

FCC Part 15C Measurement and Test Report

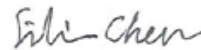
For

ZAGG Inc.

910 West Legacy Center Way Midvale Utah 84047 United States

FCC ID: QTG-ZKPIN

FCC Rule(s):	<u>FCC Part 15.247</u>
Product Description:	<u>Keyboard</u>
Tested Model:	<u>ZKB97MFN17</u>
Report No.:	<u>WTX19X04024333W</u>
Sample Receipt Date:	<u>2019-04-22</u>
Tested Date:	<u>2019-04-23 to 2019-05-08</u>
Issued Date:	<u>2019-05-08</u>
Tested By:	<u>Ray Yang / Engineer</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.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: ZAGG Inc.
Address of applicant: 910 West Legacy Center Way Midvale Utah 84047 United States
Manufacturer: Dongguan Mingpan Electronic Technology Co.,Ltd.
Address of manufacturer: Yayao Industrial estate,Huaide Community,Humen Town,Dongguan City

General Description of EUT	
Product Name:	Keyboard
Brand Name:	ZAGG
Model No.:	ZKB97MFN17
Adding Model(s):	ZKB105MFN17, ZKB79MFN17, ZKB11MFN17
Rated Voltage:	DC 3.7V by Battery
Battery Capacity:	450mAh
Power Adapter:	/
<i>Note: The test data is gathered from a production sample, provided by the manufacturer. The appearance of others models listed in the report is different from main-test model ZKB97MFN17, but the circuit and the electronic construction do not change, declared by the manufacturer.</i>	

Technical Characteristics of EUT	
Bluetooth Version:	V4.0 (BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	1.554dBm (Conducted)
Data Rate:	1Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	PCB Antenna
Antenna Gain:	0dBi

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
/	/	/	/

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

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	2018-05-22	2019-05-21
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2018-05-22	2019-05-21
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2018-05-22	2019-05-21
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2018-05-22	2019-05-21
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2018-05-22	2019-05-21
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2017-06-08	2020-06-07
SEMT-1042	Horn Antenna	ETS	3117	00086197	2017-06-08	2020-06-07
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2017-06-08	2020-06-07
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2017-06-08	2020-06-07
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2018-05-22	2019-05-21
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2018-05-22	2019-05-21
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2018-05-22	2019-05-21
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2018-05-22	2019-05-21
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2018-05-22	2019-05-21
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2018-05-22	2019-05-21
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2018-03-19	2021-03-18
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2018-05-22	2019-05-21
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2018-05-22	2019-05-21
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2018-05-22	2019-05-21
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)*	CCS	EZ-EMC	V1.0
EMI Test Software (Conducted Emission)*	CCS	EZ-EMC	V1.0

*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 § 2.1093, the portable 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 Procedure

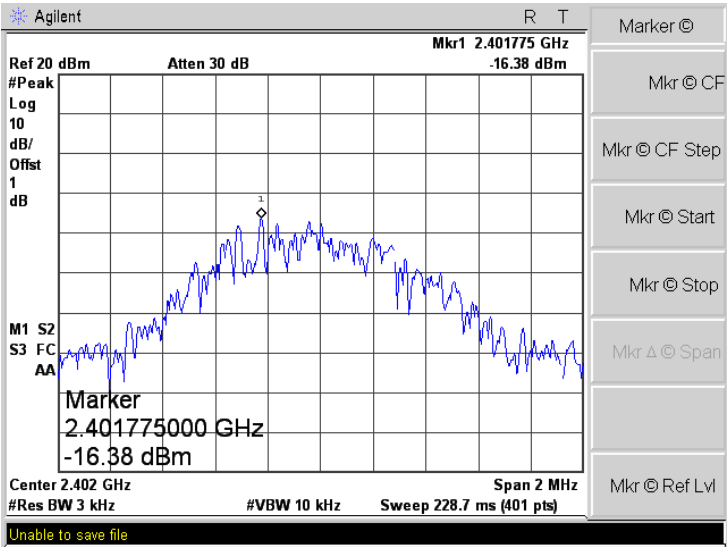
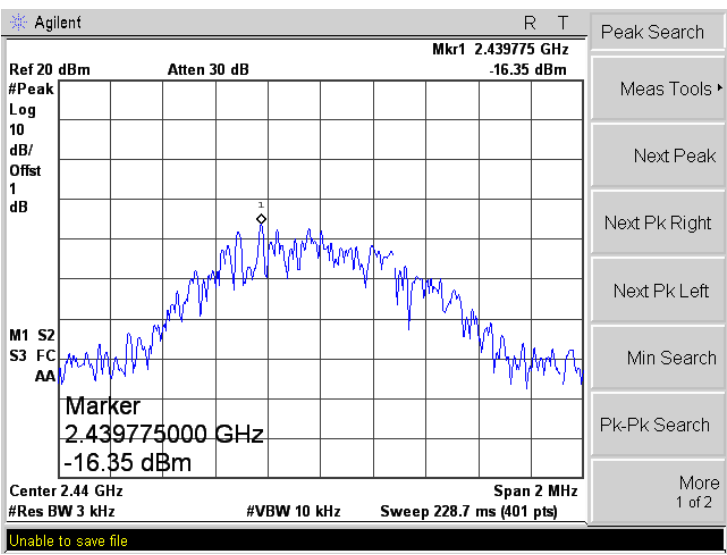
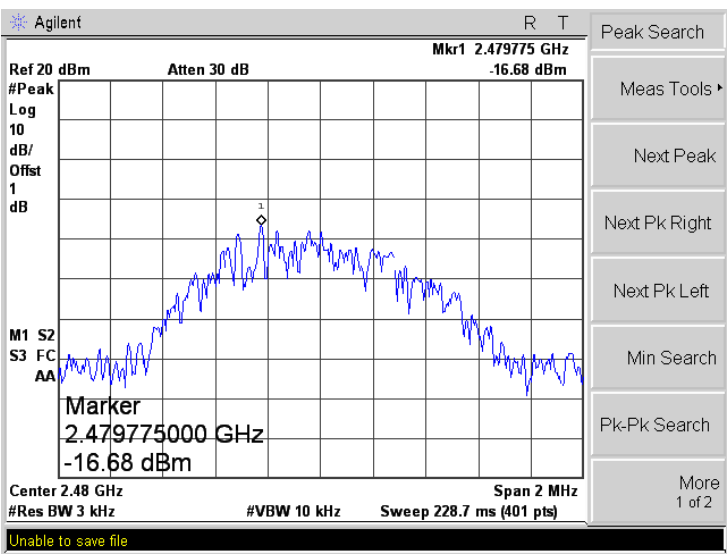
According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

- 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
GFSK(BLE)	Low	-16.38	8
	Middle	-16.35	8
	High	-16.68	8

Please refer to the following test plots:

<p>Low</p>	 <p>Agilent R T Ref 20 dBm Atten 30 dB Mkr1 2.401775 GHz -16.38 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.401775000 GHz -16.38 dBm Center 2.402 GHz Span 2 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 228.7 ms (401 pts) Unable to save file</p>
<p>Middle</p>	 <p>Agilent R T Ref 20 dBm Atten 30 dB Mkr1 2.439775 GHz -16.35 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.439775000 GHz -16.35 dBm Center 2.44 GHz Span 2 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 228.7 ms (401 pts) Unable to save file</p>
<p>High</p>	 <p>Agilent R T Ref 20 dBm Atten 30 dB Mkr1 2.479775 GHz -16.68 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.479775000 GHz -16.68 dBm Center 2.48 GHz Span 2 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 228.7 ms (401 pts) Unable to save file</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

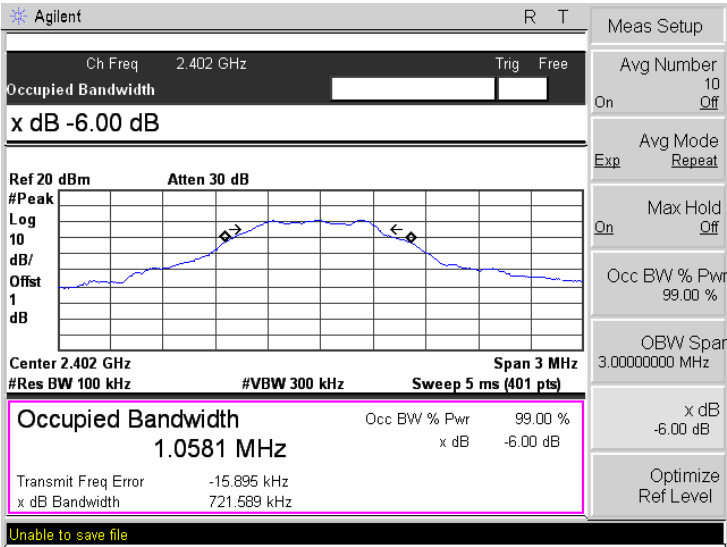
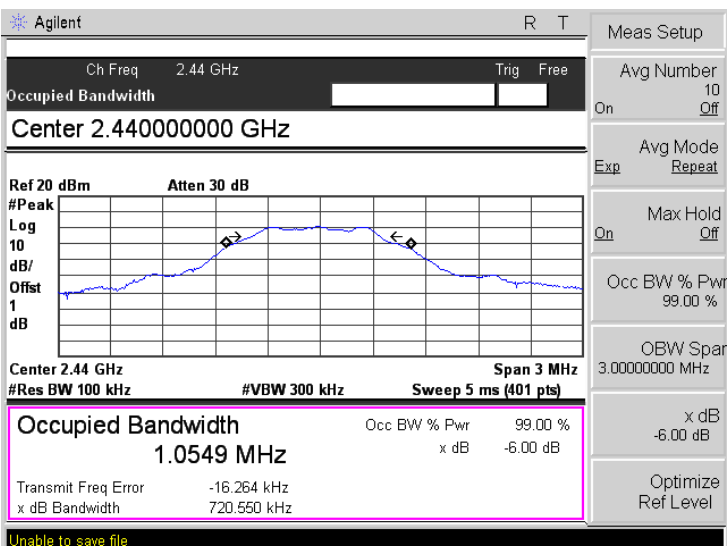
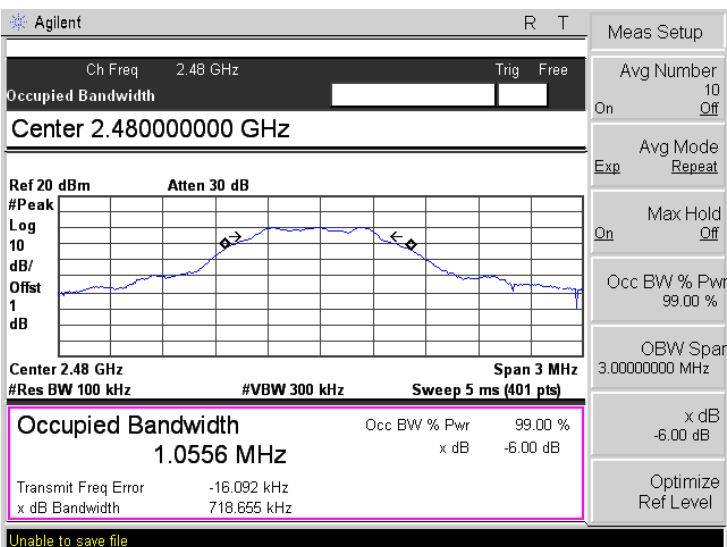
According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

- 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 MHz	Limit kHz
GFSK(BLE)	Low	0.722	≥ 500
	Middle	0.721	≥ 500
	High	0.719	≥ 500

Please refer to the following test plots:

<p>Low</p>	 <p>Agilent R T Meas Setup</p> <p>Ch Freq 2.402 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>x dB -6.00 dB</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.402 GHz Span 3 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 5 ms (401 pts)</p> <p>Occupied Bandwidth 1.0581 MHz</p> <p>Occ BW % Pwr 99.00 %</p> <p>x dB -6.00 dB</p> <p>Transmit Freq Error -15.895 kHz</p> <p>x dB Bandwidth 721.589 kHz</p> <p>Unable to save file</p> <p>Meas Setup</p> <p>Avg Number 10 On Off</p> <p>Avg Mode Exp Repeat</p> <p>Max Hold On Off</p> <p>Occ BW % Pwr 99.00 %</p> <p>OBW Spar 3.00000000 MHz</p> <p>x dB -6.00 dB</p> <p>Optimize Ref Level</p>
<p>Middle</p>	 <p>Agilent R T Meas Setup</p> <p>Ch Freq 2.44 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.440000000 GHz</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.44 GHz Span 3 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 5 ms (401 pts)</p> <p>Occupied Bandwidth 1.0549 MHz</p> <p>Occ BW % Pwr 99.00 %</p> <p>x dB -6.00 dB</p> <p>Transmit Freq Error -16.264 kHz</p> <p>x dB Bandwidth 720.550 kHz</p> <p>Unable to save file</p> <p>Meas Setup</p> <p>Avg Number 10 On Off</p> <p>Avg Mode Exp Repeat</p> <p>Max Hold On Off</p> <p>Occ BW % Pwr 99.00 %</p> <p>OBW Spar 3.00000000 MHz</p> <p>x dB -6.00 dB</p> <p>Optimize Ref Level</p>
<p>High</p>	 <p>Agilent R T Meas Setup</p> <p>Ch Freq 2.48 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.480000000 GHz</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.48 GHz Span 3 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 5 ms (401 pts)</p> <p>Occupied Bandwidth 1.0556 MHz</p> <p>Occ BW % Pwr 99.00 %</p> <p>x dB -6.00 dB</p> <p>Transmit Freq Error -16.092 kHz</p> <p>x dB Bandwidth 718.655 kHz</p> <p>Unable to save file</p> <p>Meas Setup</p> <p>Avg Number 10 On Off</p> <p>Avg Mode Exp Repeat</p> <p>Max Hold On Off</p> <p>Occ BW % Pwr 99.00 %</p> <p>OBW Spar 3.00000000 MHz</p> <p>x dB -6.00 dB</p> <p>Optimize Ref Level</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.

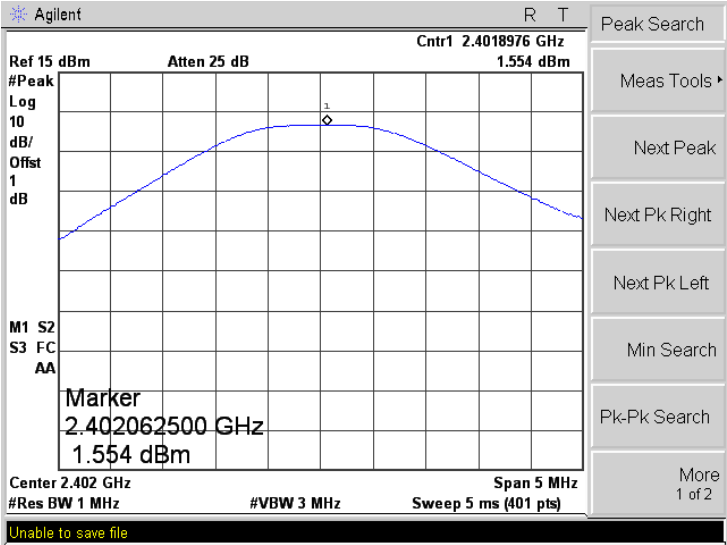
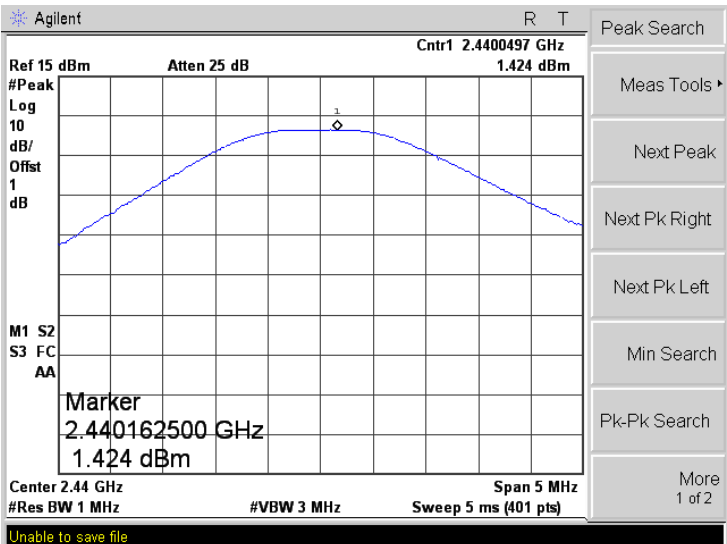
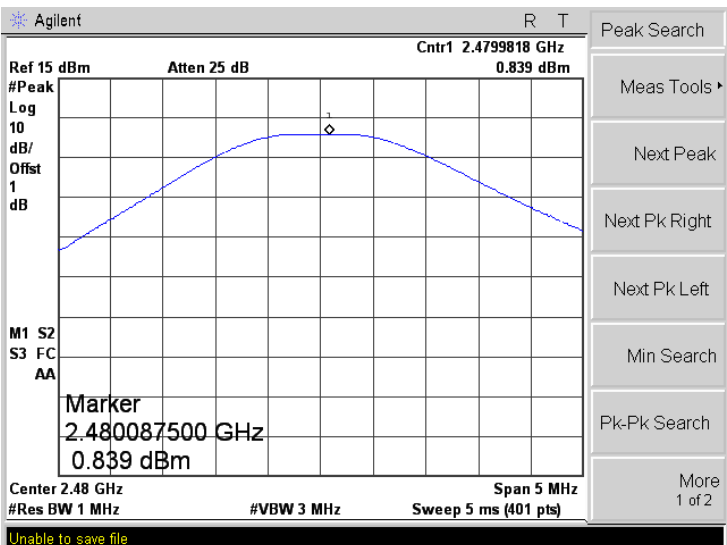
7.2 Test Procedure

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
GFSK(BLE)	Low	1.554	1.430	1000
	Middle	1.424	1.388	1000
	High	0.839	1.213	1000

<p>Low</p>	 <p>Agilent R T Ref 15 dBm Atten 25 dB Cntr1 2.4018976 GHz 1.554 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.402062500 GHz 1.554 dBm Center 2.402 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 5 ms (401 pts) Unable to save file</p>
<p>Middle</p>	 <p>Agilent R T Ref 15 dBm Atten 25 dB Cntr1 2.4400497 GHz 1.424 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.440162500 GHz 1.424 dBm Center 2.44 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 5 ms (401 pts) Unable to save file</p>
<p>High</p>	 <p>Agilent R T Ref 15 dBm Atten 25 dB Cntr1 2.4799818 GHz 0.839 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 2.480087500 GHz 0.839 dBm Center 2.48 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 5 ms (401 pts) Unable to save file</p>

8. Field Strength of Spurious Emissions

8.1 Standard Applicable

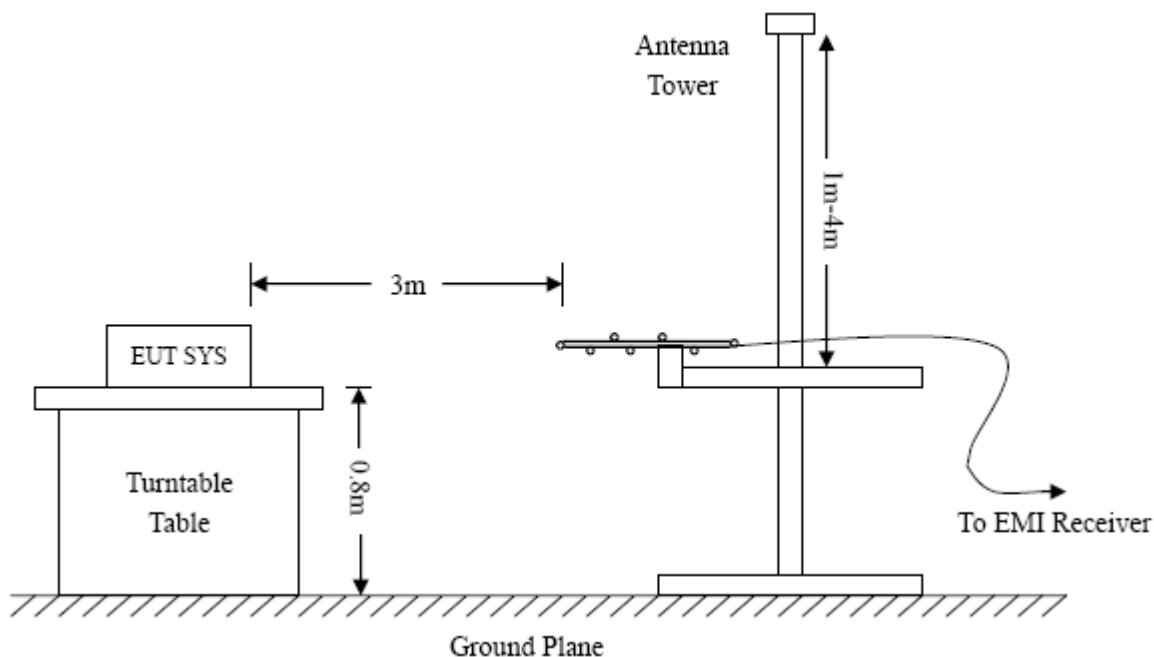
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within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

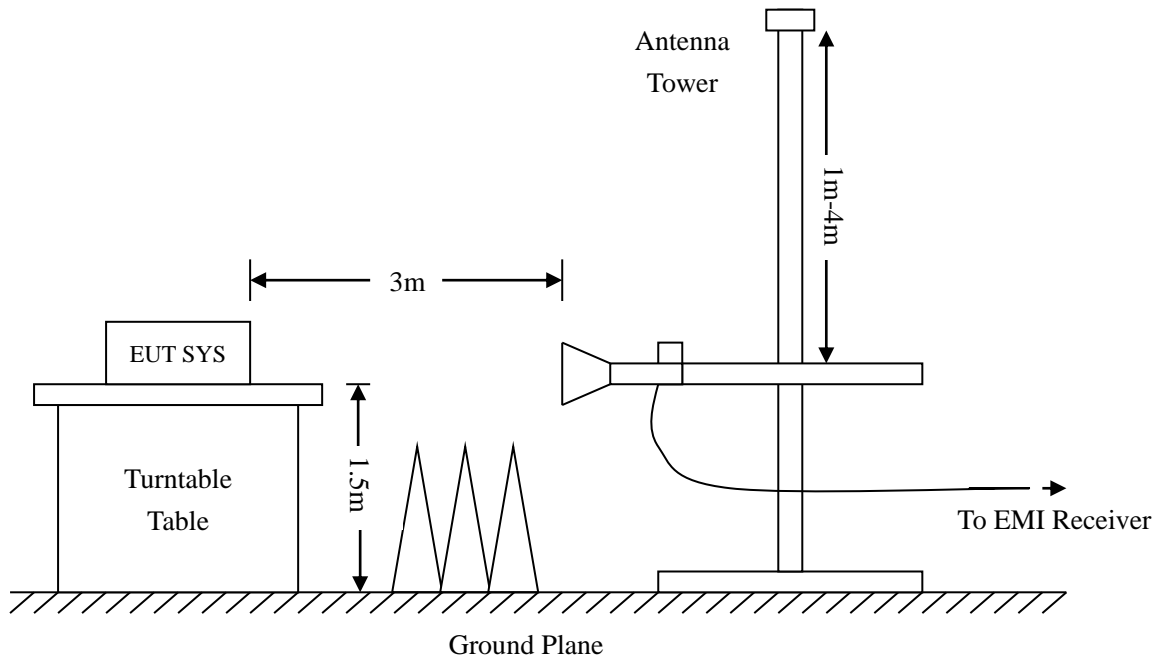
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

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:

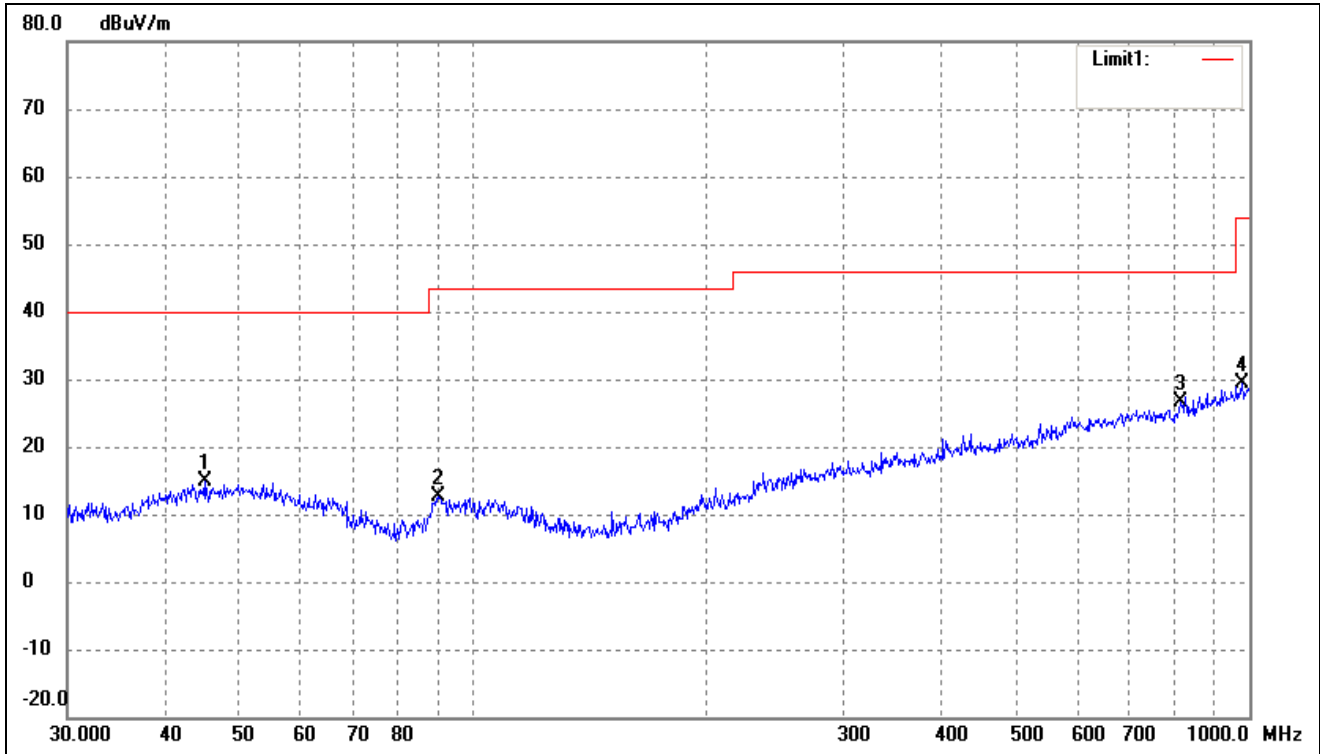
$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

8.4 Summary of Test Results/Plots

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

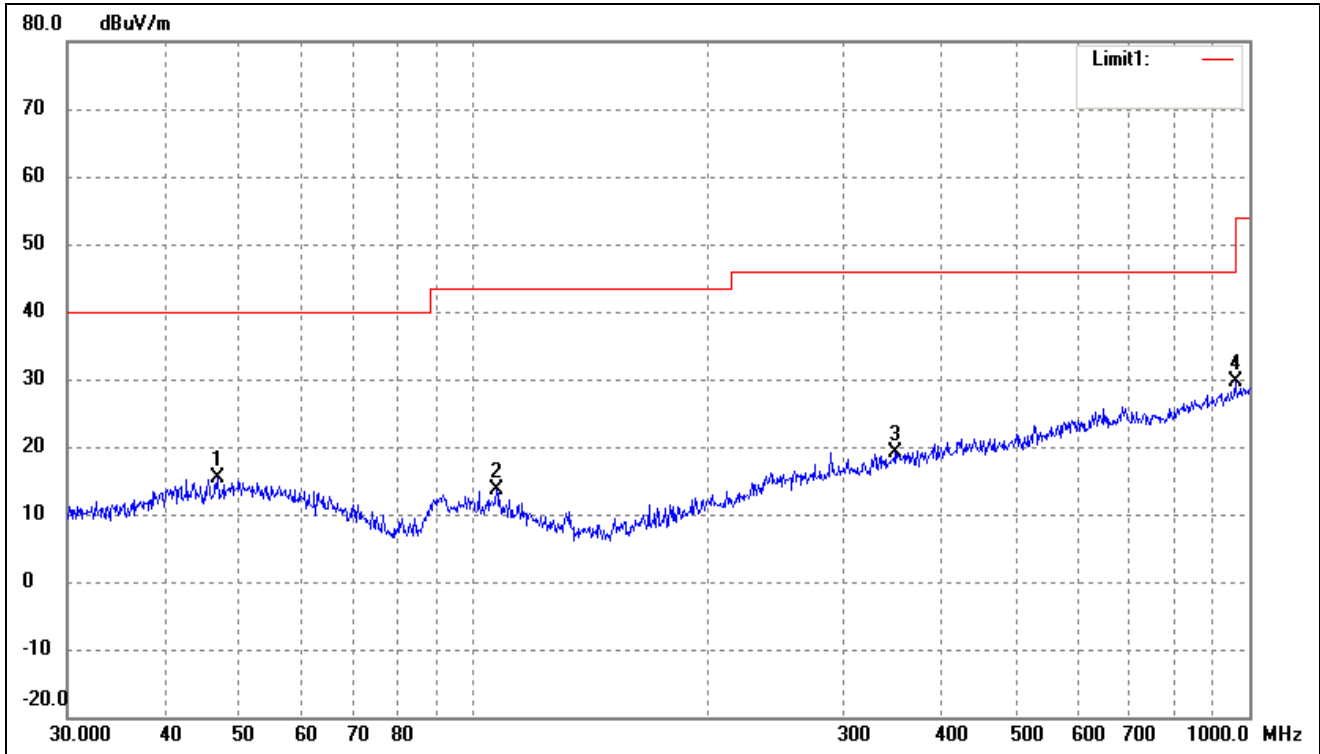
➤ Spurious Emissions Below 1GHz

Test Channel	Low	Polarity:	Horizontal
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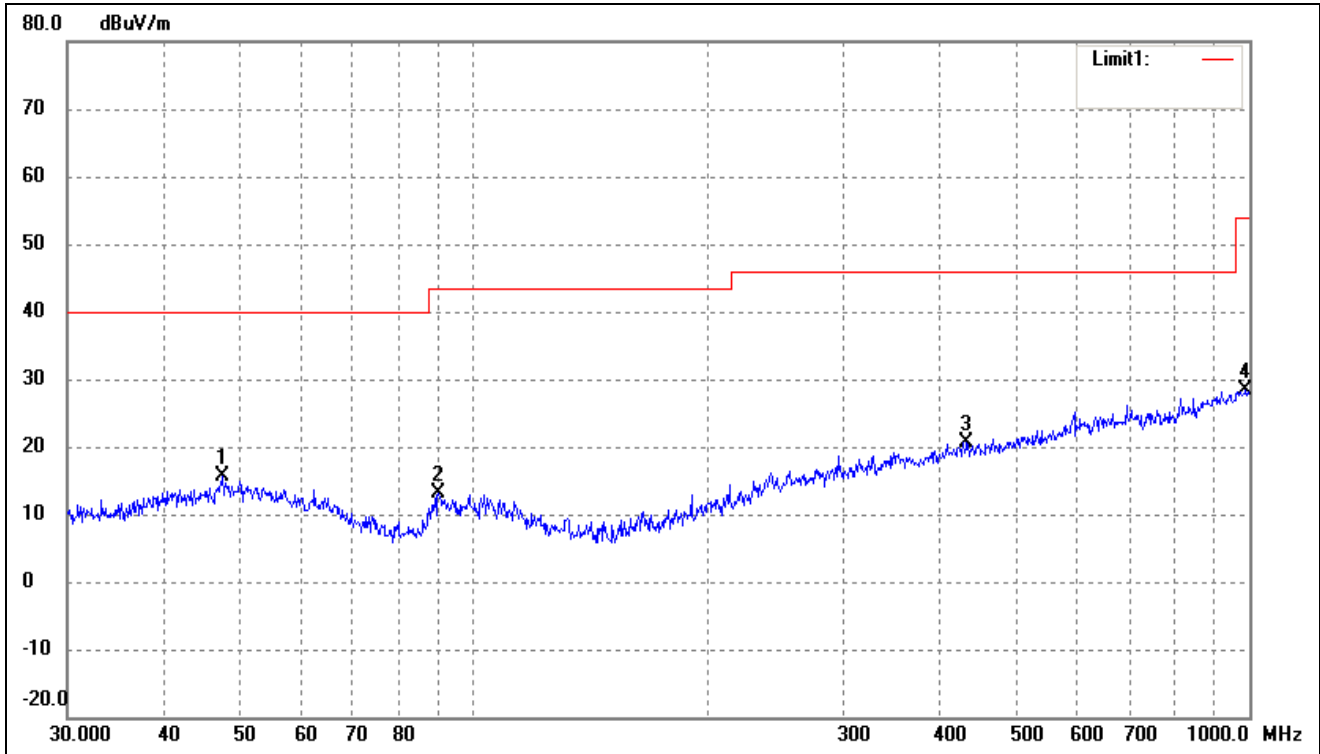
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	45.0583	26.69	-11.93	14.76	40.00	-25.24	184	100	peak
2	90.2205	25.98	-13.44	12.54	43.50	-30.96	279	100	peak
3	815.9678	26.94	-0.42	26.52	46.00	-19.48	62	100	peak
4	979.1804	27.14	2.24	29.38	54.00	-24.62	247	100	peak

Test Channel	Low	Polarity:	Vertical
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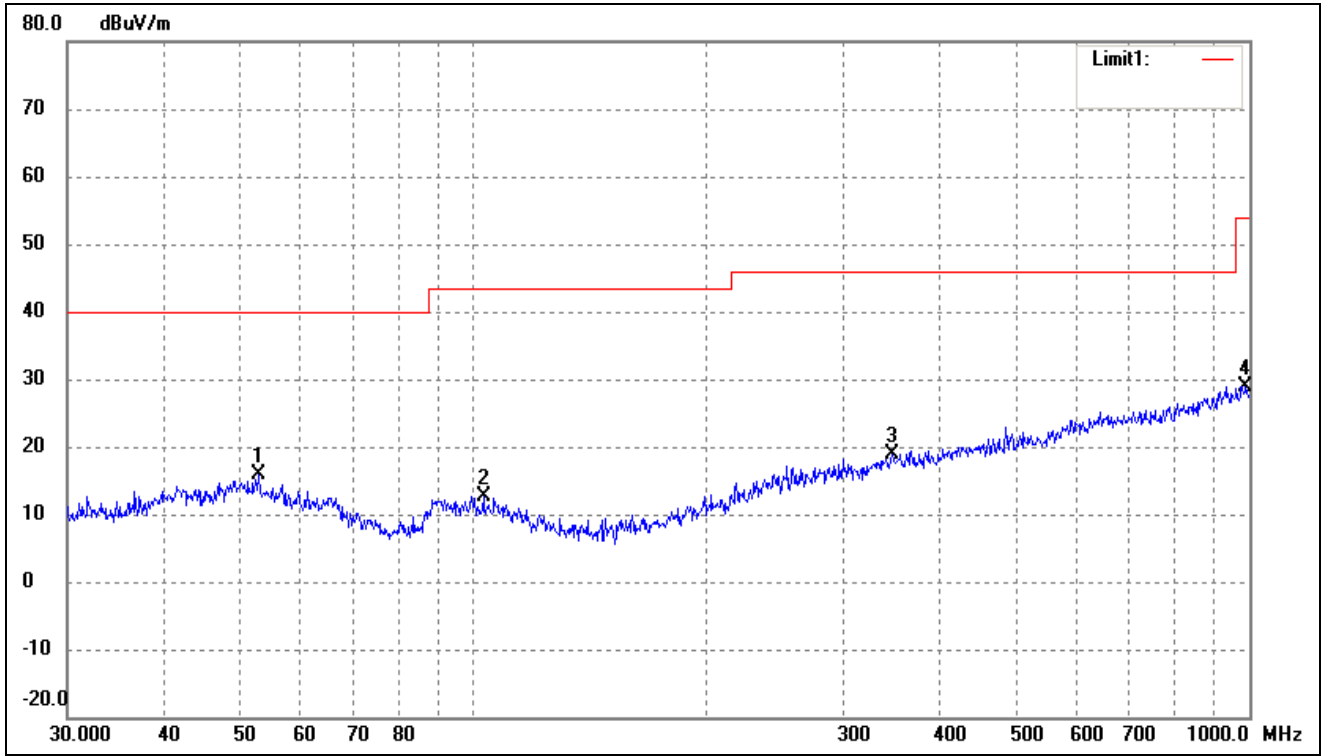
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	46.8303	27.14	-11.74	15.40	40.00	-24.60	322	100	peak
2	107.1337	27.19	-13.58	13.61	43.50	-29.89	94	100	peak
3	349.2500	26.08	-6.91	19.17	46.00	-26.83	76	100	peak
4	958.7943	27.80	1.80	29.60	46.00	-16.40	92	100	peak

Test Channel	Middle	Polarity:	Horizontal
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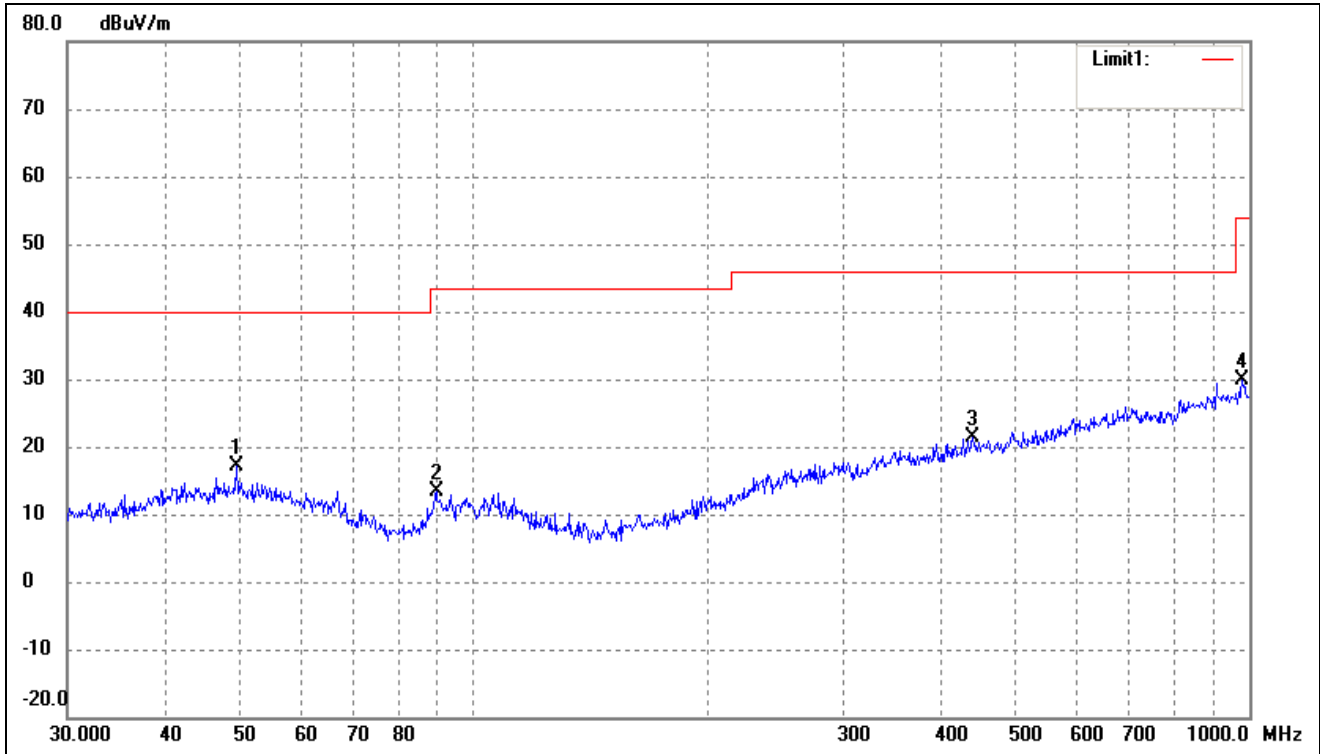
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	47.4918	27.34	-11.70	15.64	40.00	-24.36	74	100	peak
2	90.2205	26.63	-13.44	13.19	43.50	-30.31	177	100	peak
3	432.5457	26.72	-6.06	20.66	46.00	-25.34	112	100	peak
4	989.5355	26.37	2.10	28.47	54.00	-25.53	113	100	peak

Test Channel	Middle	Polarity:	Vertical
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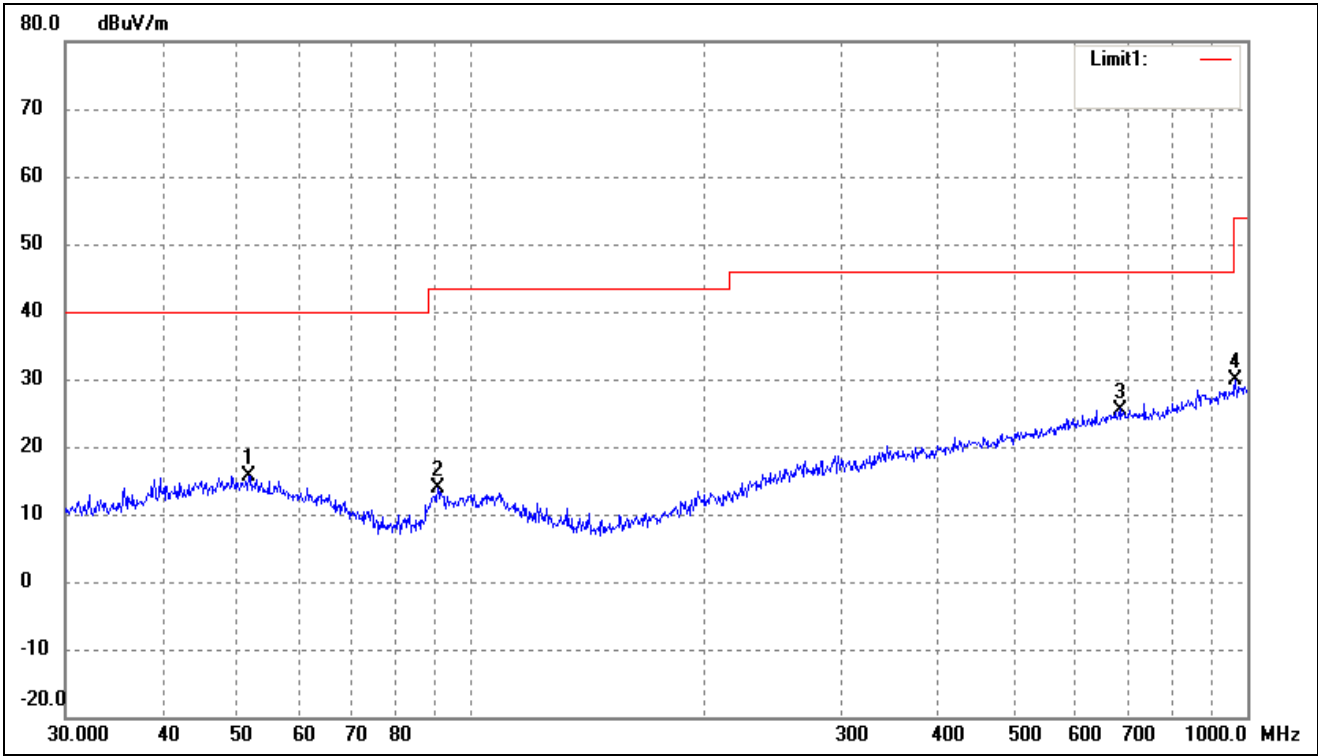
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	52.9453	27.71	-11.72	15.99	40.00	-24.01	344	100	peak
2	103.0800	26.20	-13.54	12.66	43.50	-30.84	111	100	peak
3	346.8092	25.95	-7.01	18.94	46.00	-27.06	59	100	peak
4	989.5355	26.88	2.10	28.98	54.00	-25.02	141	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	49.5328	28.63	-11.61	17.02	40.00	-22.98	238	100	peak
2	89.5900	27.15	-13.72	13.43	43.50	-30.07	297	100	peak
3	440.1963	27.55	-6.09	21.46	46.00	-24.54	94	100	peak
4	979.1804	27.52	2.24	29.76	54.00	-24.24	226	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	51.6616	27.25	-11.59	15.66	40.00	-24.34	283	100	peak
2	90.5374	27.28	-13.51	13.77	43.50	-29.73	91	100	peak
3	684.7454	27.63	-2.13	25.50	46.00	-20.50	64	100	peak
4	965.5421	27.92	1.85	29.77	54.00	-24.23	103	100	peak

➤ Spurious Emissions Below 1GHz

Frequency (MHz)	Reading (dBuV/m)	Correct dB	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar H/V	Detector
Low Channel-2402MHz							
4804.00	61.35	-3.87	57.48	74.00	-16.52	H	PK
4804.00	46.51	-3.87	42.64	54.00	-11.36	H	AV
7206.00	56.02	1.14	57.16	74.00	-16.84	H	PK
7206.00	41.88	1.19	43.07	54.00	-10.93	H	AV
4804.00	61.58	-3.86	57.72	74.00	-16.28	V	PK
4804.00	46.51	-3.86	42.65	54.00	-11.35	V	AV
7206.00	56.11	1.10	57.21	74.00	-16.79	V	PK
7206.00	41.55	1.10	42.65	54.00	-11.35	V	AV
Middle Channel-2440MHz							
4880.00	61.50	-3.74	57.76	74.00	-16.24	H	PK
4880.00	46.91	-3.74	43.17	54.00	-10.83	H	AV
7320.00	55.78	1.47	57.25	74.00	-16.75	H	PK
7320.00	41.21	1.47	42.68	54.00	-11.32	H	AV
4880.00	61.51	-3.74	57.77	74.00	-16.23	V	PK
4880.00	46.90	-3.74	43.16	54.00	-10.84	V	AV
7320.00	55.78	1.47	57.25	74.00	-16.75	V	PK
7320.00	41.45	1.47	42.92	54.00	-11.08	V	AV
High Channel-2480MHz							
4960.00	61.18	-3.59	57.59	74.00	-16.41	H	PK
4960.00	46.27	-3.59	42.68	54.00	-11.32	H	AV
7440.00	54.97	1.79	56.76	74.00	-17.24	H	PK
7440.00	41.39	1.79	43.18	54.00	-10.82	H	AV
4960.00	61.06	-3.59	57.47	74.00	-16.53	V	PK
4960.00	46.24	-3.59	42.65	54.00	-11.35	V	AV
7440.00	55.49	1.79	57.28	74.00	-16.72	V	PK
7440.00	40.80	1.79	42.59	54.00	-11.41	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
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

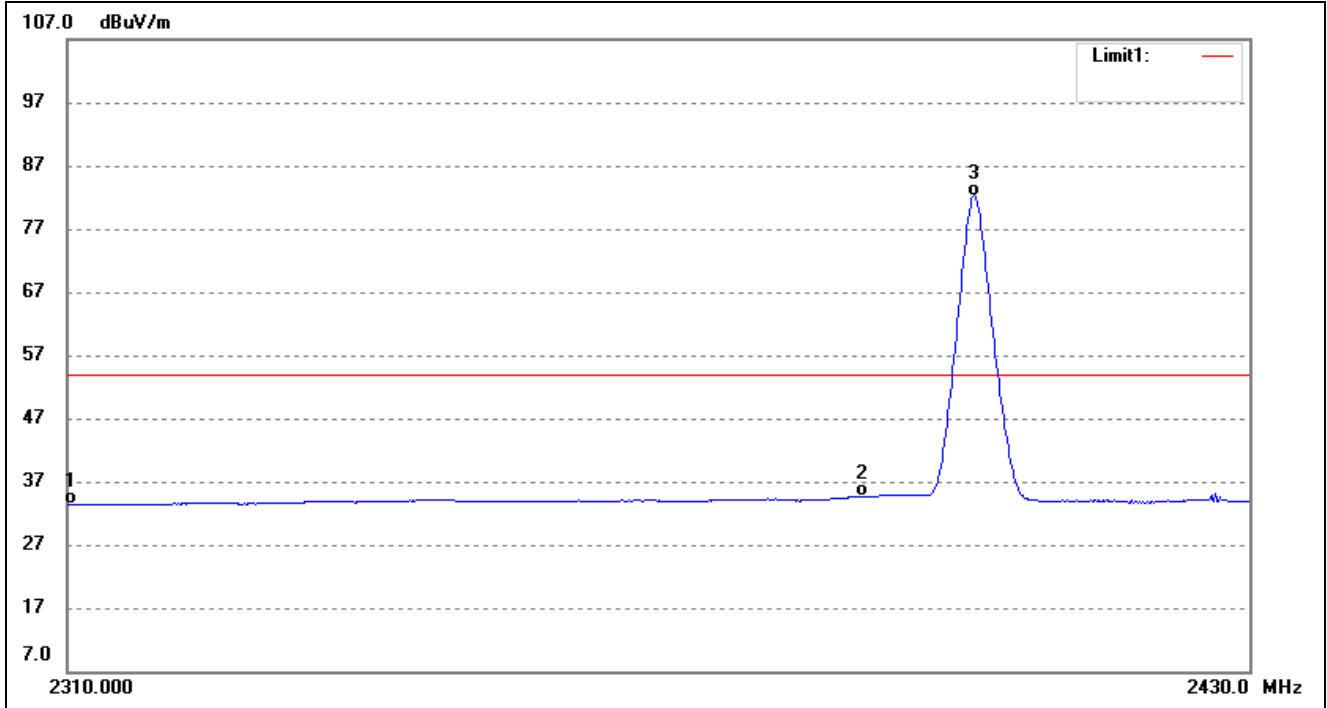
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

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

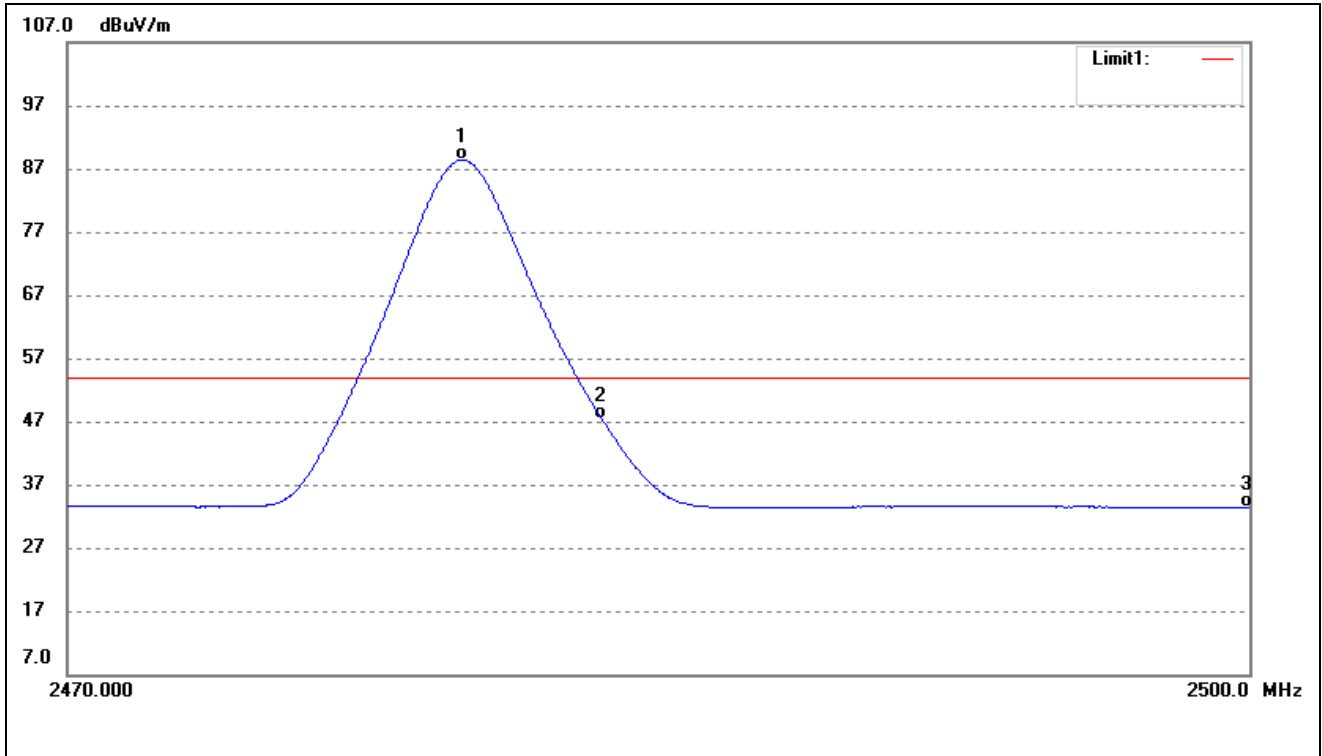
➤ Radiated test

Test Channel	Low	Polarity:	Vertical(worst case)
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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	41.15	-7.78	33.37	54.00	-20.63	Average Detector
	2310.000	51.47	-7.78	43.69	74.00	-30.31	Peak Detector
2	2390.000	42.03	-7.32	34.71	54.00	-19.29	Average Detector
	2390.000	54.80	-7.32	47.48	74.00	-26.52	Peak Detector
3	2401.494	89.50	-7.25	82.25	/	/	Average Detector
	2401.494	91.70	-7.25	84.45	/	/	Peak Detector

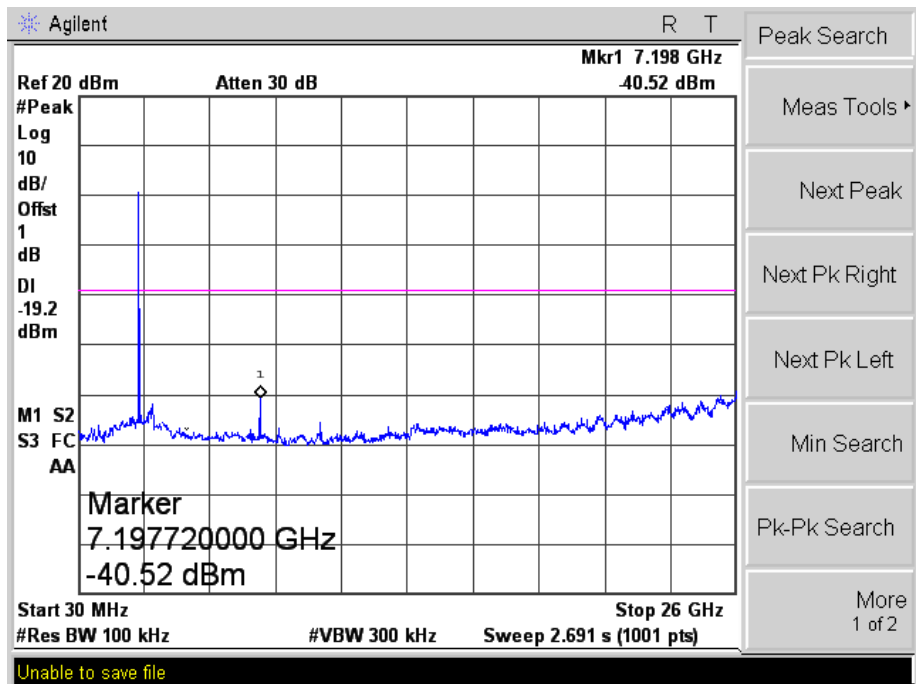
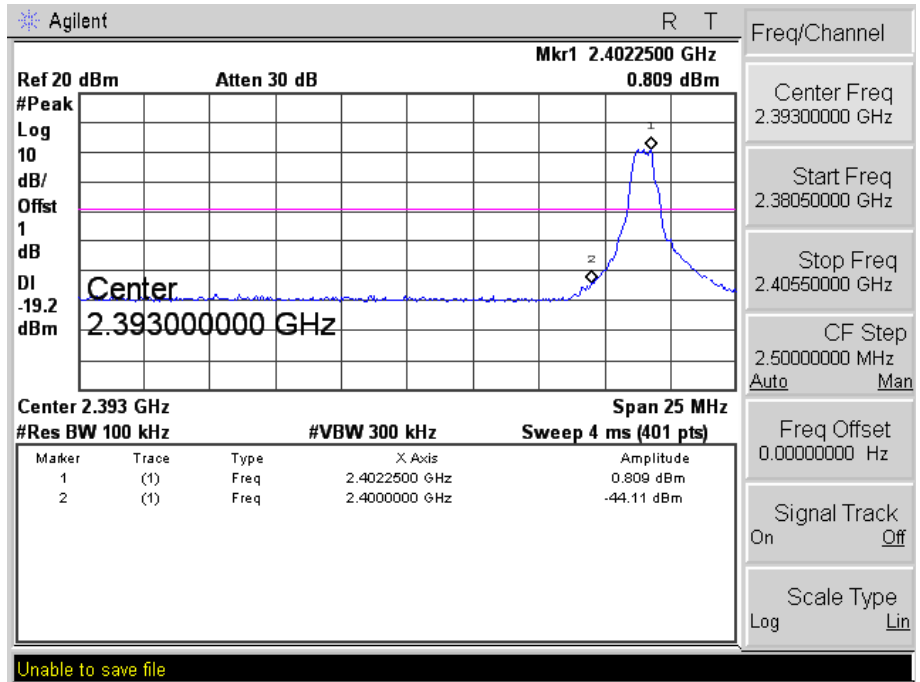
Test Channel	High	Polarity:	Vertical(worst case)
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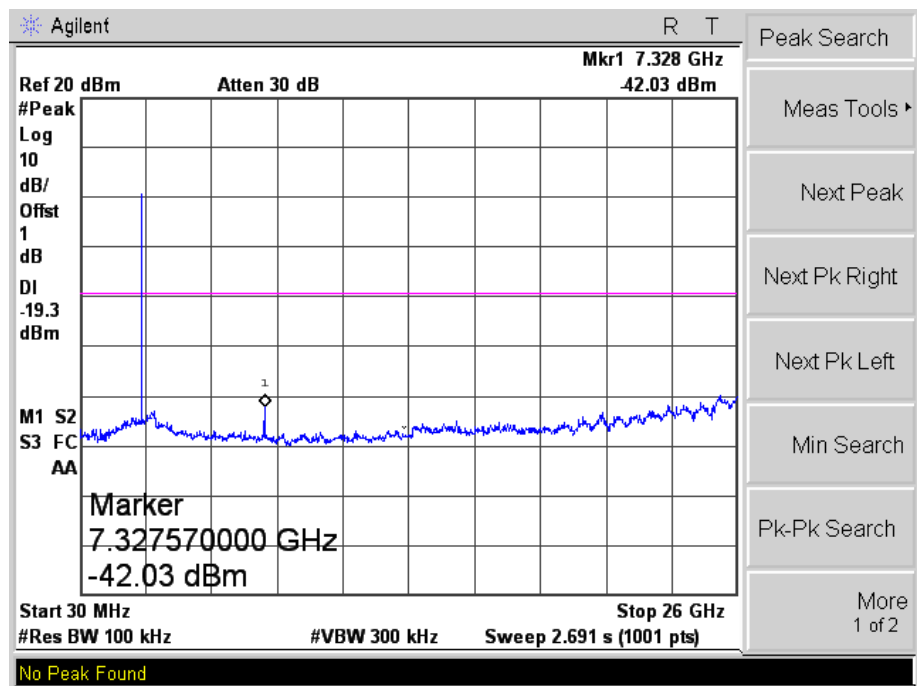
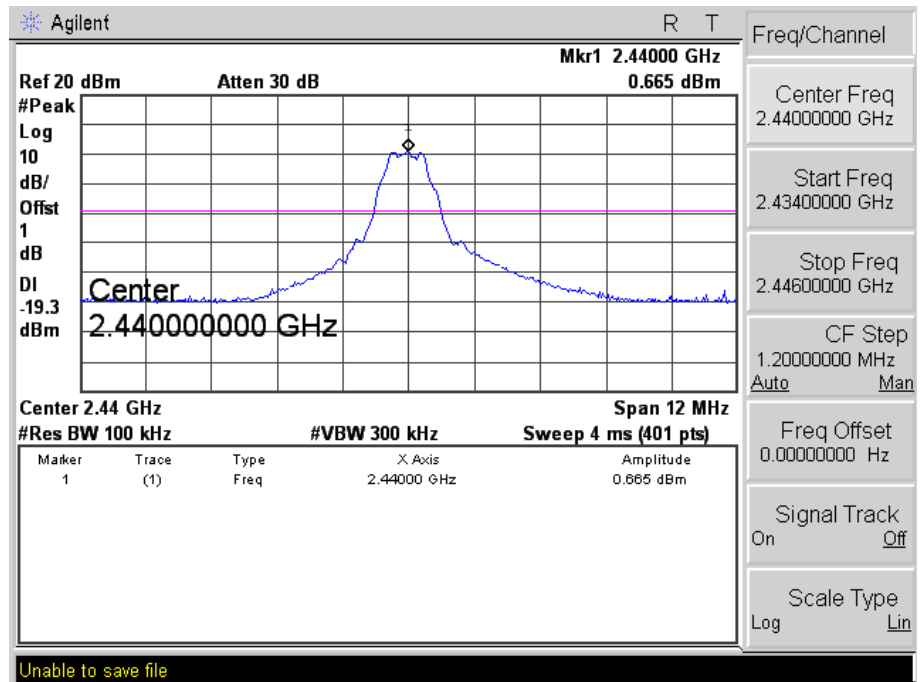
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.980	95.24	-6.79	88.45	/	/	Average Detector
	2479.950	97.56	-6.79	90.77	/	/	Peak Detector
2	2483.500	54.25	-6.77	47.48	54.00	-6.52	Average Detector
	2483.500	59.45	-6.77	52.68	74.00	-21.32	Peak Detector
3	2500.000	39.98	-6.67	33.31	54.00	-20.69	Average Detector
	2500.000	50.18	-6.67	43.51	74.00	-30.49	Peak Detector

➤ Conducted test

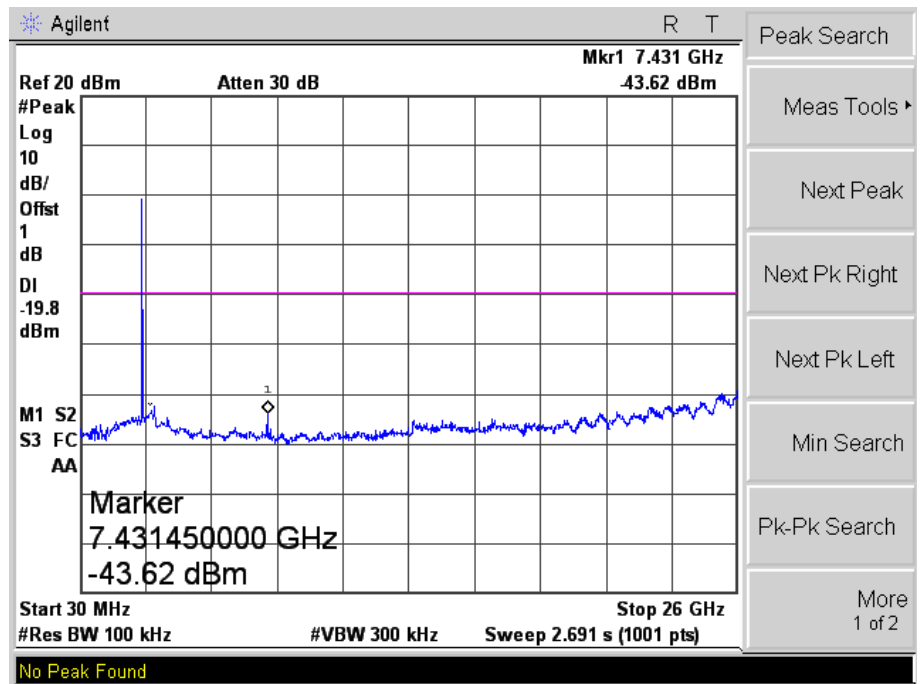
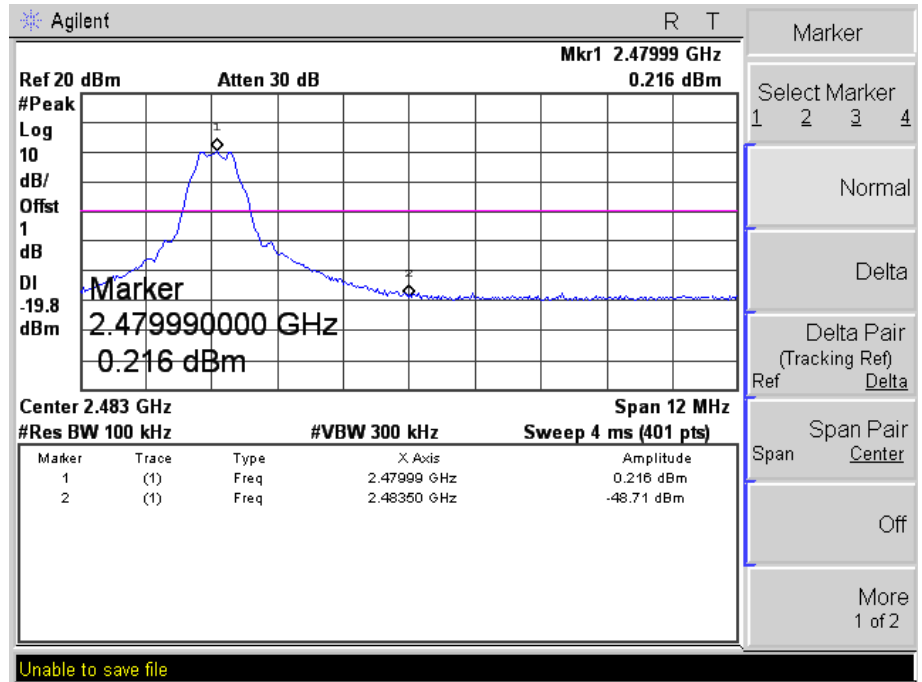
Low



Middle



High



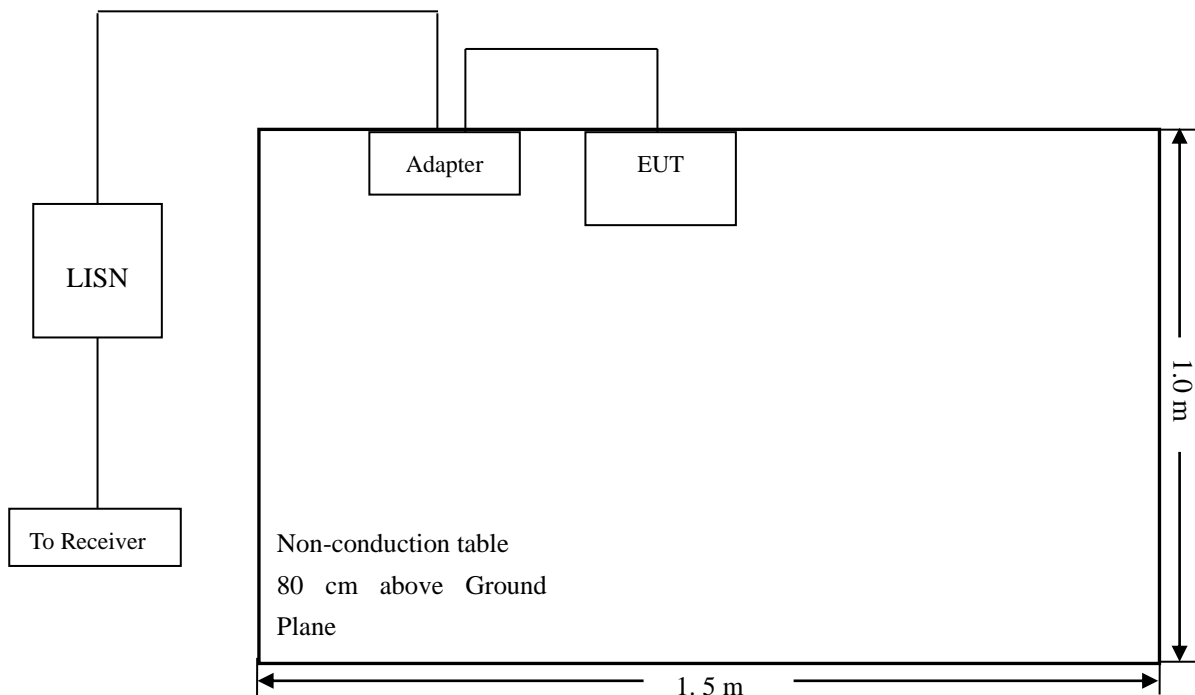
10. Conducted Emissions

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



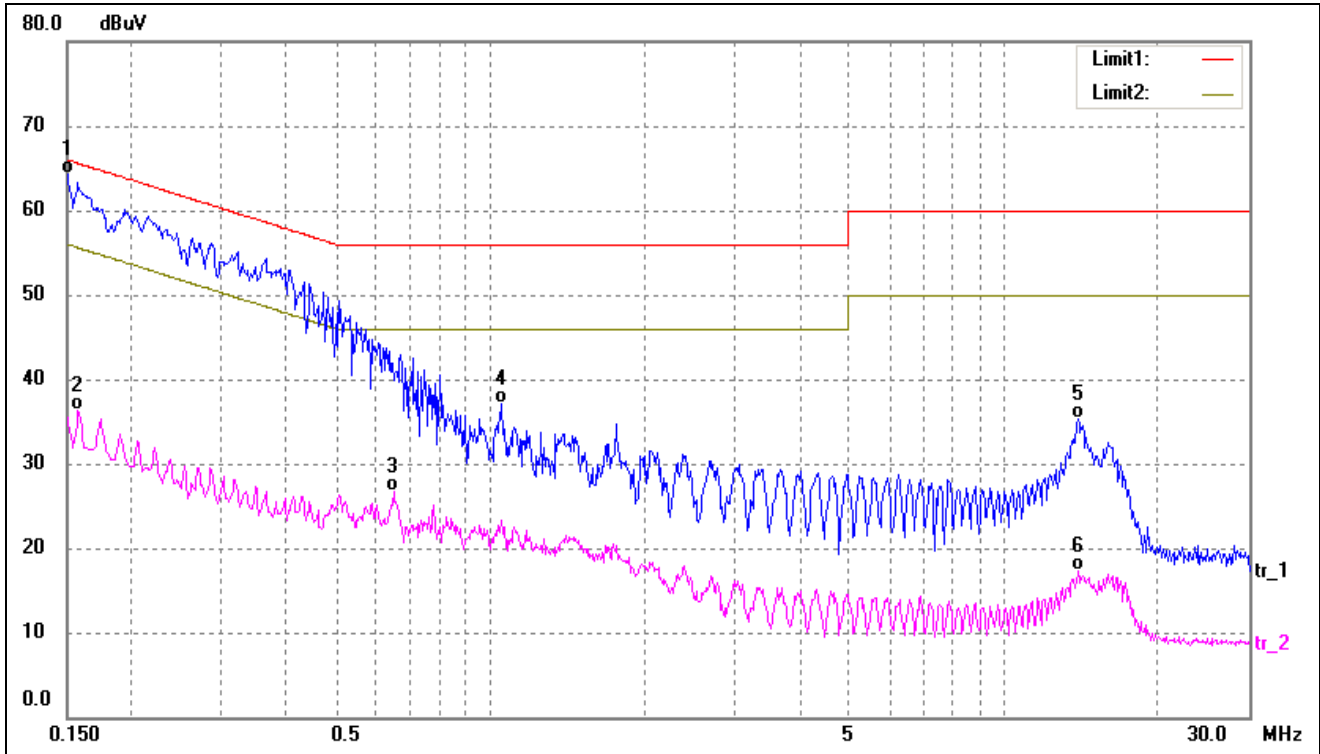
10.3 Test Receiver Setup

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

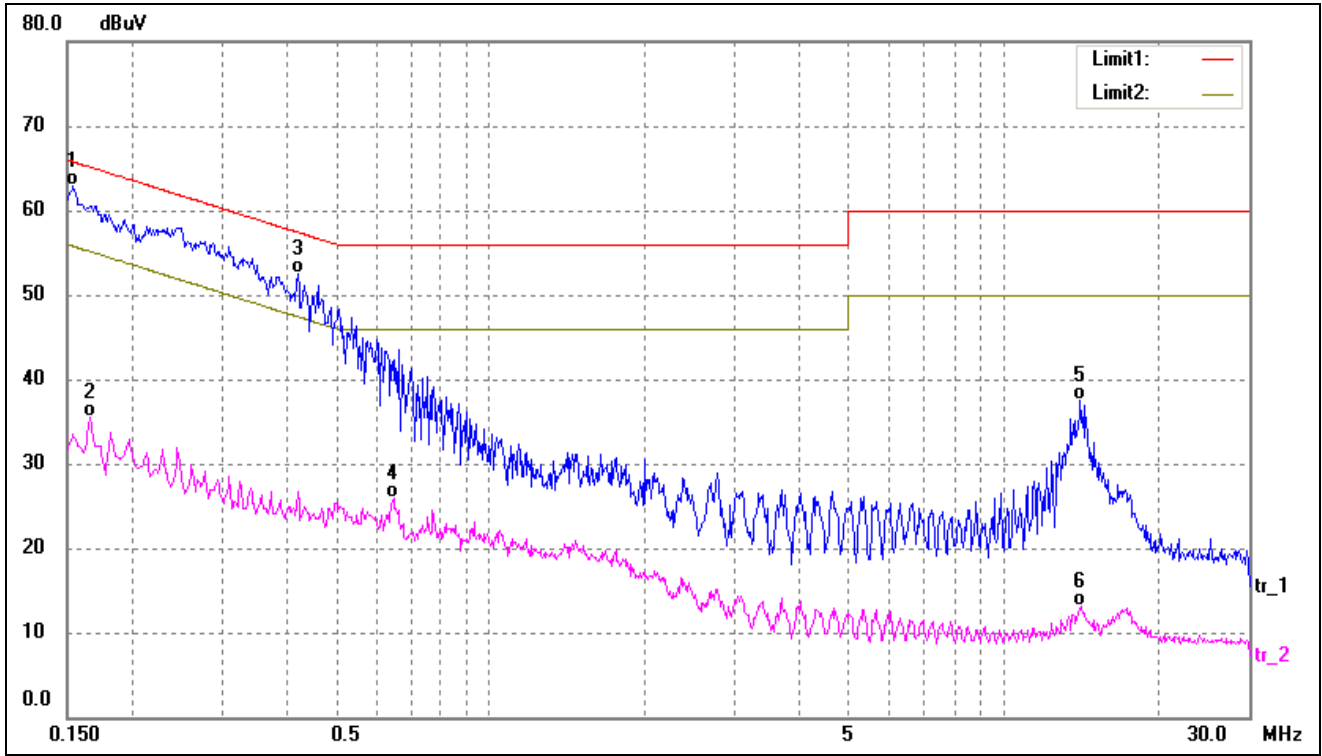
10.4 Summary of Test Results/Plots

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*	0.1500	54.15	10.10	64.25	65.99	-1.74	QP
2	0.1580	26.29	10.10	36.39	55.56	-19.17	AVG
3	0.6500	16.31	10.36	26.67	46.00	-19.33	AVG
4	1.0540	26.52	10.51	37.03	56.00	-18.97	QP
5	13.9380	24.26	11.01	35.27	60.00	-24.73	QP
6	13.9380	6.32	11.01	17.33	50.00	-32.67	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*	0.1539	52.82	10.10	62.92	65.78	-2.86	QP
2	0.1660	25.37	10.11	35.48	55.15	-19.67	AVG
3	0.4220	42.18	10.26	52.44	57.41	-4.97	QP
4	0.6500	15.52	10.36	25.88	46.00	-20.12	AVG
5	14.0740	26.55	11.02	37.57	60.00	-22.43	QP
6	14.1980	2.16	11.02	13.18	50.00	-36.82	AVG

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