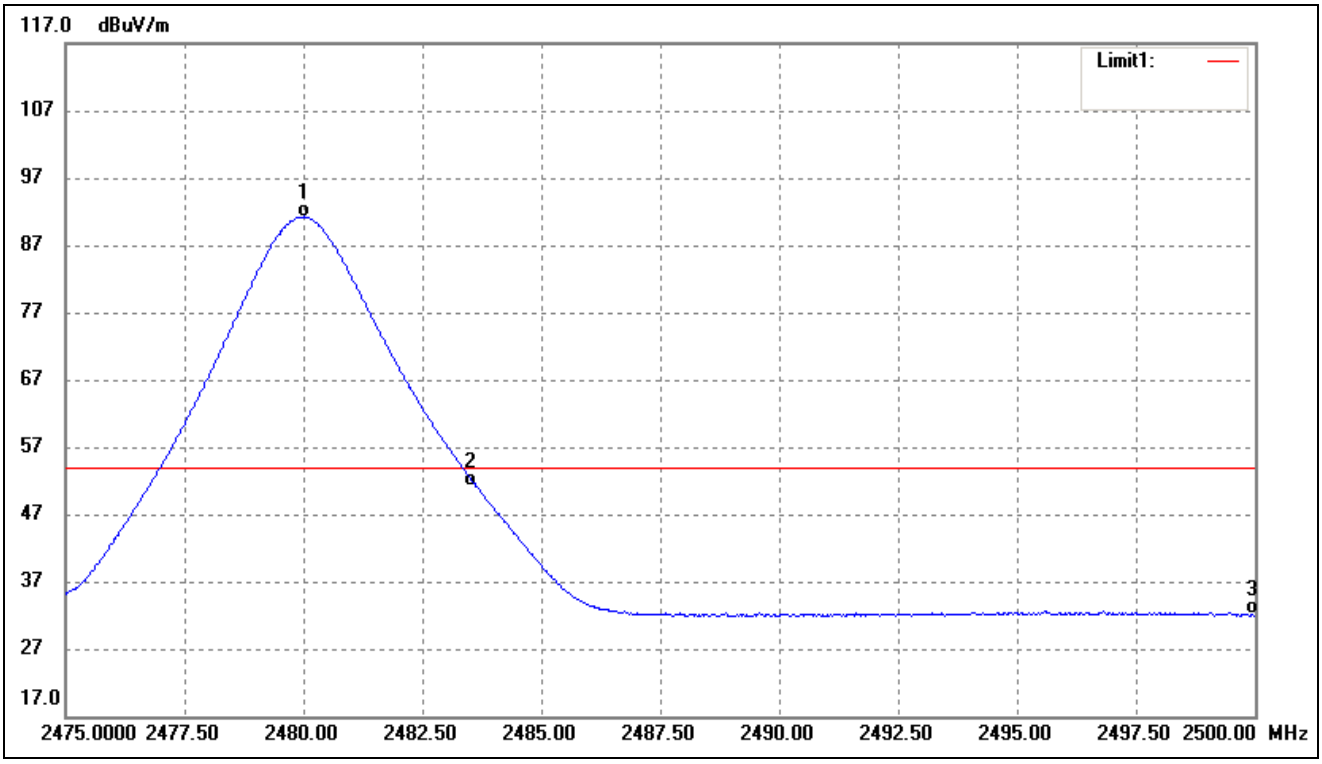
➢ Radiated test

Test Channel	Low	Polarity:	Vertical(worst case)



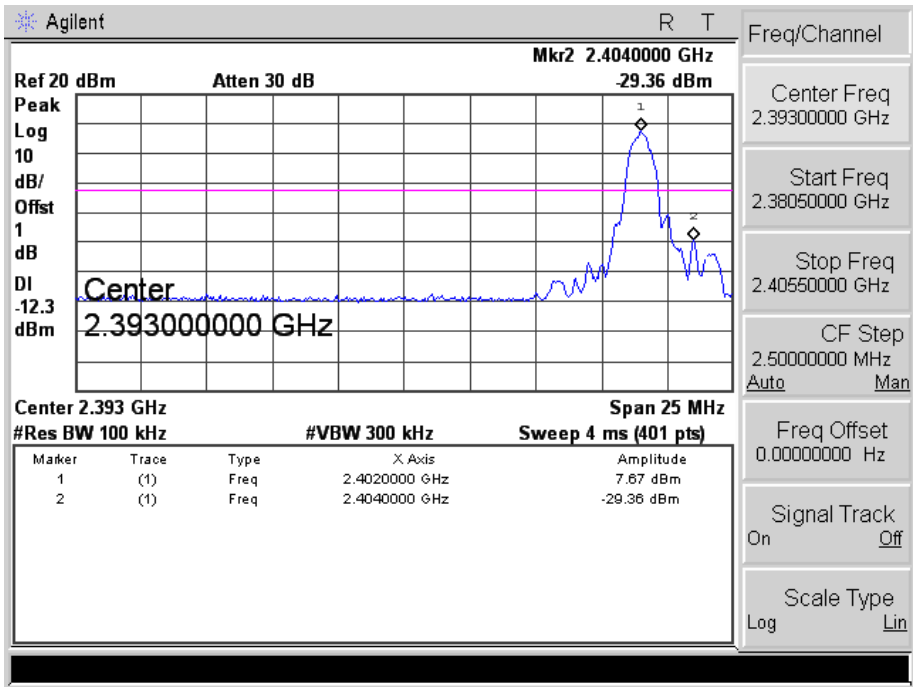
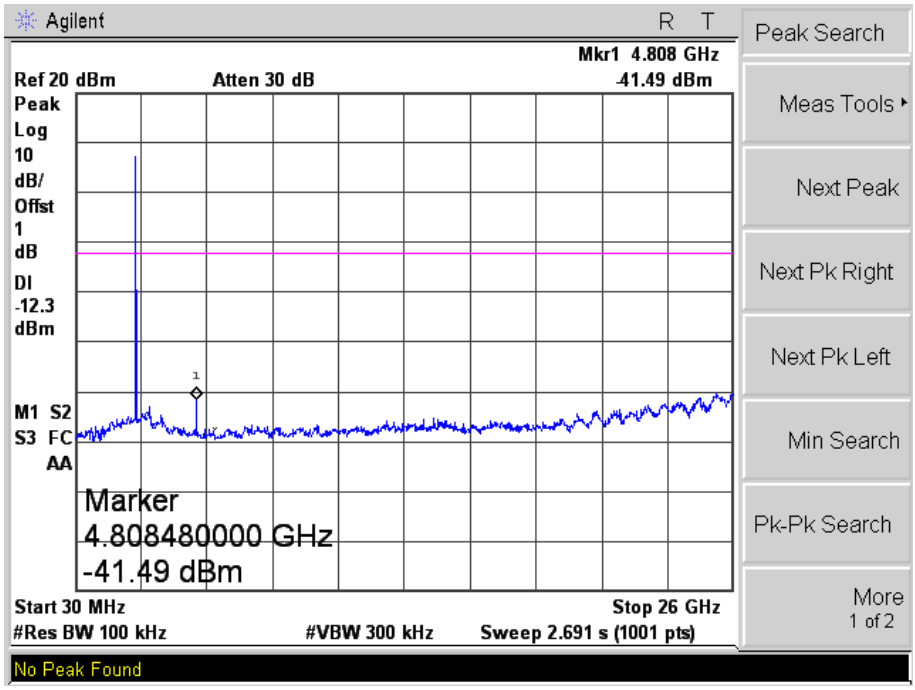
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	41.56	-9.35	32.21	54.00	-21.79	Average Detector
	2310.000	53.08	-9.35	43.73	74.00	-30.27	Peak Detector
2	2390.000	40.72	-9.22	31.50	54.00	-22.50	Average Detector
	2390.000	52.48	-9.22	43.26	74.00	-30.74	Peak Detector
3	2402.100	104.71	-9.20	95.51	/	/	Average Detector
	2402.300	109.14	-9.20	99.94	/	/	Peak Detector

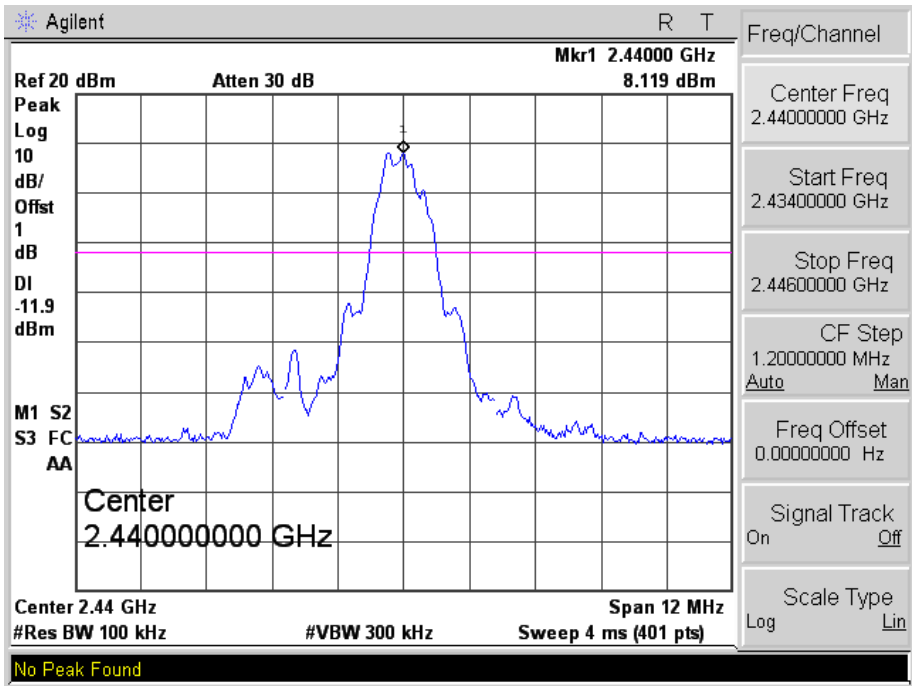
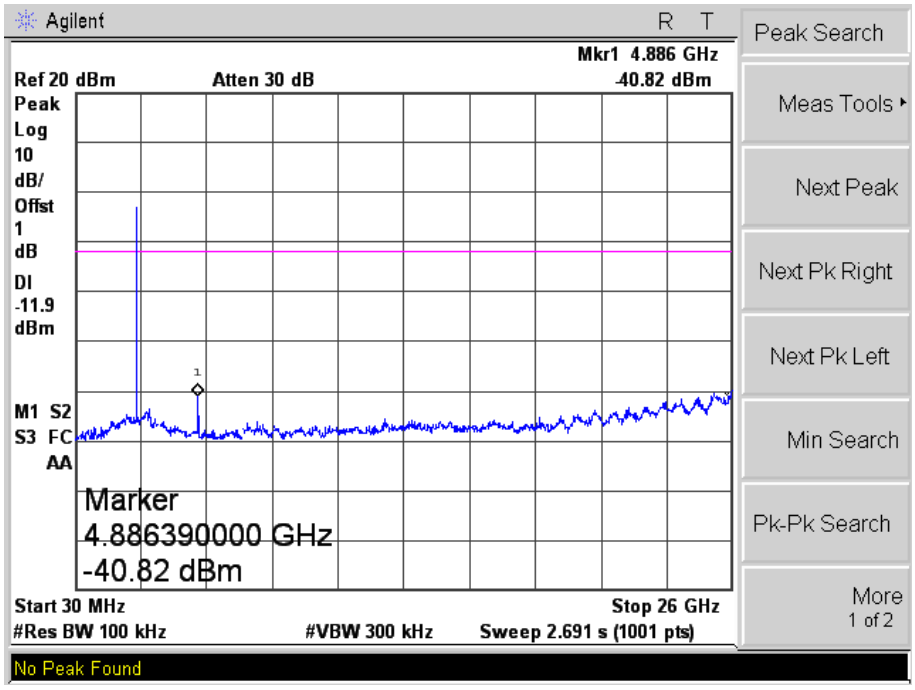
Test Channel	High	Polarity:	Vertical(worst case)

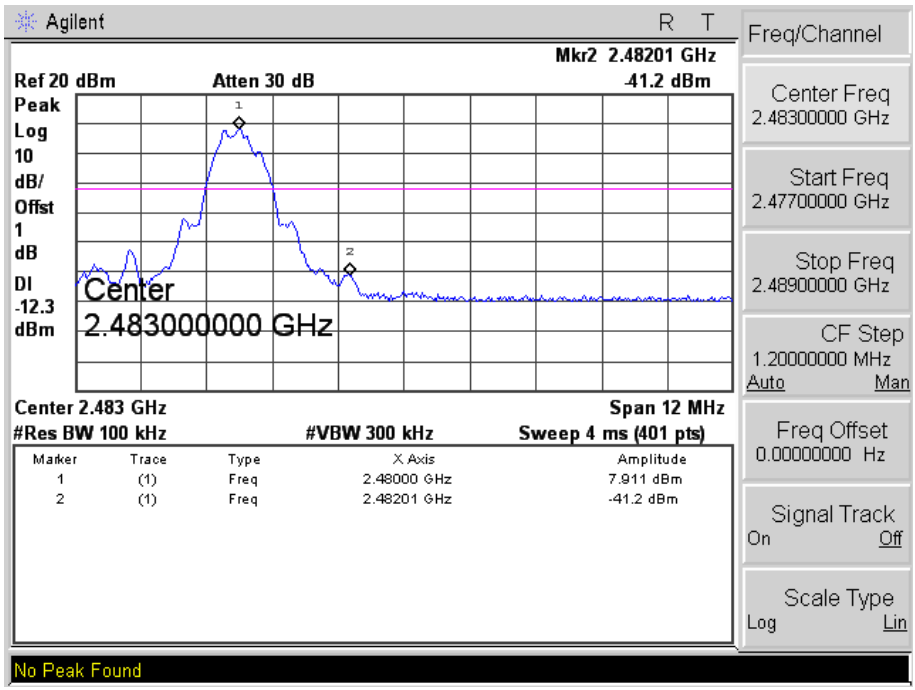
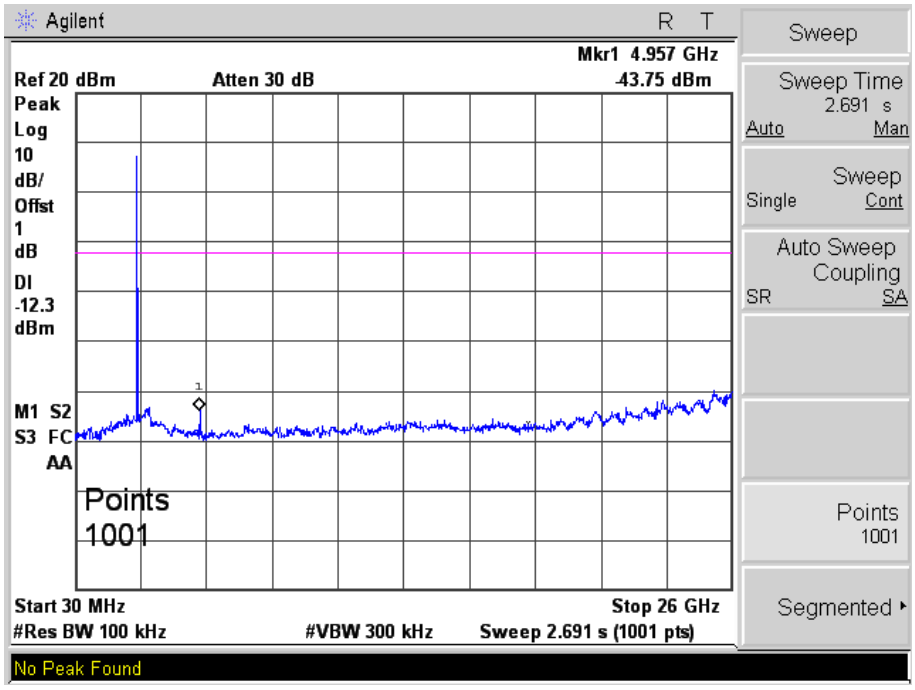


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.000	100.31	-9.06	91.25	/	/	Average Detector
	2479.700	104.48	-9.06	95.42	/	/	Peak Detector
2	2483.500	60.12	-9.07	51.05	54.00	-2.95	Average Detector
	2483.500	67.80	-9.07	58.73	74.00	-15.27	Peak Detector
3	2500.000	41.11	-9.03	32.08	54.00	-21.92	Average Detector
	2500.000	52.30	-9.03	43.27	74.00	-30.73	Peak Detector

➢ Conducted test

Low	 

Middle	 Agilent R T Mkr1 2.44000 GHz Ref 20 dBm Atten 30 dB 8.119 dBm Peak Log 10 dB/ Offst 1 dB Dl -11.9 dBm M1 S2 S3 FC AA Center 2.440000000 GHz Center 2.44 GHz Span 12 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 4 ms (401 pts) No Peak Found Freq/Channel Center Freq 2.44000000 GHz Start Freq 2.43400000 GHz Stop Freq 2.44600000 GHz CF Step 1.20000000 MHz Auto Man Freq Offset 0.00000000 Hz Signal Track On Off Scale Type Log Lin  Agilent R T Mkr1 4.886 GHz Ref 20 dBm Atten 30 dB -40.82 dBm Peak Log 10 dB/ Offst 1 dB Dl -11.9 dBm M1 S2 S3 FC AA Marker 4.886390000 GHz -40.82 dBm Start 30 MHz Stop 26 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 2.691 s (1001 pts) No Peak Found Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2

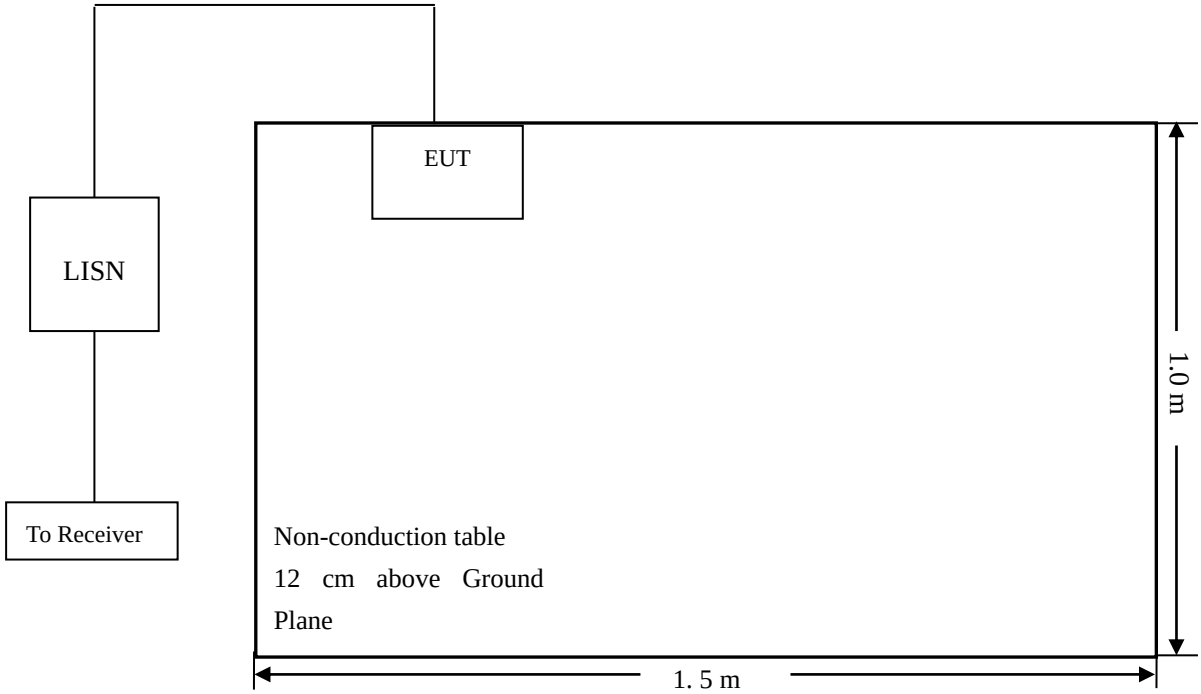
High	 Agilent R T Mkr2 2.48201 GHz Ref 20 dBm Atten 30 dB -41.2 dBm Peak Log 10 dB/ Offst 1 dB Dl -12.3 dBm Center 2.483000000 GHz Center 2.483 GHz Span 12 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 4 ms (401 pts) Marker Trace Type X Axis Amplitude 1 (1) Freq 2.48000 GHz 7.911 dBm 2 (1) Freq 2.48201 GHz -41.2 dBm No Peak Found Freq/Channel Center Freq 2.48300000 GHz Start Freq 2.47700000 GHz Stop Freq 2.48900000 GHz CF Step 1.20000000 MHz Auto Man Freq Offset 0.00000000 Hz Signal Track On Off Scale Type Log Lin  Agilent R T Mkr1 4.957 GHz Ref 20 dBm Atten 30 dB -43.75 dBm Peak Log 10 dB/ Offst 1 dB Dl -12.3 dBm M1 S2 S3 FC AA Points 1001 Start 30 MHz Stop 26 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 2.691 s (1001 pts) No Peak Found Sweep Sweep Time 2.691 s Auto Man Sweep Single Cont Auto Sweep Coupling SR SA Points 1001 Segmented

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



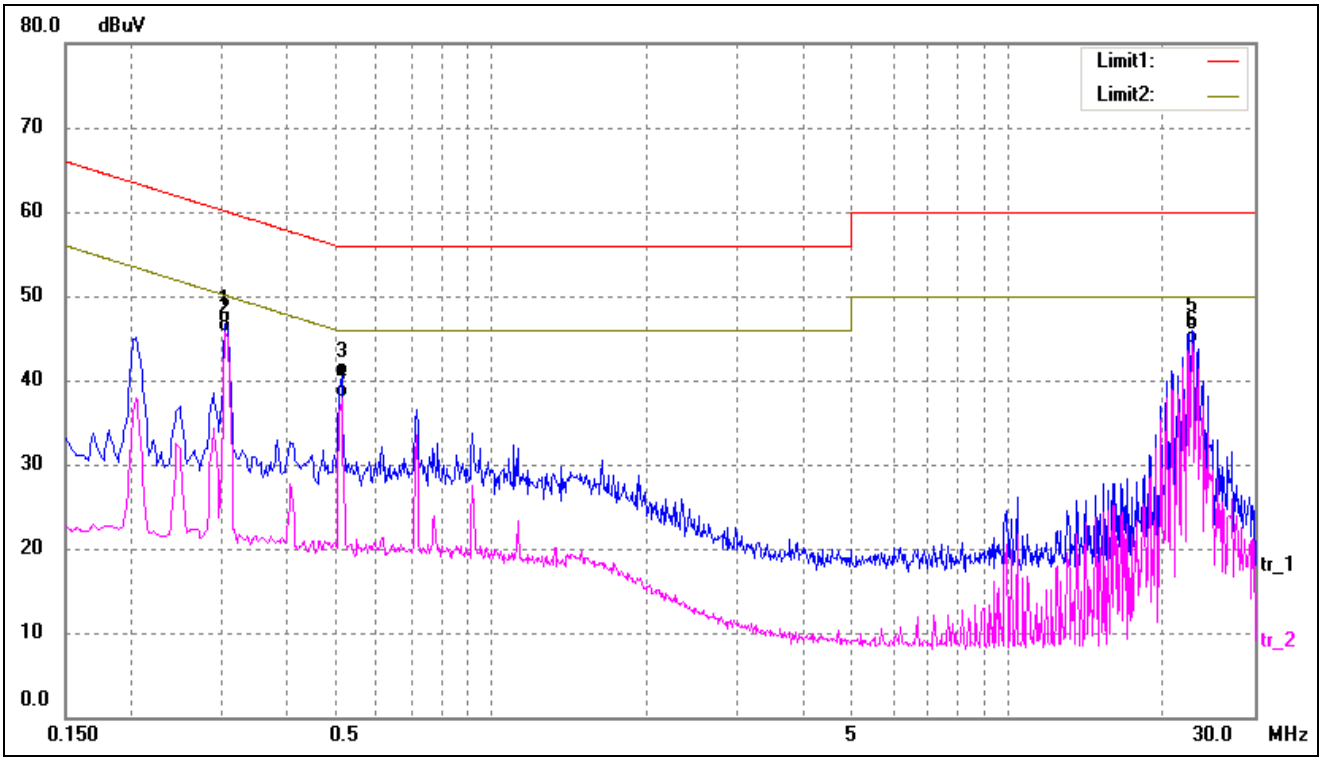
10.3 Test Receiver Setup

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

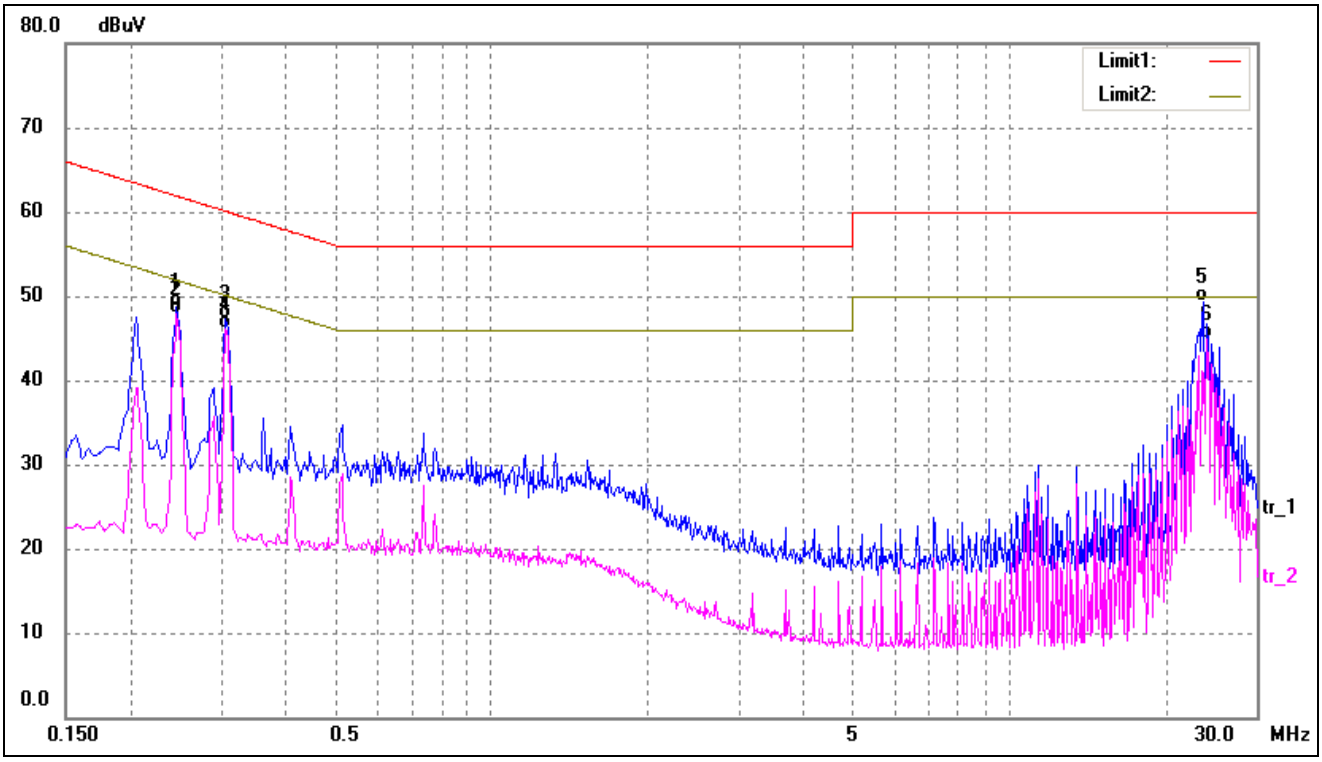
10.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.3060	36.54	10.19	46.73	60.08	-13.35	QP
2*	0.3060	35.52	10.19	45.71	50.08	-4.37	AVG
3	0.5140	30.28	10.29	40.57	56.00	-15.43	QP
4	0.5140	27.59	10.29	37.88	46.00	-8.12	AVG
5	22.7740	34.66	11.20	45.86	60.00	-14.14	QP
6	22.7740	33.16	11.20	44.36	50.00	-5.64	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.2460	38.62	10.15	48.77	61.89	-13.12	QP
2	0.2460	37.69	10.15	47.84	51.89	-4.05	AVG
3	0.3060	37.08	10.19	47.27	60.08	-12.81	QP
4*	0.3060	35.99	10.19	46.18	50.08	-3.90	AVG
5	23.6380	38.10	11.21	49.31	60.00	-10.69	QP
6	24.1340	33.72	11.21	44.93	50.00	-5.07	AVG

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