

TEST REPORT

Reference No..... : WTF20X07042659W
FCC ID : BRWSPMAR10360T
Applicant : Horizon Hobby, LLC.
Address : 2904 Research Rd., Champaign, IL, 61822 United States
Product Name : AR10360T 10 Channel AS3X/SAFE Telemetry Receiver
Test Model. : SPMAR10360T
Standards : FCC Part 15.247
Date of Receipt sample : Jul.06, 2020
Date of Test..... : Jul.06, 2020 to Aug.04, 2020
Date of Issue : Aug.04, 2020
Test Result..... : **Pass**

Remarks:

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

Prepared By:

Waltek Testing Group (Shenzhen) Co., Ltd.

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

Tel.: +86-755-33663308

Fax.: +86-755-33663309

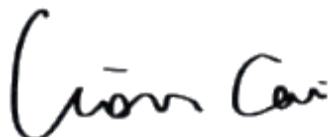
Tested by:

Reviewed By:

Approved & Authorized By:



Jason Su / Project Engineer



Lion Cai / RF Manager



Silin Chen / Manager

TABLE OF CONTENTS

1. GENERAL INFORMATION	4
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
1.2 TEST STANDARDS	5
1.3 TEST METHODOLOGY	5
1.4 TEST FACILITY	5
1.5 EUT SETUP AND TEST MODE	6
1.6 MEASUREMENT UNCERTAINTY	7
1.7 TEST EQUIPMENT LIST AND DETAILS	8
2. SUMMARY OF TEST RESULTS	10
3. RF EXPOSURE	11
3.1 STANDARD APPLICABLE	11
3.2 TEST RESULT	11
4. ANTENNA REQUIREMENT	12
4.1 STANDARD APPLICABLE	12
4.2 EVALUATION INFORMATION	12
5. FREQUENCY HOPPING SYSTEM REQUIREMENTS	13
6. QUANTITY OF HOPPING CHANNELS AND CHANNEL SEPARATION	14
6.1 STANDARD APPLICABLE	14
6.2 TEST SETUP BLOCK DIAGRAM	14
6.3 TEST PROCEDURE	14
6.4 SUMMARY OF TEST RESULTS/PLOTS	15
7. DWELL TIME OF HOPPING CHANNEL	19
7.1 STANDARD APPLICABLE	19
7.2 TEST SETUP BLOCK DIAGRAM	19
7.3 TEST PROCEDURE	19
7.4 SUMMARY OF TEST RESULTS/PLOTS	20
8. 20DB BANDWIDTH	27
8.1 STANDARD APPLICABLE	27
8.2 TEST SETUP BLOCK DIAGRAM	27
8.3 TEST PROCEDURE	27
8.4 SUMMARY OF TEST RESULTS/PLOTS	28
9. RF OUTPUT POWER	31
9.1 STANDARD APPLICABLE	31
9.2 TEST SETUP BLOCK DIAGRAM	31
9.3 TEST PROCEDURE	31
9.4 SUMMARY OF TEST RESULTS/PLOTS	31
10. FIELD STRENGTH OF SPURIOUS EMISSIONS	35
10.1 STANDARD APPLICABLE	35
10.2 TEST PROCEDURE	35
10.3 CORRECTED AMPLITUDE & MARGIN CALCULATION	37
10.4 SUMMARY OF TEST RESULTS/PLOTS	37
11. OUT OF BAND EMISSIONS	52
11.1 STANDARD APPLICABLE	52
11.2 TEST PROCEDURE	52
11.3 SUMMARY OF TEST RESULTS/PLOTS	53
12. CONDUCTED EMISSIONS	68
12.1 TEST PROCEDURE	68
12.2 BASIC TEST SETUP BLOCK DIAGRAM	68
12.3 TEST RECEIVER SETUP	68
12.4 SUMMARY OF TEST RESULTS/PLOTS	68

Report version

Version No.	Date of issue	Description
Rev.00	Aug.04, 2020	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Horizon Hobby, LLC.
Address of applicant: 2904 Research Rd., Champaign, IL, 61822 United States

Manufacturer: Horizon Hobby, LLC.
Address of manufacturer: 2904 Research Rd., Champaign, IL, 61822 United States

General Description of EUT	
Product Name:	AR10360T 10 Channel AS3X/SAFE Telemetry Receiver
Trade Name:	/
Model No.:	SPMAR10360T
Adding Model(s):	/
Rated Voltage:	DC5V
Battery Capacity:	/
Power Adapter:	/
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Frequency Range:	2404-2476MHz
RF Output Power:	Antenna A: 19.88dBm (Conducted) Antenna B: 19.88dBm (Conducted)
Modulation:	GFSK
Quantity of Channels:	23
Channel Separation:	3MHz/4MHz
Type of Antenna:	External Antenna
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, The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory

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

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

FCC – Registration No.: 125990

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

Industry Canada (IC) Registration No.: 11464A

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

1.5 EUT Setup and Test Mode

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

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	2404MHz
TM2	Middle Channel	2440MHz
TM3	High Channel	2476MHz
TM4	Hopping	2404-2476MHz

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
Notebook	Lenovo	E445	/

1.6 Measurement Uncertainty

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

1.7 Test Equipment List and Details

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

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

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

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§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
§15.209(a)	Radiated Spurious Emissions	Compliant
§15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§15.247(a)(1)	Channel Separation	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell time)	Compliant
§15.247(a)	20dB Bandwidth	Compliant
§15.247(b)(1)	RF Power Output	Compliant
§15.247(d)	Band Edge (Out of Band Emissions)	Compliant
§15.247(a)(1)	Frequency Hopping Sequence	Compliant
§15.247(g), (h)	Frequency Hopping System	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 SAR 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 two External antennas, fulfill the requirement of this section.

5. Frequency Hopping System Requirements

5.1 Standard Applicable

According to FCC Part 15.247(a)(1), the system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

5.2 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses transmitter radio which operates in 2400-2483.5 MHz band. It uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 18 bands (4 MHz each; centred from 2403.01 to 2471.0 MHz) in the range 2,400-2,483.5 MHz.

This device was tested with a system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for 558074 D01 15.247 Meas Guidance v05r02 and FCC Part 15.247 rule.

5.3 EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 4, 10, 14, 15, 16, 14, 11, 15, 6, 8, 4, 1, 3, 13, 14, 17, 6, 14, 7, 18, 11, 6, 13, 12, 2, 11, 5, 3, 17, 11, 12, 18, 13, 7, 5, 2, 7, 6, 13, 14, 8, 10, 14, 15, 17, 4, 1, 11, 10, 11, 18, 6, 17, 11, 1, 4, 18, 5, 11, 12, 16, 15, 2, 17, 13, 9, 10, 15, 5, 1, 18, 12, 1, 6 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

Waltek Testing Group (Shenzhen) Co., Ltd.

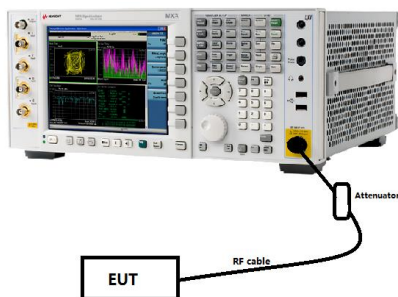
<http://www.semtest.com.cn>

6. Quantity of Hopping Channels and Channel Separation

6.1 Standard Applicable

According to FCC 15.247(a)(1), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

6.2 Test Setup Block Diagram



6.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.3, the number of hopping frequencies test method as follows.

- Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- VBW $\geq$ RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace: Max hold.
- Allow the trace to stabilize.

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.2, the EUT shall have its hopping function enabled, the Carrier frequency separation test method as follows:

- Span: Wide enough to capture the peaks of two adjacent channels.
- RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- Video (or average) bandwidth (VBW) $\geq$ RBW.
- Sweep: Auto.
- Detector function: Peak.

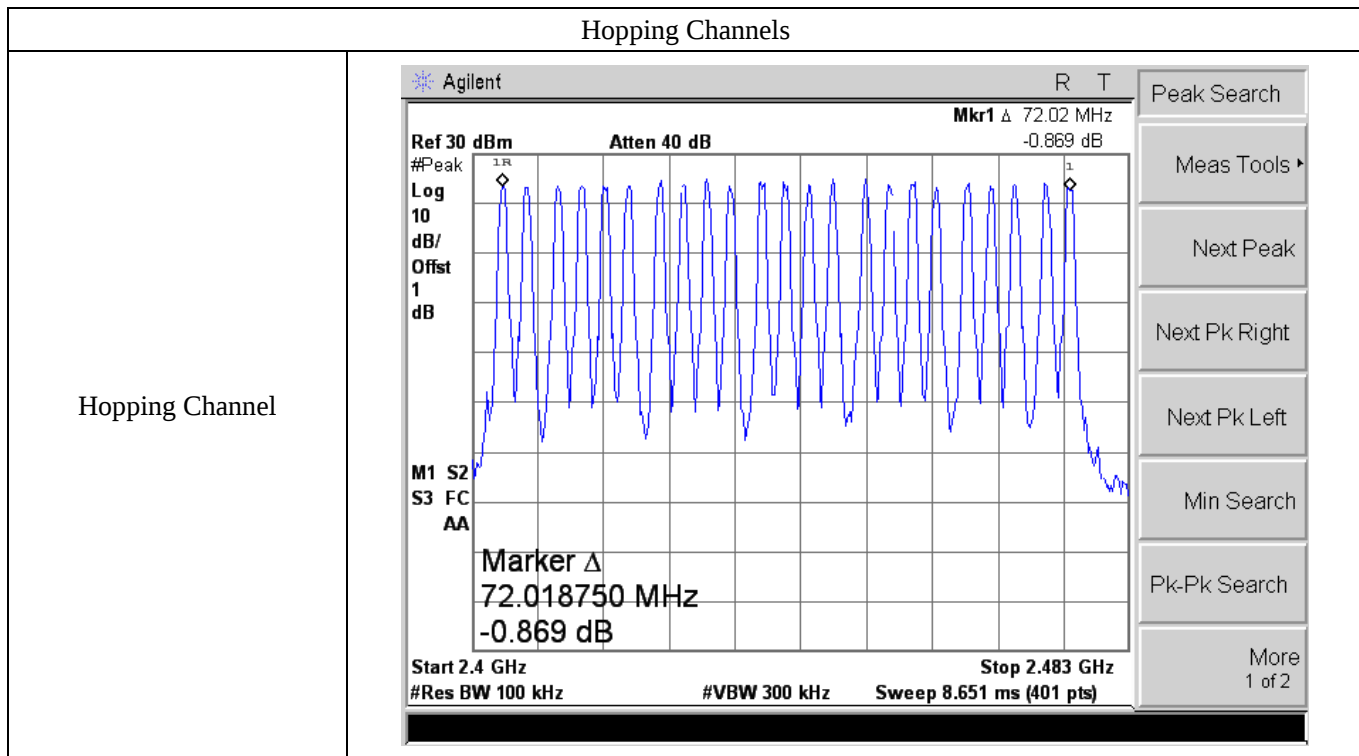
f) Trace: Max hold.

g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

6.4 Summary of Test Results/Plots

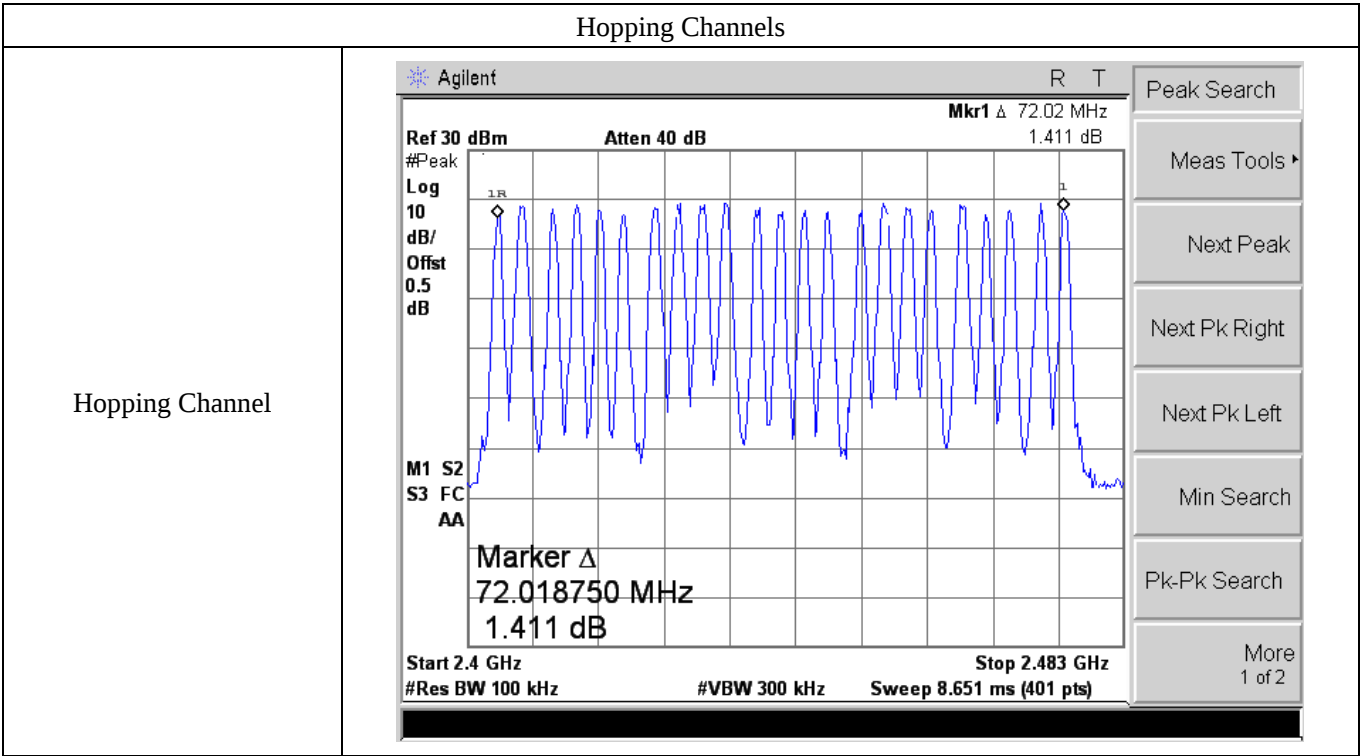
Antenna A:



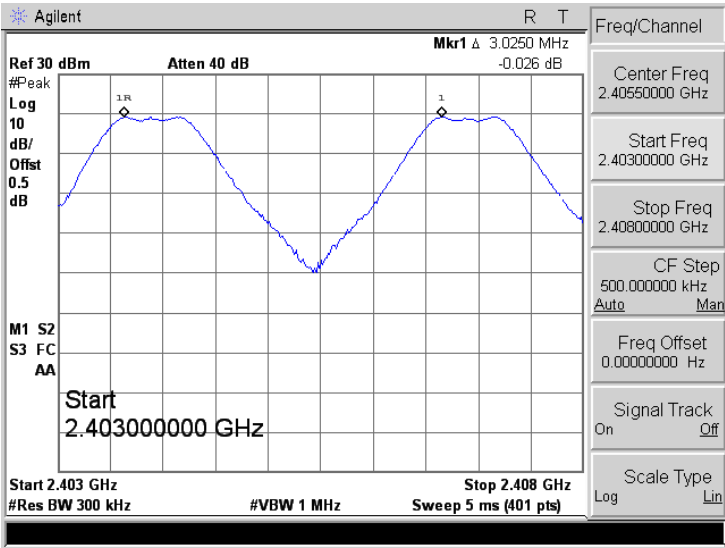
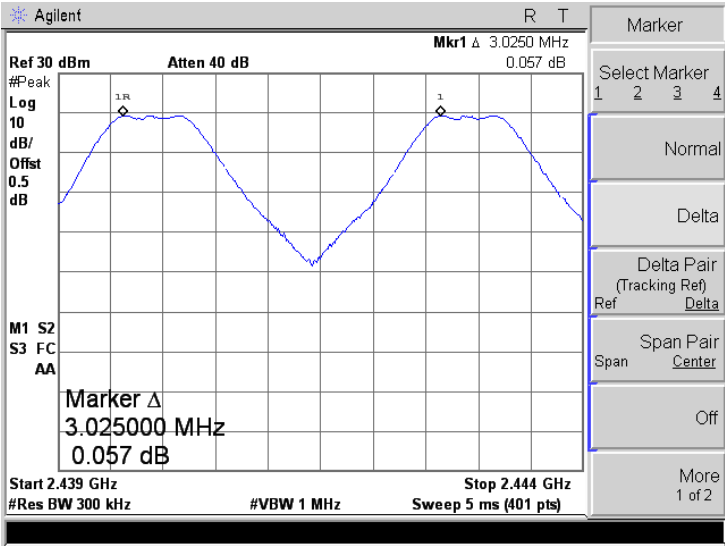
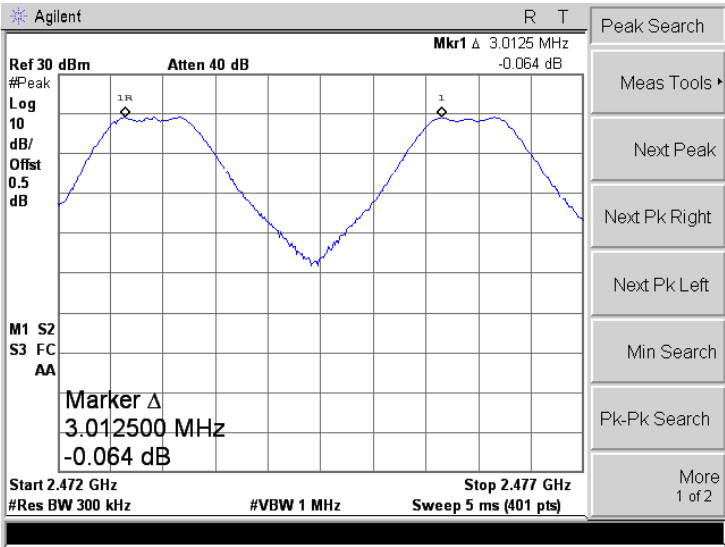
Mode	Channel	Carrier Frequencies Separation (MHz)	Result
GFSK	Low	3012.5	Pass
	Middle	2962.5	Pass
	High	2987.5	Pass

Antenna A: Channel Separation-GFSK	
Low Channel	Agilent R T Ref 30 dBm Atten 40 dB Mkr1 Δ 3.0125 MHz 0.058 dB #Peak Log 10 dB/ Offset 0.5 dB M1 S2 S3 FC AA Marker Δ 3.012500 MHz 0.058 dB Center 2.405 GHz #Res BW 300 kHz #VBW 1 MHz Sweep 5 ms (401 pts) Span 5 MHz No Peak Found Peak Search Meas Tools ▶ Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2

Antenna B:



Mode	Channel	Carrier Frequencies Separation (MHz)	Result
GFSK	Low	3025.0	Pass
	Middle	3025.0	Pass
	High	3012.5	Pass

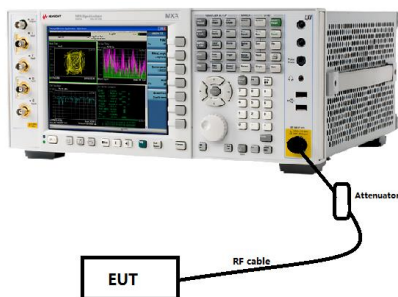
Antenna B: Channel Separation-GFSK	
Low Channel	
Middle Channel	
High Channel	

7. Dwell Time of Hopping Channel

7.1 Standard Applicable

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

7.2 Test Setup Block Diagram



7.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.4, the dwell time of a hopping channel test method as follows.

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$(\text{Number of hops in the period specified in the requirements}) = (\text{number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time})$$

Waltek Testing Group (Shenzhen) Co., Ltd.

<http://www.semtest.com.cn>

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation. The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

7.4 Summary of Test Results/Plots

The test period: $T = 0.4 \text{ Second} * 23 \text{ Channel} = 9.2 \text{ s}$

Dwell time = time slot length * (Hopping rate / Number of hopping channels) * Period

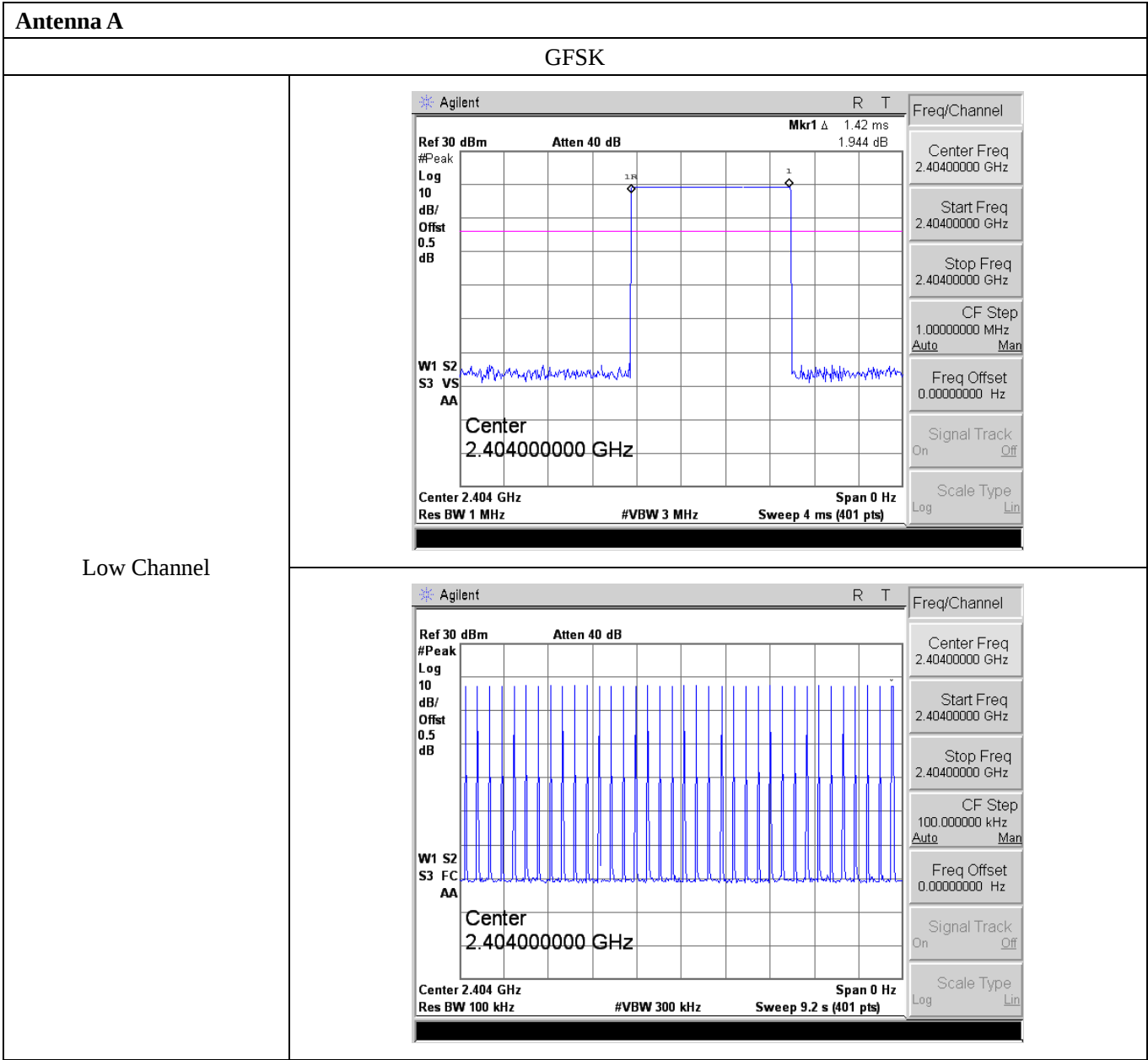
Antenna A:

Modulation	Test Channel	Time Slot Length	Dwell Time	Limit
		ms	ms	ms
GFSK	Low	1.42	51.12	400
	Middle	1.44	51.84	400
	High	1.42	51.12	400

Antenna B:

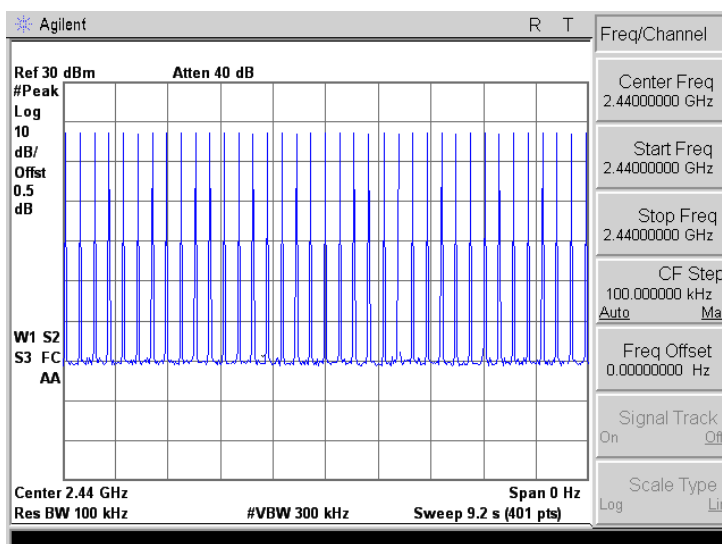
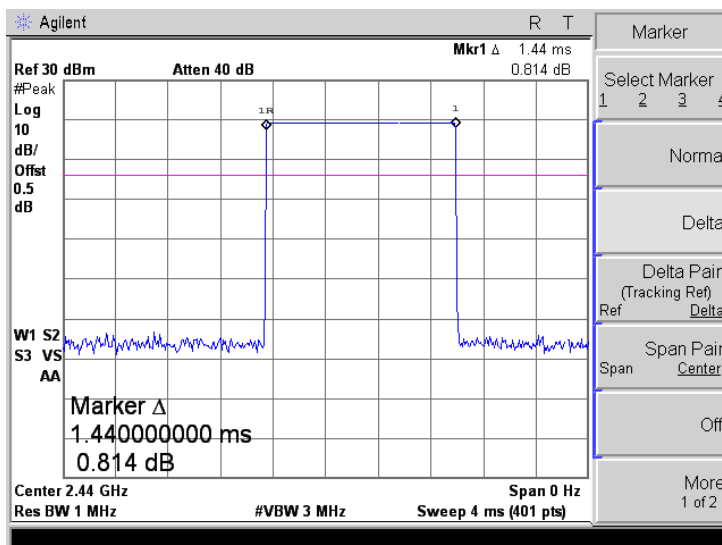
Modulation	Test Channel	Time Slot Length	Dwell Time	Limit
		ms	ms	ms
GFSK	Low	1.44	51.84	400
	Middle	1.44	51.84	400
	High	1.42	51.12	400

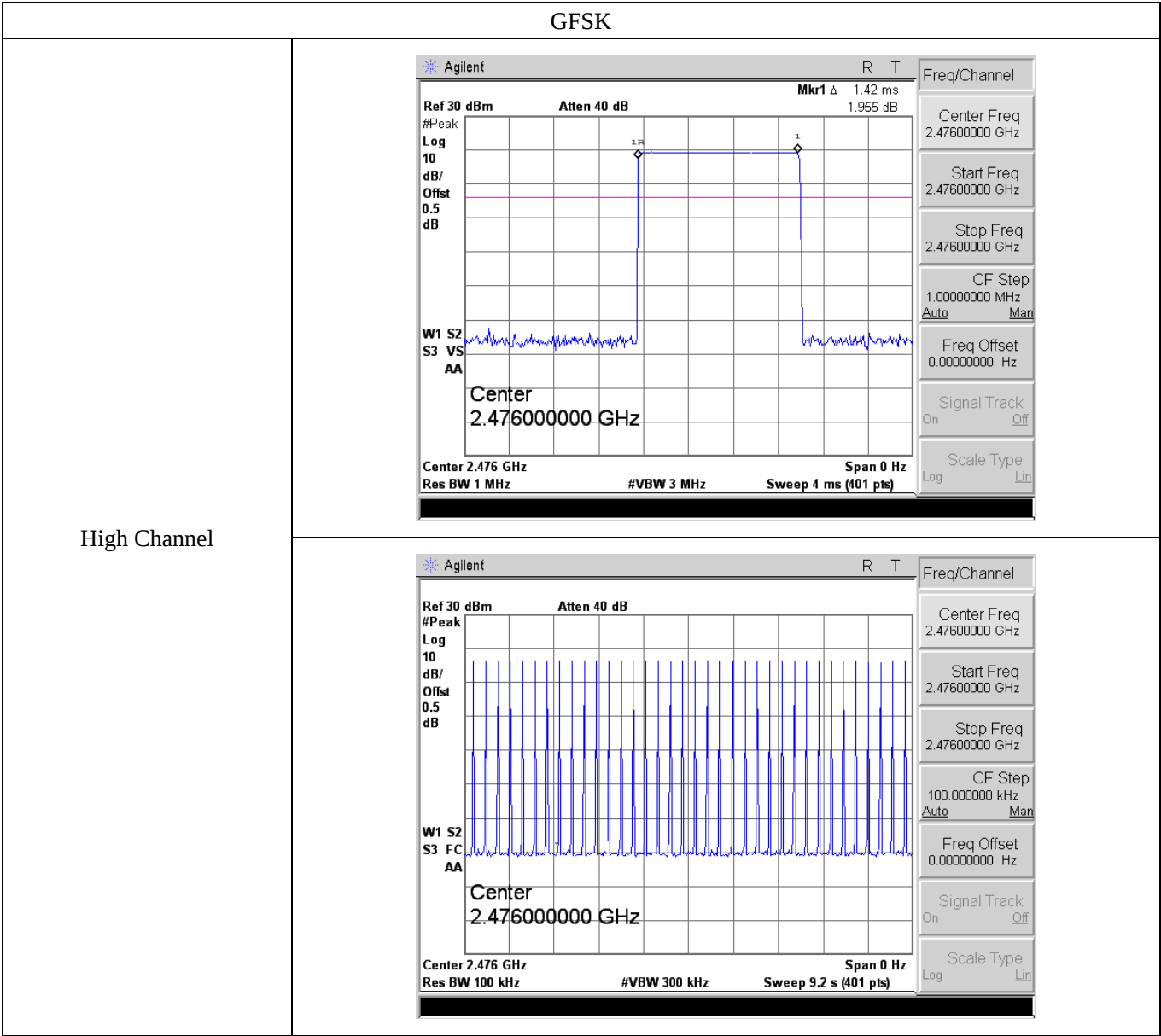
Please refer to the test plots as below:

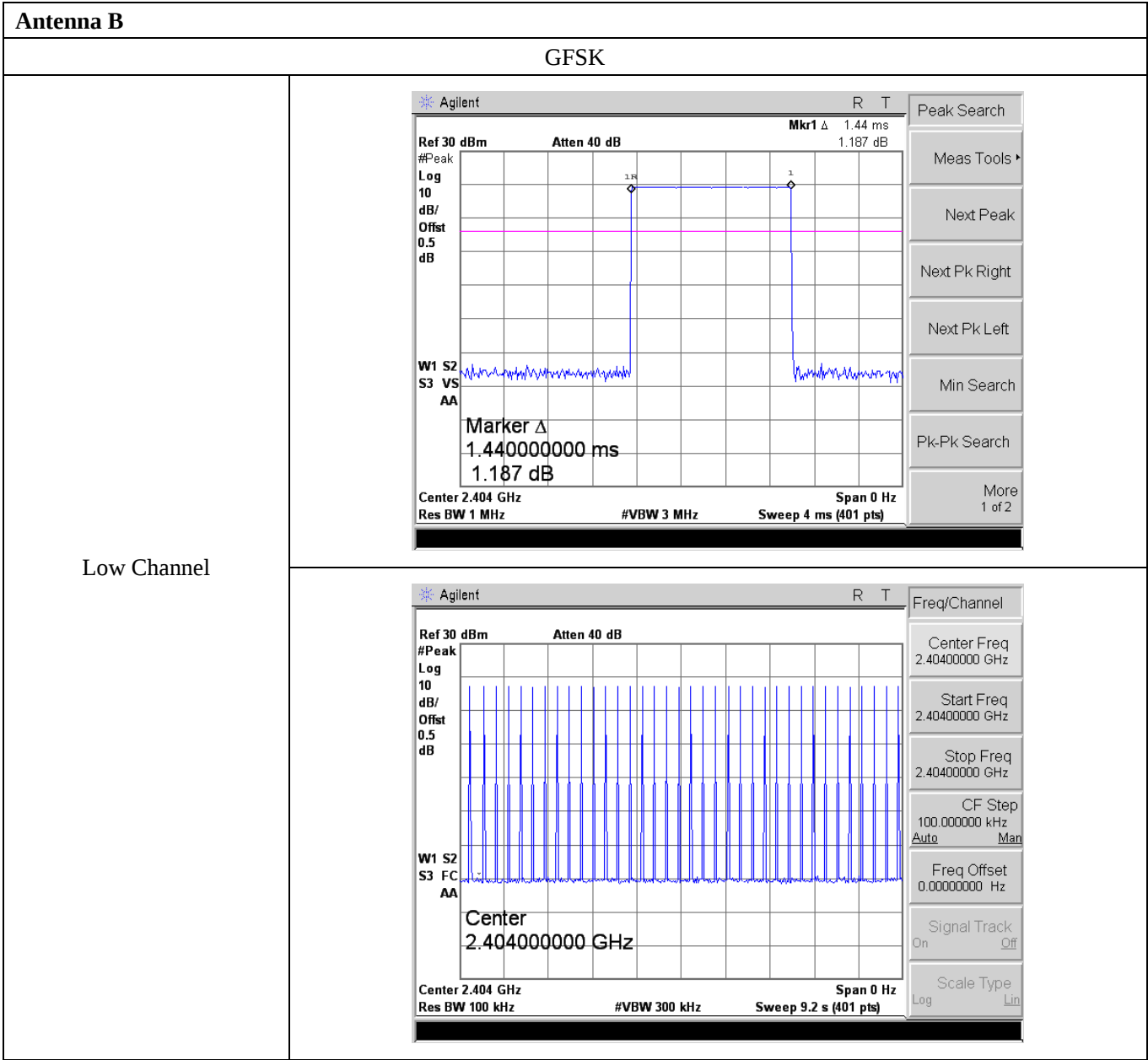


GFSK

Middle Channel

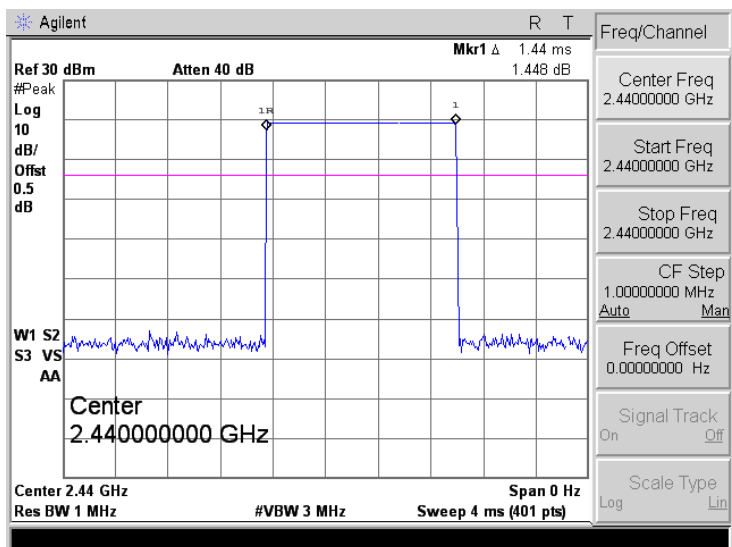






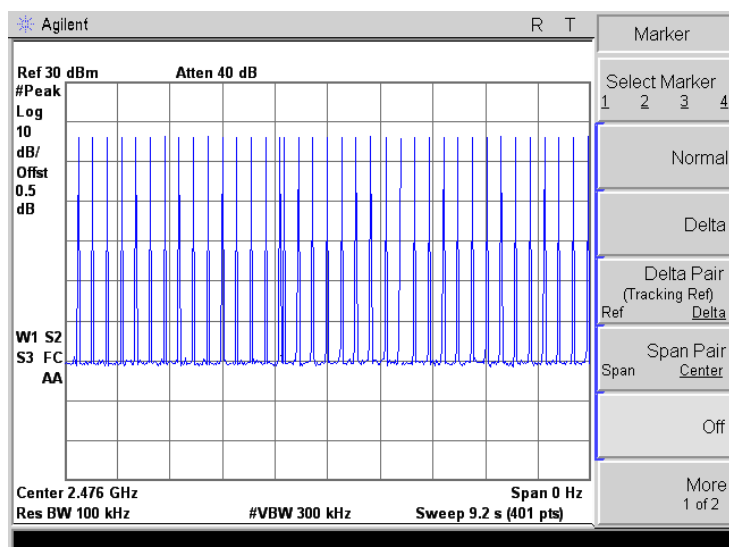
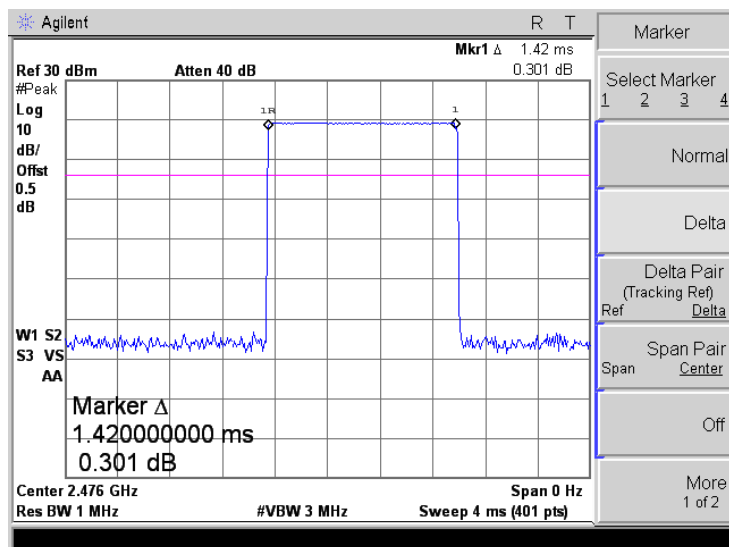
GFSK

Middle Channel



GFSK

High Channel

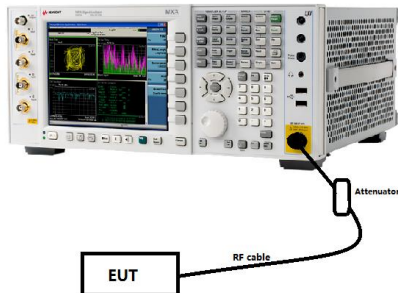


8. 20dB Bandwidth

8.1 Standard Applicable

According to 15.247(a) and 15.215(c), 20dB bandwidth is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.2 Test Setup Block Diagram



8.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 6.9.2, the 20dB bandwidth test method as follows.

- The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level.
- Steps a) through c) might require iteration to adjust within the specified tolerances.
- The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- Set detection mode to peak and trace mode to max hold.
- Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- Determine the “-xx dB down amplitude” using $[(\text{reference value}) - \text{xx}]$. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

Waltek Testing Group (Shenzhen) Co., Ltd.

<http://www.semtest.com.cn>

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

8.4 Summary of Test Results/Plots

Antenna A

Test Mode	Test Channel MHz	20 dB Bandwidth MHz	Result
GFSK	2404	1.112	Pass
	2440	1.117	Pass
	2476	1.109	Pass

Antenna B

Test Mode	Test Channel MHz	20 dB Bandwidth MHz	Result
GFSK	2404	1.119	Pass
	2440	1.126	Pass
	2476	1.118	Pass

Antenna A: GFSK	
Low Channel	Agilent R T Ch Freq 2.404 GHz Trig Free Occupied Bandwidth Center 2.404000000 GHz Ref 29.5 dBm Atten 40 dB #Peak Log 10 dB/ Offset 0.5 dB Center 2.404 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 5 ms (401 pts) Occupied Bandwidth 1.0394 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -102.887 kHz x dB Bandwidth 1.112 MHz Freq/Channel Center Freq 2.40400000 GHz Start Freq 2.40250000 GHz Stop Freq 2.40550000 GHz CF Step 300.000000 kHz Auto Man Freq Offset 0.00000000 Hz Signal Track On Off Scale Type Log Lin
Middle Channel	Agilent R T Ch Freq 2.44 GHz Trig Free Occupied Bandwidth Center 2.440000000 GHz Ref 29.5 dBm Atten 40 dB #Peak Log 10 dB/ Offset 0.5 dB Center 2.44 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 5 ms (401 pts) Occupied Bandwidth 1.0441 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -101.074 kHz x dB Bandwidth 1.117 MHz Freq/Channel Center Freq 2.44000000 GHz Start Freq 2.438500000 GHz Stop Freq 2.441500000 GHz CF Step 300.000000 kHz Auto Man Freq Offset 0.00000000 Hz Signal Track On Off Scale Type Log Lin
High Channel	Agilent R T Ch Freq 2.476 GHz Trig Free Occupied Bandwidth Center 2.476000000 GHz Ref 29.5 dBm Atten 40 dB #Peak Log 10 dB/ Offset 0.5 dB Center 2.476 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 5 ms (401 pts) Occupied Bandwidth 1.0343 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -105.827 kHz x dB Bandwidth 1.109 MHz Freq/Channel Center Freq 2.47600000 GHz Start Freq 2.474500000 GHz Stop Freq 2.477500000 GHz CF Step 300.000000 kHz Auto Man Freq Offset 0.00000000 Hz Signal Track On Off Scale Type Log Lin

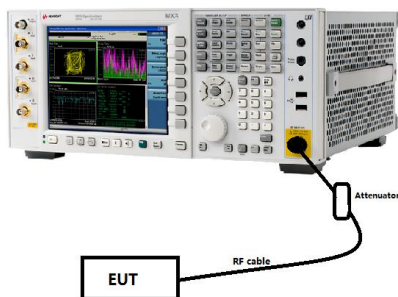
Antenna B: GFSK	
Low Channel	Agilent R T Ch Freq 2.404 GHz Trig Free Occupied Bandwidth Center 2.404000000 GHz Ref 30 dBm Atten 40 dB #Peak Log 10 dB/ Offset 0.5 dB Center 2.404 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 5 ms (401 pts) Occupied Bandwidth 1.0477 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -99.771 kHz x dB Bandwidth 1.119 MHz Freq/Channel Center Freq 2.40400000 GHz Start Freq 2.40250000 GHz Stop Freq 2.40550000 GHz CF Step 300.000000 kHz Auto Man Freq Offset 0.00000000 Hz Signal Track On Off Scale Type Log Lin
Middle Channel	Agilent R T Ch Freq 2.44 GHz Trig Free Occupied Bandwidth Ref Level Offset 0.50 dB Ref 29.5 dBm Atten 40 dB #Peak Log 10 dB/ Offset 0.5 dB Center 2.44 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 5 ms (401 pts) Occupied Bandwidth 1.0517 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -92.881 kHz x dB Bandwidth 1.126 MHz Trace/View 1 2 3 Trace Clear Write Max Hold Min Hold View Blank More 1 of 2
High Channel	Agilent R T Ch Freq 2.476 GHz Trig Free Occupied Bandwidth Ref Level 30.00 dBm Ref 30 dBm Atten 40 dB #Peak Log 10 dB/ Offset 0.5 dB Center 2.476 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 5 ms (401 pts) Occupied Bandwidth 1.0475 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -105.318 kHz x dB Bandwidth 1.118 MHz Amplitude Ref Level 30.00 dBm Attenuation 40.00 dB Auto Man Scale/Div 10.00 dB Scale Type Log Lin Presel Center Presel Adjust 0.00000000 Hz More 1 of 3

9. RF Output Power

9.1 Standard Applicable

According to 15.247(b)(1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

9.2 Test Setup Block Diagram



9.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.5, the output power test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

- a) Use the following spectrum analyzer settings:
 - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - 2) RBW > 20 dB bandwidth of the emission being measured.
 - 3) VBW $\geq$ RBW.
 - 4) Sweep: Auto.
 - 5) Detector function: Peak.
 - 6) Trace: Max hold.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.
- d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
- e) A plot of the test results and setup description shall be included in the test report.

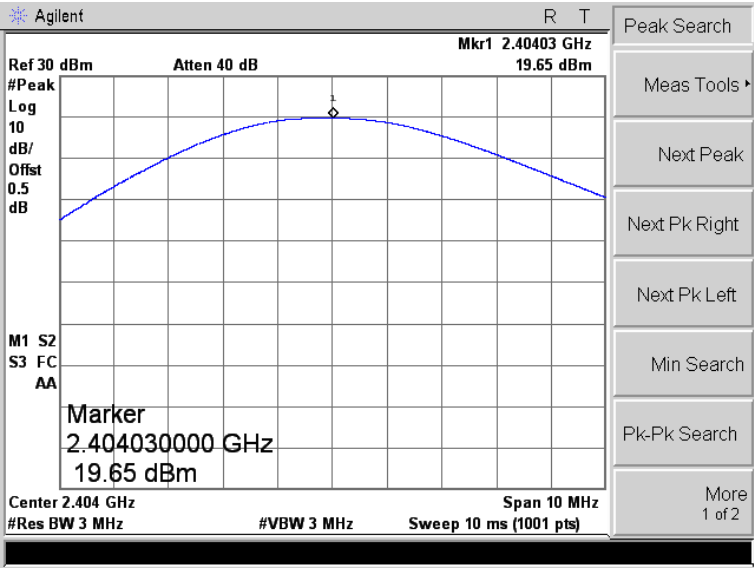
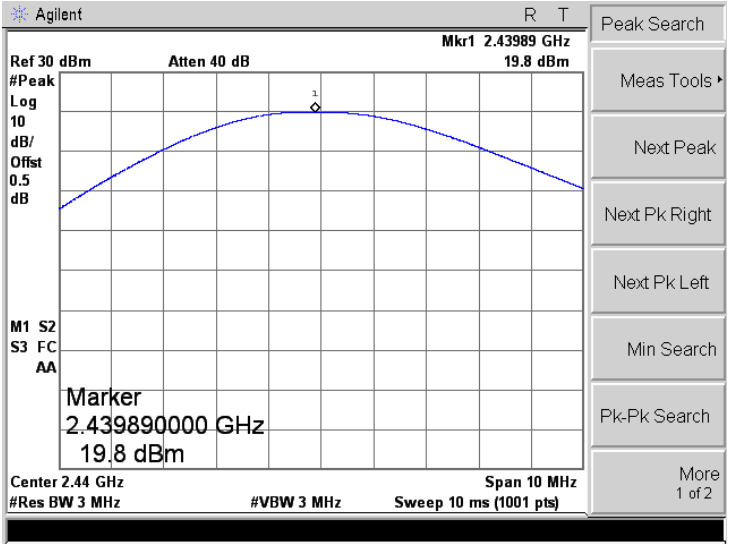
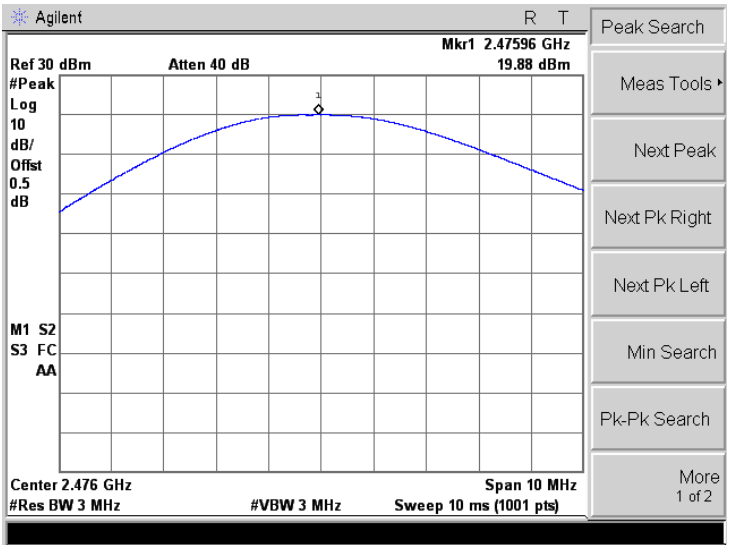
9.4 Summary of Test Results/Plots

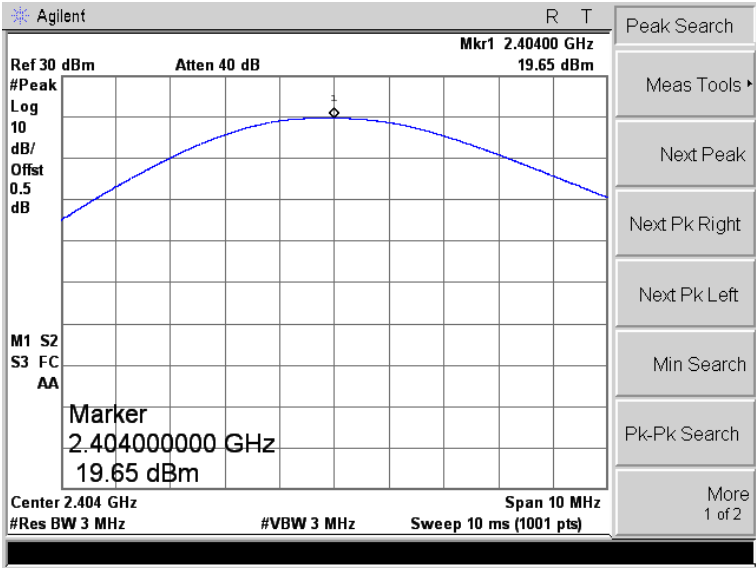
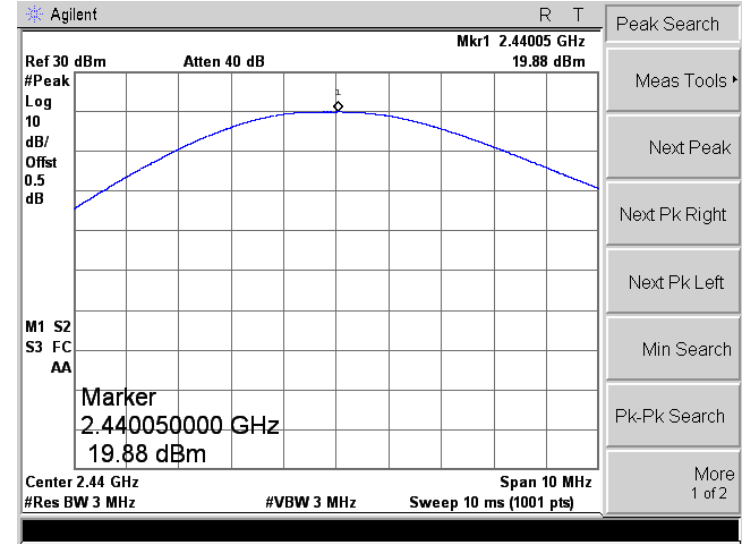
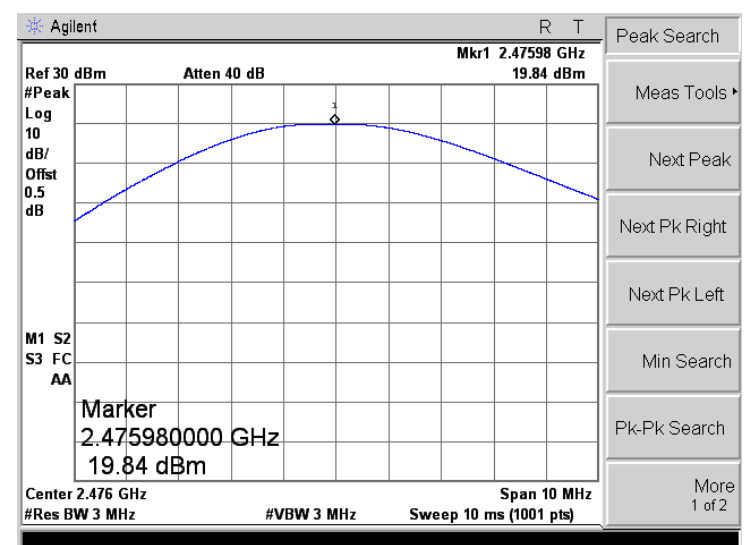
Antenna A

Modulation type	Channel	Output power (dBm)	Output power (mW)	Limit (mW)	Result
GFSK	Low	19.65	92.26	125	Pass
	Middle	19.80	95.50		
	High	19.88	97.27		

Antenna B

Modulation type	Channel	Output power (dBm)	Output power (mW)	Limit (mW)	Result
GFSK	Low	19.65	92.26	125	Pass
	Middle	19.88	97.27		
	High	19.84	96.38		

Antenna A: GFSK	
Low Channel	
Middle Channel	
High Channel	

Antenna B: GFSK	
Low Channel	
Middle Channel	
High Channel	

10. Field Strength of Spurious Emissions

10.1 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).

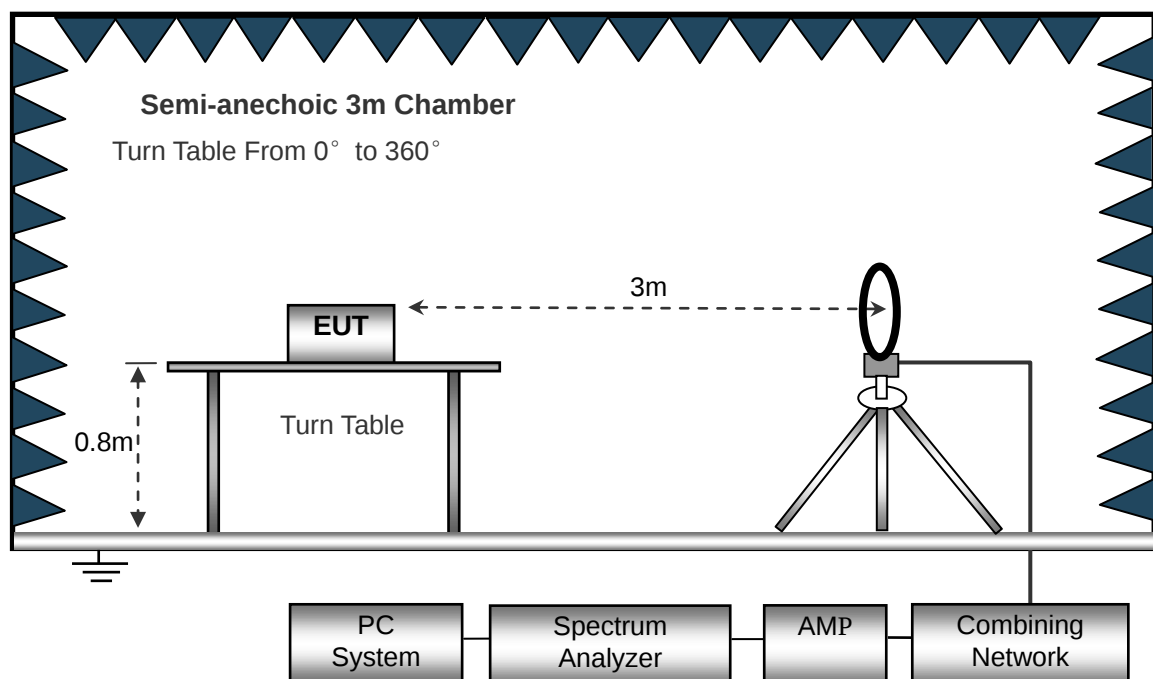
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

10.2 Test Procedure

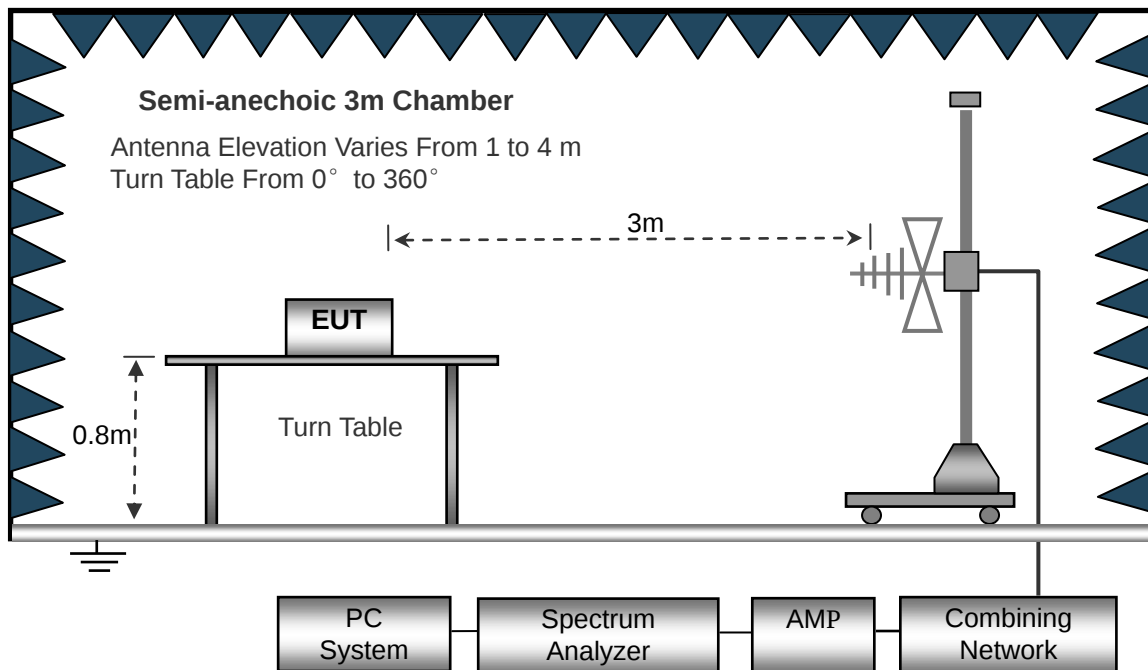
The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.

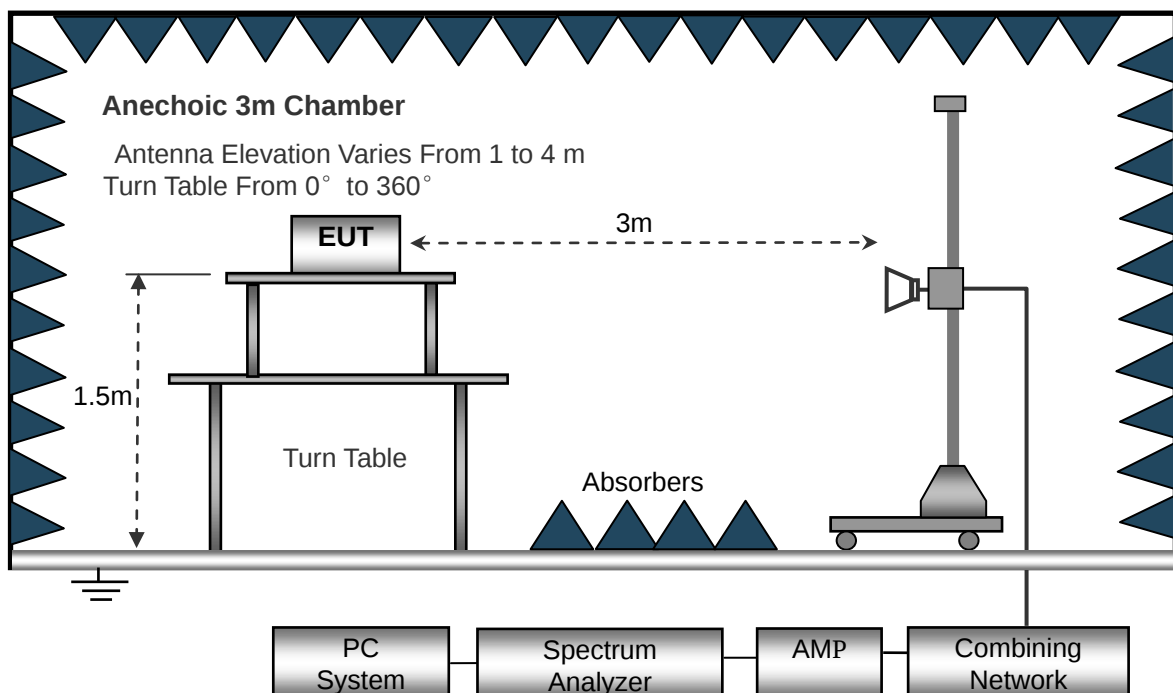
The test setup for emission measurement below 30MHz..



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



The test setup for emission measurement above 1 GHz..



Frequency :9kHz-30MHz

RBW=10KHz,

VBW =30KHz

Sweep time= Auto

Trace = max hold

Detector function = peak

Frequency :30MHz-1GHz

RBW=120KHz,

VBW=300KHz

Sweep time= Auto

Trace = max hold

Detector function = peak, QP

Frequency :Above 1GHz

RBW=1MHz,

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

Sweep time= Auto

Trace = max hold

Detector function = peak, AV

Waltek Testing Group (Shenzhen) Co., Ltd.

<http://www.semtest.com.cn>

10.3 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:

$$\begin{aligned}\text{Corr. Ampl.} &= \text{Indicated Reading} + \text{Correct} \\ \text{Correct} &= \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}\end{aligned}$$

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

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

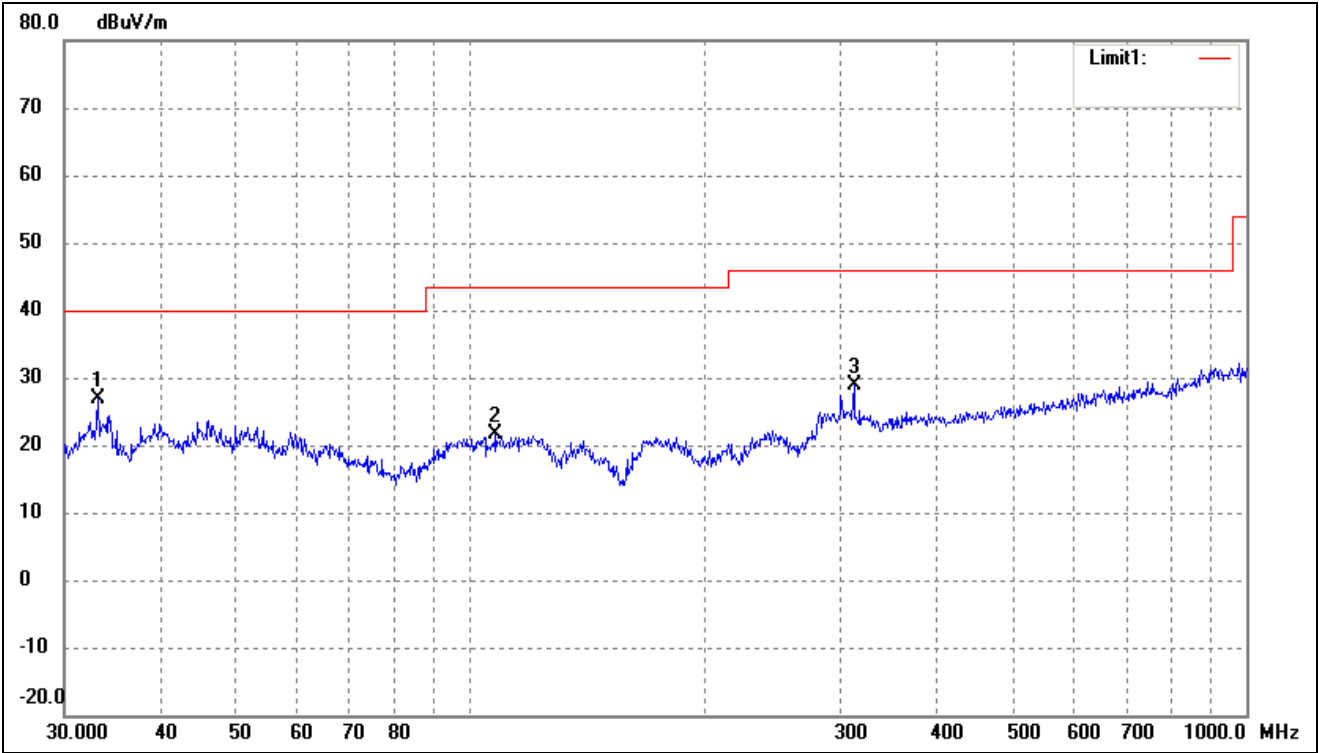
10.4 Summary of Test Results/Plots

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

All test modes (different data rate and different modulation) are performed, but only the worst case (GFSK) is recorded in this report.

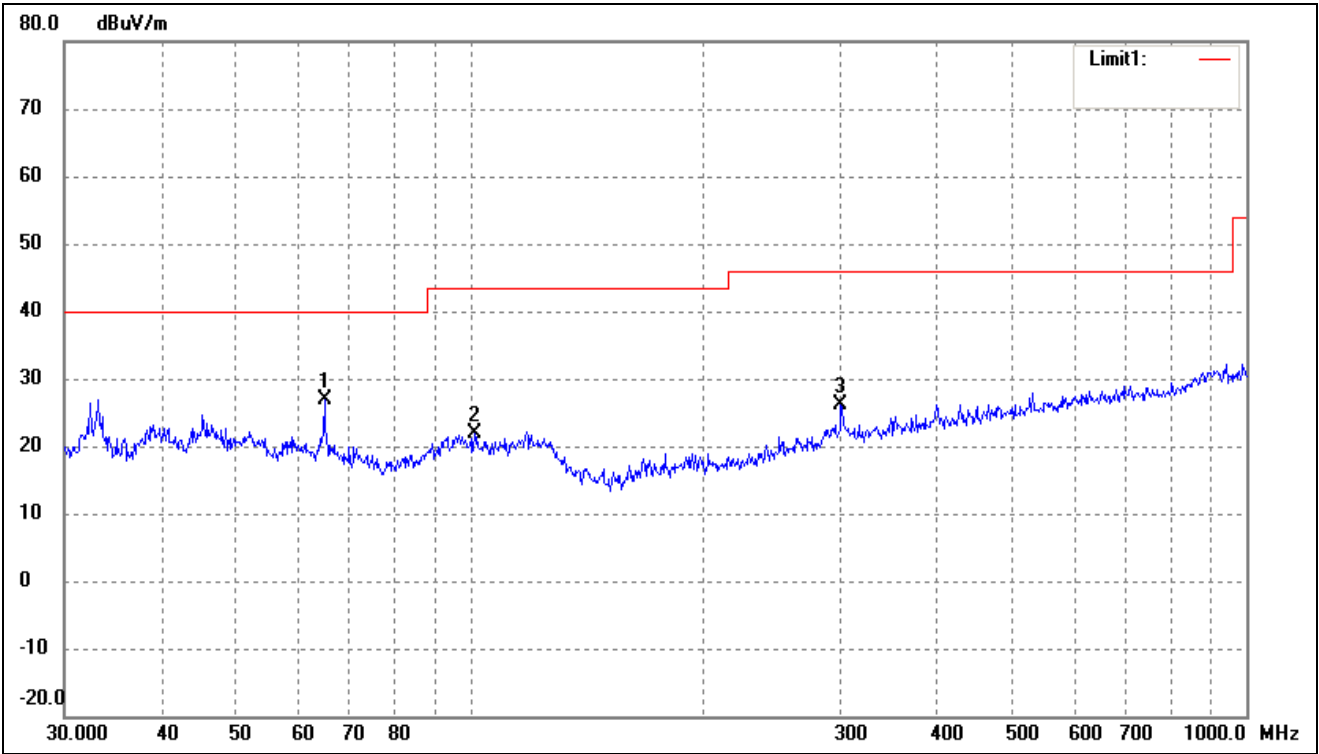
- Spurious Emissions Below 1GHz
- Antenna A

Test Channel	Low Channel	Polarity:	Horizontal
--------------	-------------	-----------	------------



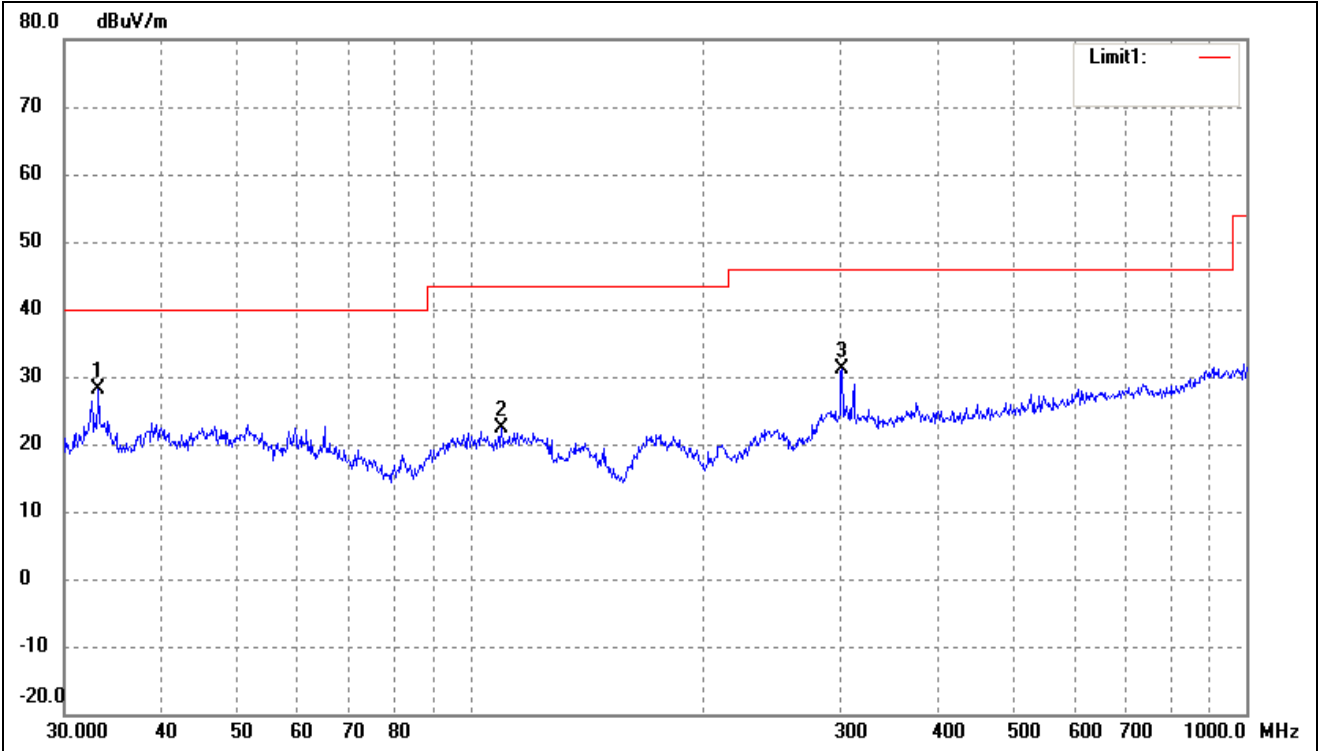
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.0950	40.96	-13.98	26.98	40.00	-13.02	-	-	peak
2	107.8877	35.04	-13.31	21.73	43.50	-21.77	-	-	peak
3	312.1794	37.73	-8.95	28.78	46.00	-17.22	-	-	peak

Test Channel	Low Channel	Polarity:	Vertical
--------------	-------------	-----------	----------



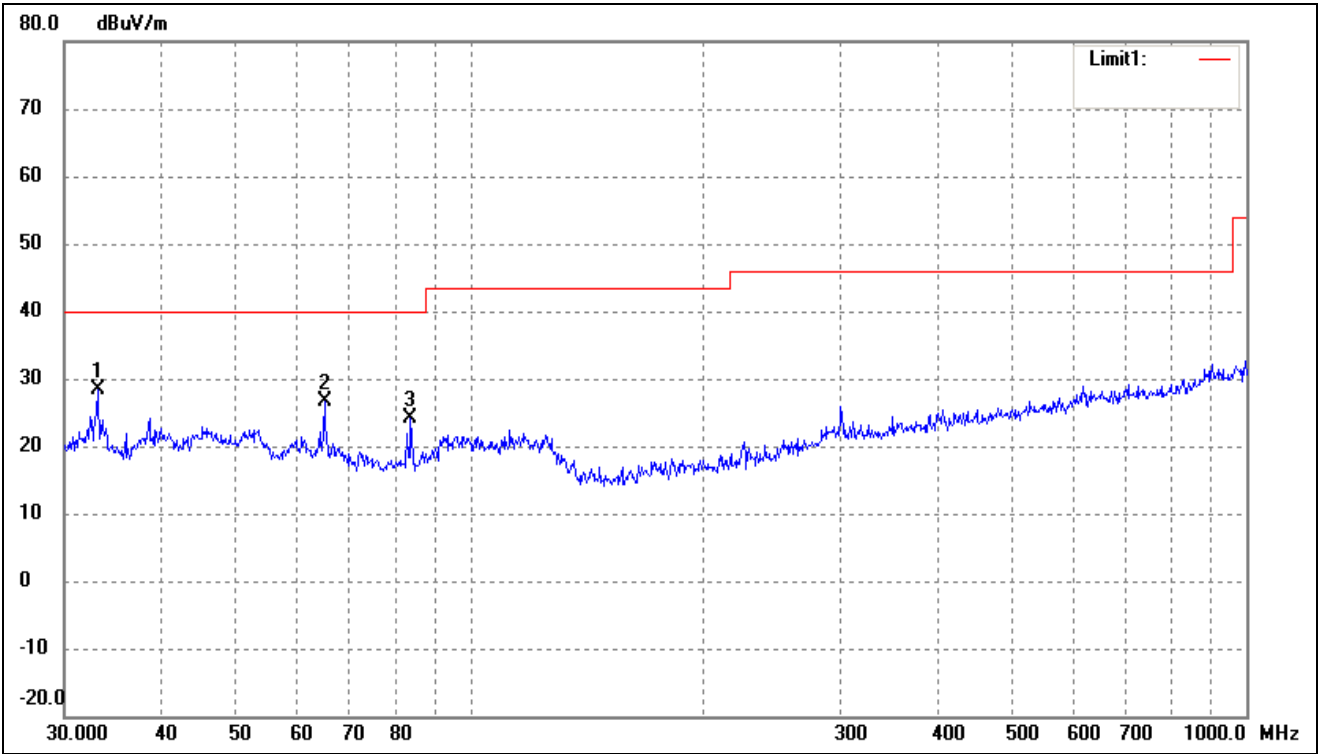
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	()	(cm)	
1	64.8865	40.71	-13.91	26.80	40.00	-13.20	-	-	peak
2	101.2885	35.18	-13.31	21.87	43.50	-21.63	-	-	peak
3	300.3673	35.00	-8.92	26.08	46.00	-19.92	-	-	peak

Test Channel	Middle Channel	Polarity:	Horizontal
--------------	----------------	-----------	------------



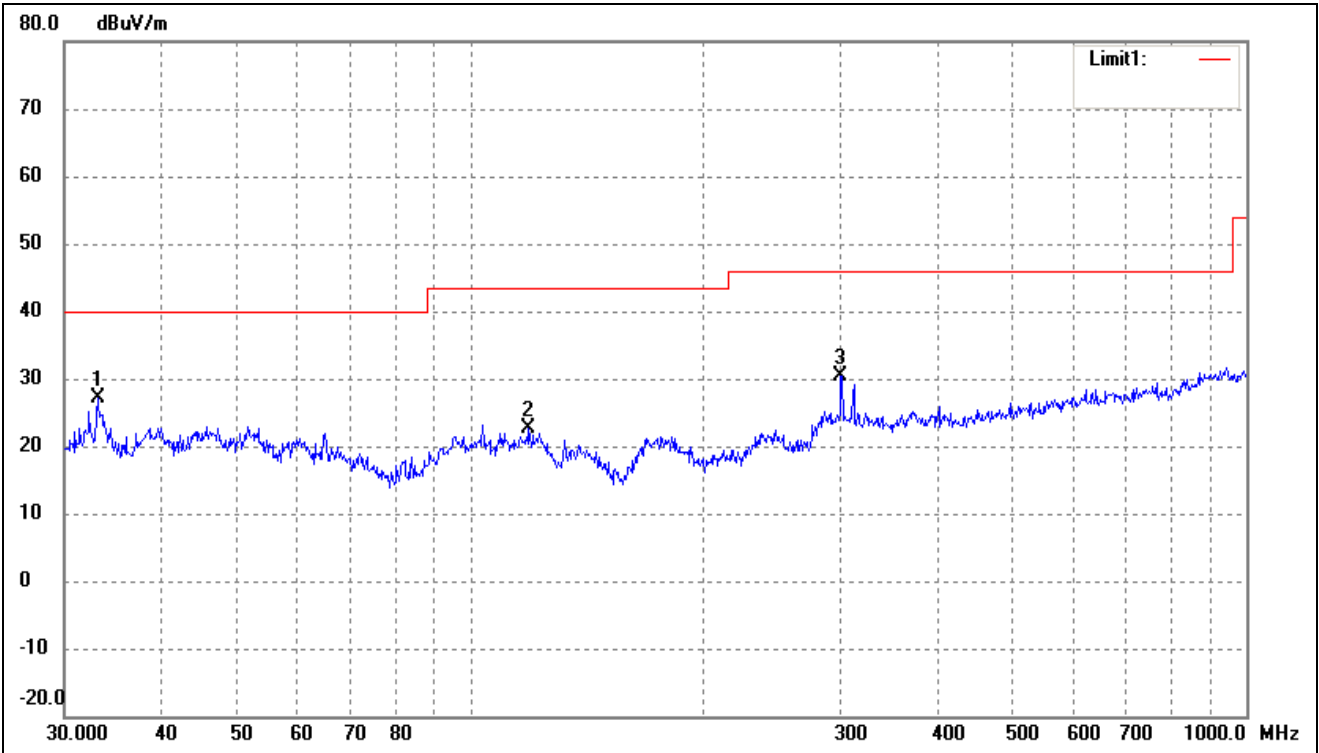
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.2112	42.12	-13.97	28.15	40.00	-11.85	-	-	peak
2	109.7960	35.59	-13.32	22.27	43.50	-21.23	-	-	peak
3	301.4224	40.01	-8.92	31.09	46.00	-14.91	-	-	peak

Test Channel	Middle Channel	Polarity:	Vertical
--------------	----------------	-----------	----------



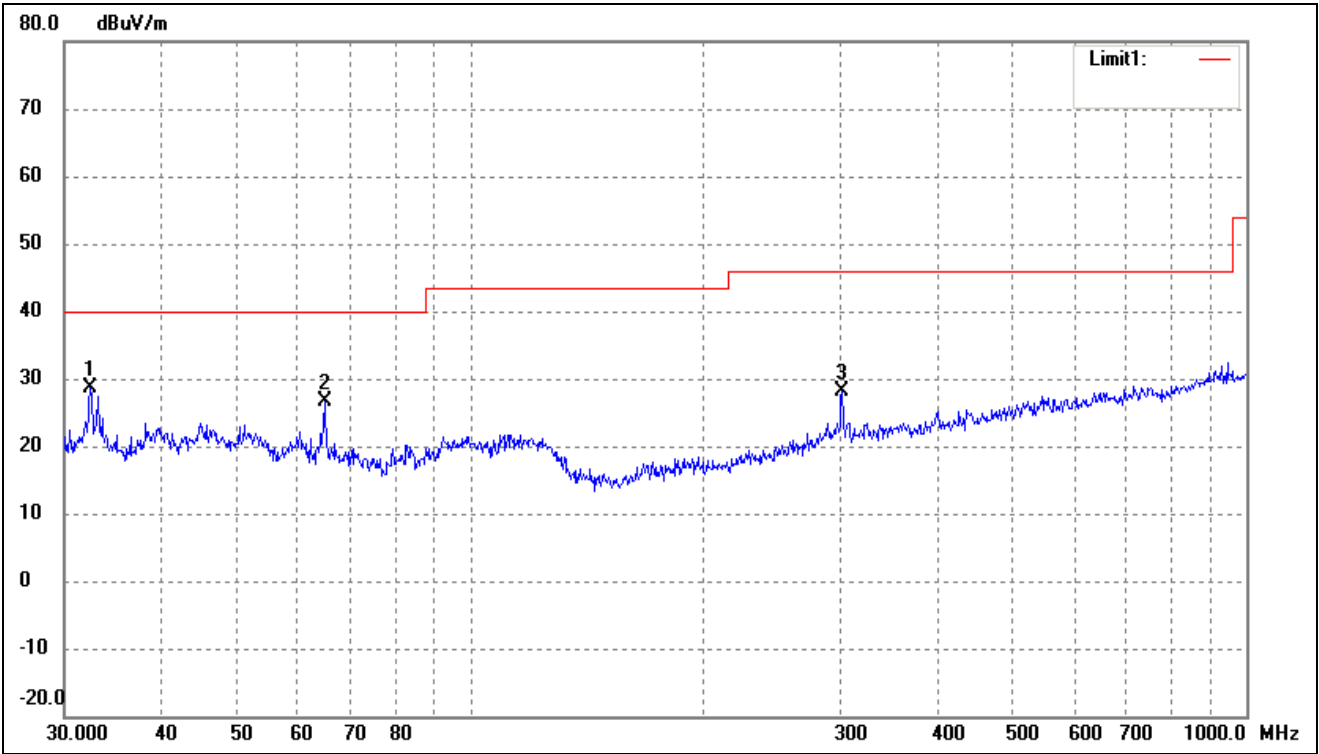
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.0950	42.44	-13.98	28.46	40.00	-11.54	-	-	peak
2	64.8865	40.46	-13.91	26.55	40.00	-13.45	-	-	peak
3	83.8156	40.38	-16.22	24.16	40.00	-15.84	-	-	peak

Test Channel	High Channel	Polarity:	Horizontal
--------------	--------------	-----------	------------



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.0950	41.00	-13.98	27.02	40.00	-12.98	-	-	peak
2	119.0180	36.89	-14.20	22.69	43.50	-20.81	-	-	peak
3	300.3673	39.41	-8.92	30.49	46.00	-15.51	-	-	peak

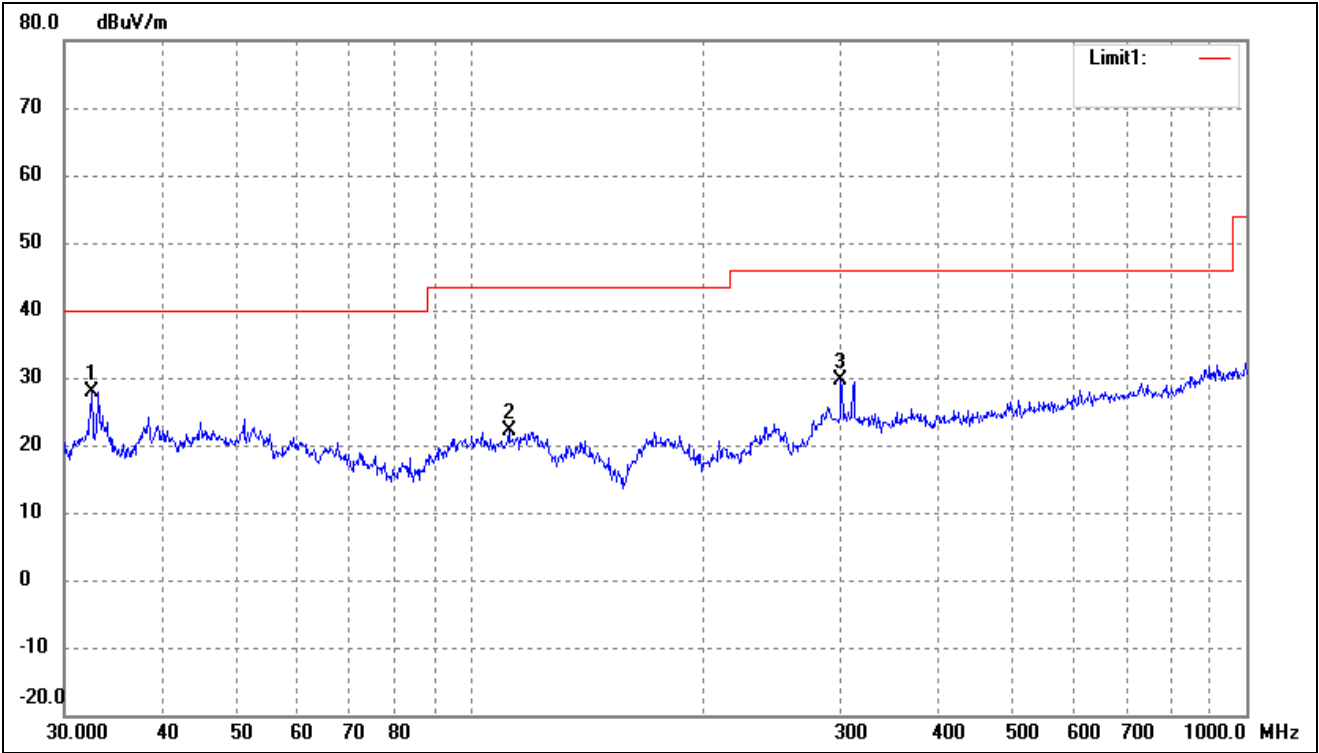
Test Channel	High Channel	Polarity:	Vertical
--------------	--------------	-----------	----------



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	()	(cm)	
1	32.4059	42.57	-14.02	28.55	40.00	-11.45	-	-	peak
2	64.8865	40.43	-13.91	26.52	40.00	-13.48	-	-	peak
3	301.4224	36.99	-8.92	28.07	46.00	-17.93	-	-	peak

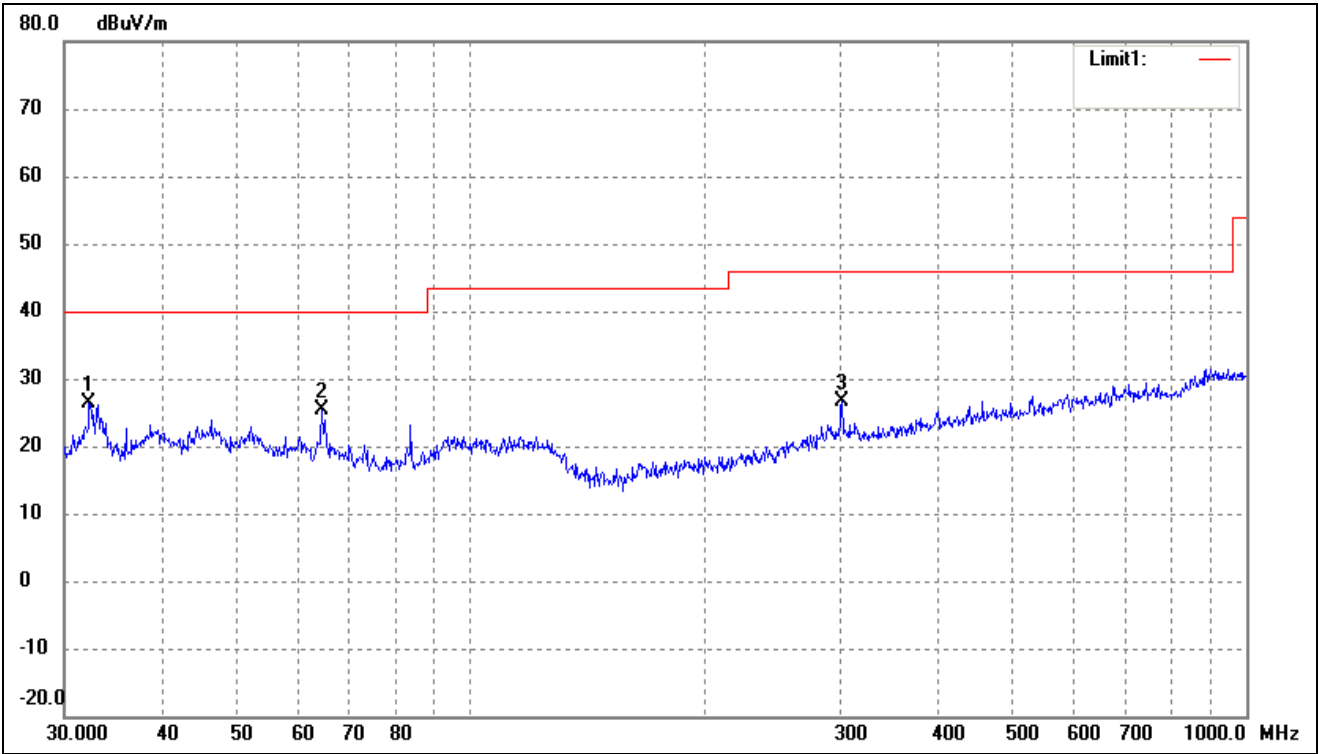
➤ Antenna B

Test Channel	Low Channel	Polarity:	Horizontal
--------------	-------------	-----------	------------



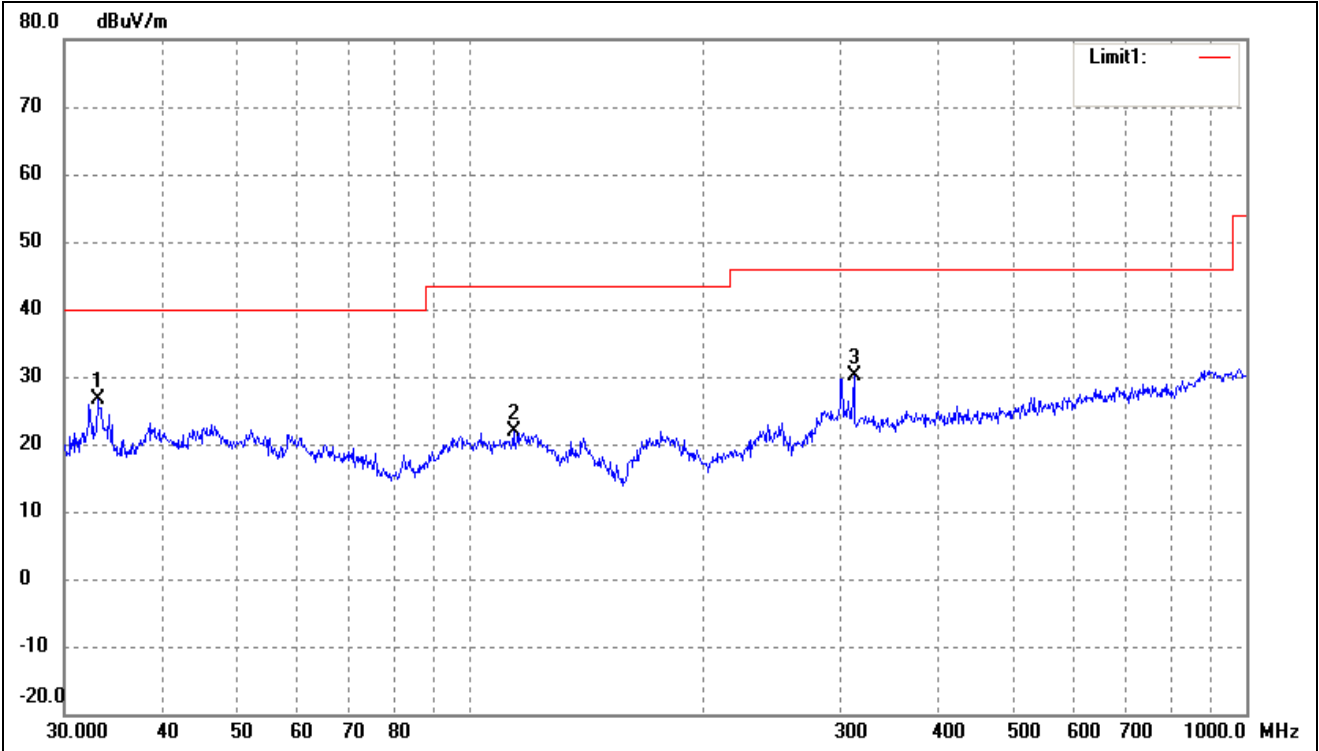
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	()	(cm)	
1	32.5198	41.80	-14.01	27.79	40.00	-12.21	-	-	peak
2	112.1305	35.75	-13.52	22.23	43.50	-21.27	-	-	peak
3	300.3673	38.56	-8.92	29.64	46.00	-16.36	-	-	peak

Test Channel	Low Channel	Polarity:	Vertical
--------------	-------------	-----------	----------



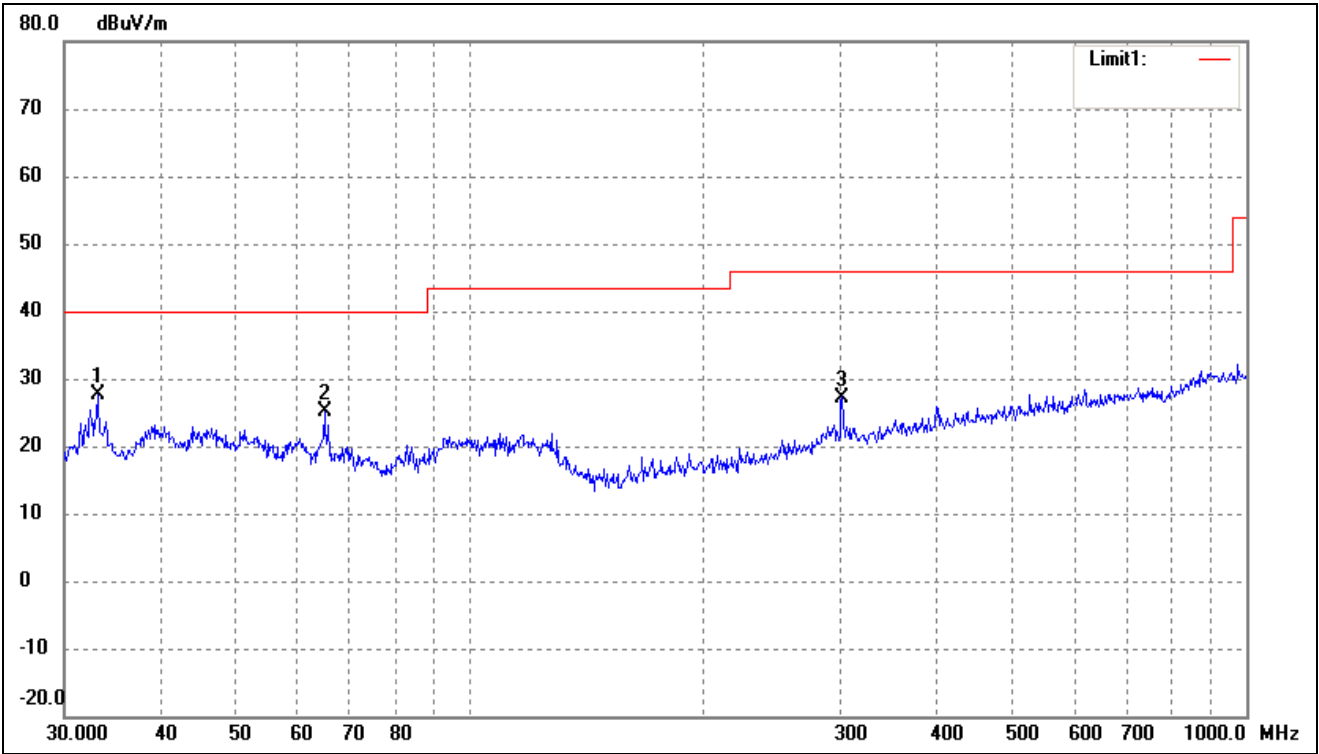
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	32.2925	40.31	-14.03	26.28	40.00	-13.72	-	-	peak
2	64.4331	39.27	-13.82	25.45	40.00	-14.55	-	-	peak
3	301.4224	35.58	-8.92	26.66	46.00	-19.34	-	-	peak

Test Channel	Middle Channel	Polarity:	Horizontal
--------------	----------------	-----------	------------



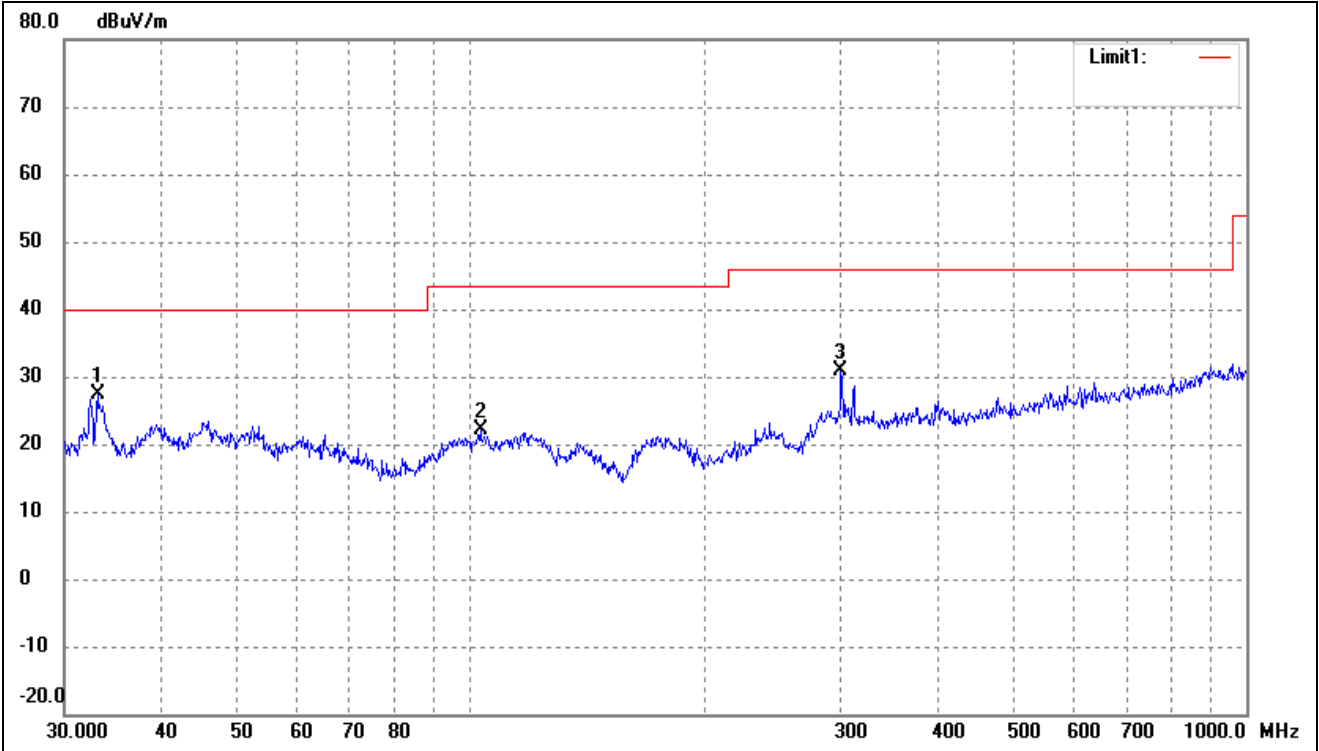
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.0950	40.52	-13.98	26.54	40.00	-13.46	-	-	peak
2	113.7143	35.48	-13.68	21.80	43.50	-21.70	-	-	peak
3	312.1794	38.98	-8.95	30.03	46.00	-15.97	-	-	peak

Test Channel	Middle Channel	Polarity:	Vertical
--------------	----------------	-----------	----------



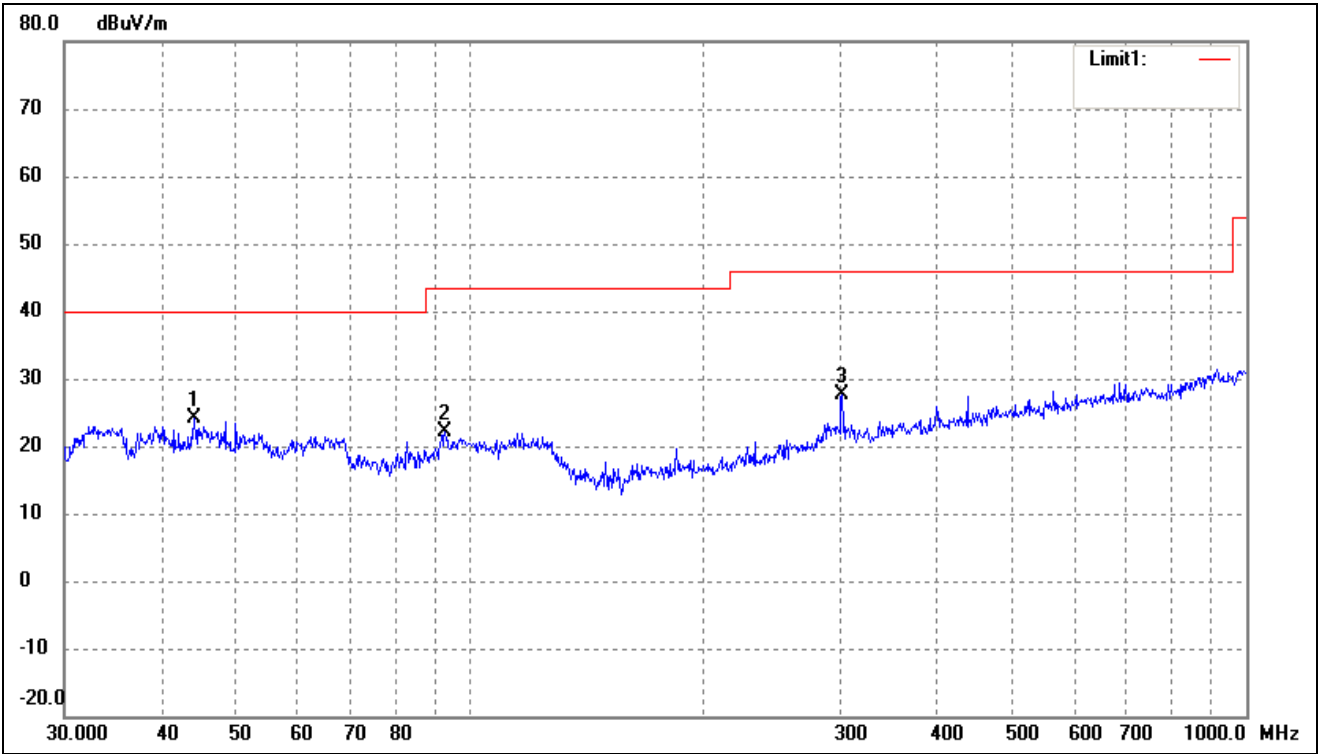
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.0950	41.61	-13.98	27.63	40.00	-12.37	-	-	peak
2	64.8865	39.09	-13.91	25.18	40.00	-14.82	-	-	peak
3	301.4224	36.17	-8.92	27.25	46.00	-18.75	-	-	peak

Test Channel	High Channel	Polarity:	Horizontal
--------------	--------------	-----------	------------



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	()	(cm)	
1	33.0950	41.43	-13.98	27.45	40.00	-12.55	-	-	peak
2	103.0800	35.54	-13.32	22.22	43.50	-21.28	-	-	peak
3	300.3673	39.78	-8.92	30.86	46.00	-15.14	-	-	peak

Test Channel	High Channel	Polarity:	Vertical
--------------	--------------	-----------	----------



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	44.1202	35.95	-11.84	24.11	40.00	-15.89	-	-	peak
2	92.7872	36.76	-14.51	22.25	43.50	-21.25	-	-	peak
3	301.4224	36.45	-8.92	27.53	46.00	-18.47	-	-	peak

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

- Spurious Emissions Above 1GHz
- Antenna A

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2404MHz							
4808	66.30	-4.51	61.79	74.00	-12.21	H	PK
4808	50.74	-4.51	46.23	54.00	-7.77	H	AV
7212	49.66	-2.20	47.46	74.00	-26.54	H	PK
7212	38.22	-2.20	36.02	54.00	-17.98	H	AV
4808	61.45	-4.51	56.94	74.00	-17.06	V	PK
4808	46.17	-4.51	41.66	54.00	-12.34	V	AV
7212	49.63	-2.20	47.43	74.00	-26.57	V	PK
7212	38.09	-2.20	35.89	54.00	-18.11	V	AV
Middle Channel-2440MHz							
4880	56.14	-4.47	51.67	74.00	-22.33	H	PK
4880	42.82	-4.47	38.35	54.00	-15.65	H	AV
7320	37.11	-2.17	34.94	54.00	-19.06	H	PK
7320	48.03	-2.17	45.86	74.00	-28.14	H	AV
4880	63.40	-4.47	58.93	74.00	-15.07	V	PK
4880	47.80	-4.47	43.33	54.00	-10.67	V	AV
7320	37.02	-2.17	34.85	54.00	-19.15	V	PK
7320	48.40	-2.17	46.23	74.00	-27.77	V	AV
High Channel-2476MHz							
4952	62.24	-4.41	57.83	74.00	-16.17	H	PK
4952	46.93	-4.41	42.52	54.00	-11.48	H	AV
7428	48.55	-2.14	46.41	74.00	-27.59	H	PK
7428	37.84	-2.14	35.70	54.00	-18.30	H	AV
4952	56.23	-4.41	51.82	74.00	-22.18	V	PK
4952	42.35	-4.41	37.94	54.00	-16.06	V	AV
7428	49.05	-2.14	46.91	74.00	-27.09	V	PK
7428	37.90	-2.14	35.76	54.00	-18.24	V	AV

➤ Antenna B

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2404MHz							
4808	68.40	-4.51	63.89	74.00	-10.11	H	PK
4808	52.38	-4.51	47.87	54.00	-6.13	H	AV
7212	49.54	-2.20	47.34	74.00	-26.66	H	PK
7212	38.39	-2.20	36.19	54.00	-17.81	H	AV
4808	64.13	-4.51	59.62	74.00	-14.38	V	PK
4808	48.82	-4.51	44.31	54.00	-9.69	V	AV
7212	39.04	-2.20	36.84	54.00	-17.16	V	PK
7212	49.28	-2.20	47.08	74.00	-26.92	V	AV
Middle Channel-2440MHz							
4880	68.18	-4.47	63.71	74.00	-10.29	H	PK
4880	51.82	-4.47	47.35	54.00	-6.65	H	AV
7320	37.22	-2.17	35.05	54.00	-18.95	H	PK
7320	48.61	-2.17	46.44	74.00	-27.56	H	AV
4880	70.43	-4.47	65.96	74.00	-8.04	V	PK
4880	54.36	-4.47	49.89	54.00	-4.11	V	AV
7320	48.70	-2.17	46.53	74.00	-27.47	V	PK
7320	36.77	-2.17	34.60	54.00	-19.40	V	AV
High Channel-2476MHz							
4952	74.54	-4.41	70.13	74.00	-3.87	H	PK
4952	57.90	-4.41	53.49	54.00	-0.51	H	AV
7428	51.61	-2.14	49.47	74.00	-24.53	H	PK
7428	37.87	-2.14	35.73	54.00	-18.27	H	AV
4952	70.23	-4.41	65.82	74.00	-8.18	V	PK
4952	53.56	-4.41	49.15	54.00	-4.85	V	AV
7428	49.52	-2.14	47.38	74.00	-26.62	V	PK
7428	37.91	-2.14	35.77	54.00	-18.23	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.

11. Out of Band Emissions

11.1 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).

11.2 Test Procedure

According to ANSI C63.10-2013 section 7.8.6, the Band-edge measurements for RF conducted emissions test method as follows.

- a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).
- b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).
- c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.
- d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.
- e) Perform the test as follows:
 - 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
 - 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW/RBW})]$ below the reference level. Specific guidance is given in 4.1.5.2.
 - 3) Attenuation: Auto (at least 10 dB preferred).
 - 4) Sweep time: Coupled.
 - 5) Resolution bandwidth: 100 kHz.
 - 6) Video bandwidth: 300 kHz.
 - 7) Detector: Peak.
 - 8) Trace: Max hold.
- f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

- g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- h) Repeat step c) through step e) for every applicable modulation.
- i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).
- j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Restricted-band band-edge test method please refers to ANSI C63.10-2013 section 6.10.5. The 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 band-edge measurements.

According to ANSI C63.10-2013 section 7.8.8, Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

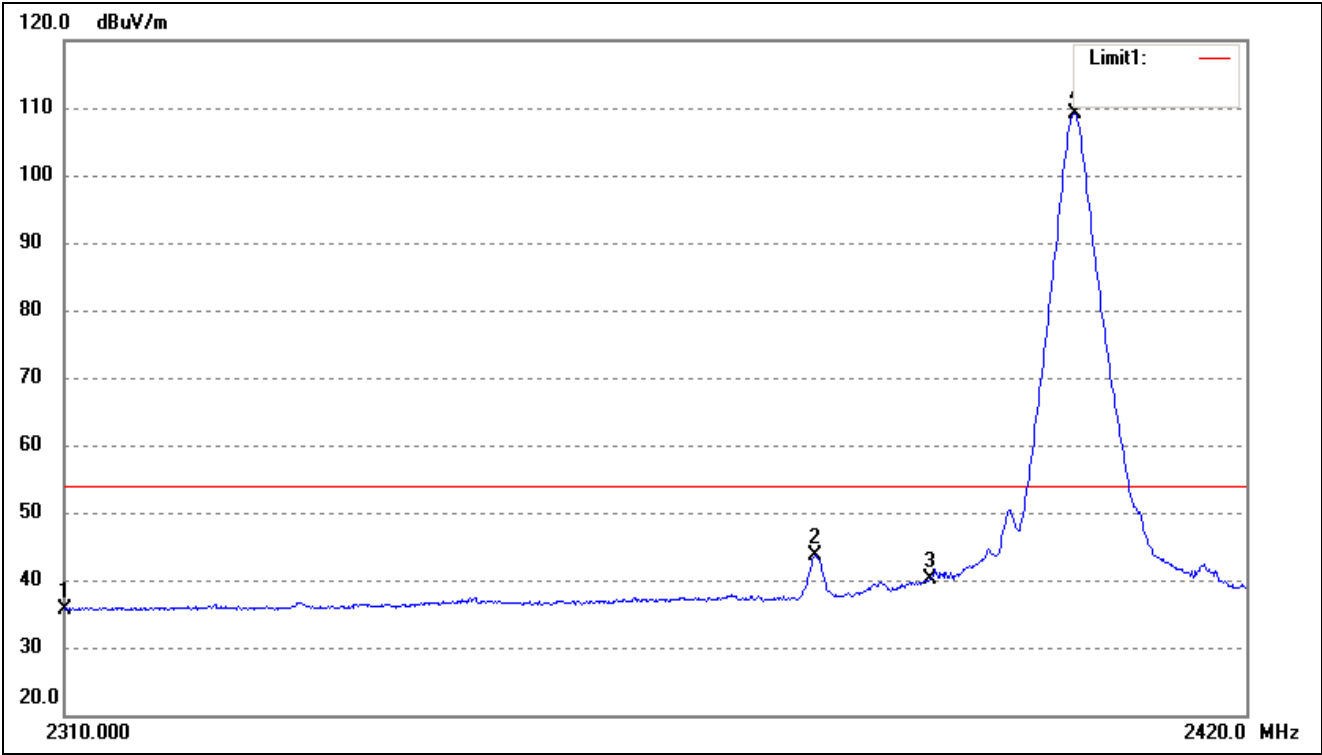
Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

11.3 Summary of Test Results/Plots

Note: All test modes (different data rate and different modulation) are performed, but only the worst case (GFSK) is recorded in this report.

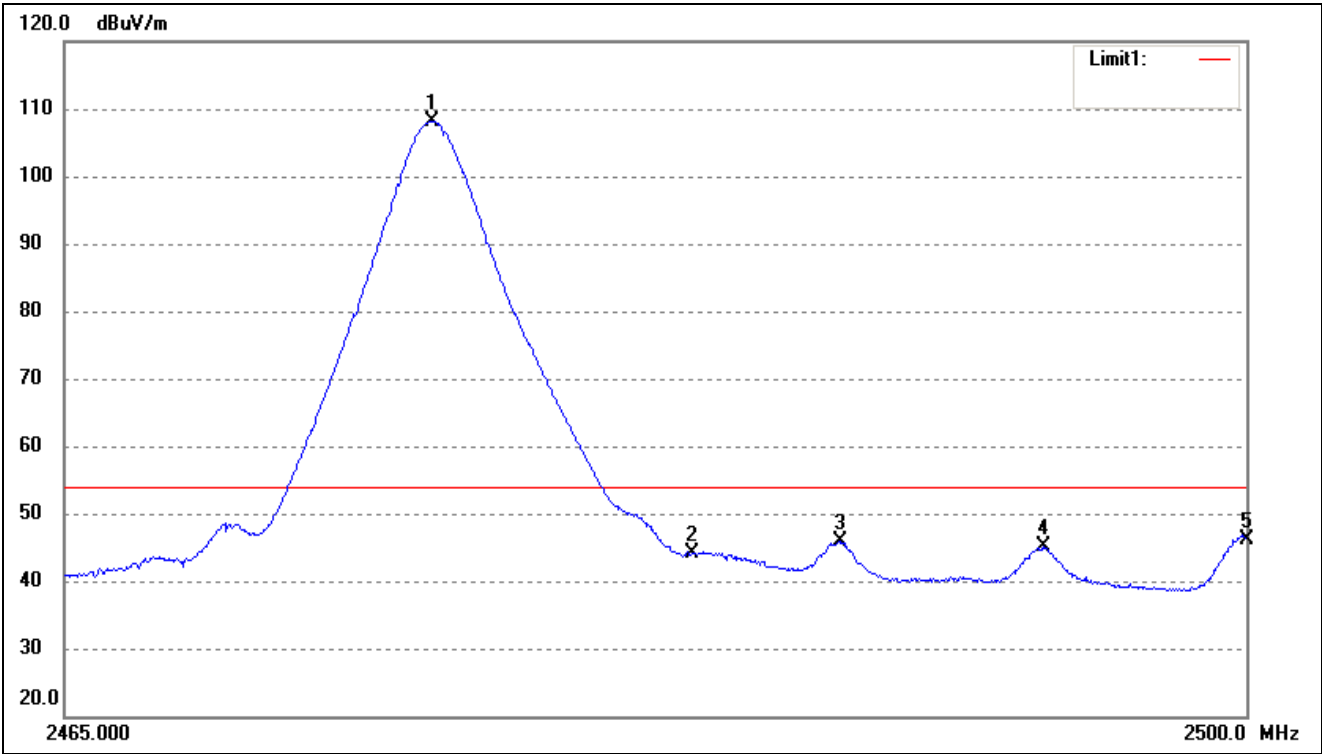
➤ Antenna A

Test Channel	Low	Polarity:	Horizontal (worst case)
--------------	-----	-----------	-------------------------



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	45.29	-9.66	35.63	54.00	-18.37	Average Detector
	2310.000	57.33	-9.66	47.67	74.00	-26.33	Peak Detector
2	2379.256	53.08	-9.52	43.56	54.00	-10.44	Average Detector
	2379.366	65.99	-9.52	56.47	74.00	-17.53	Peak Detector
3	2390.000	49.61	-9.50	40.11	54.00	-13.89	Average Detector
	2390.000	61.50	-9.50	52.00	74.00	-22.00	Peak Detector
4	2403.731	118.60	-9.48	109.12	/	/	Average Detector
	2403.284	122.19	-9.47	112.72	/	/	Peak Detector

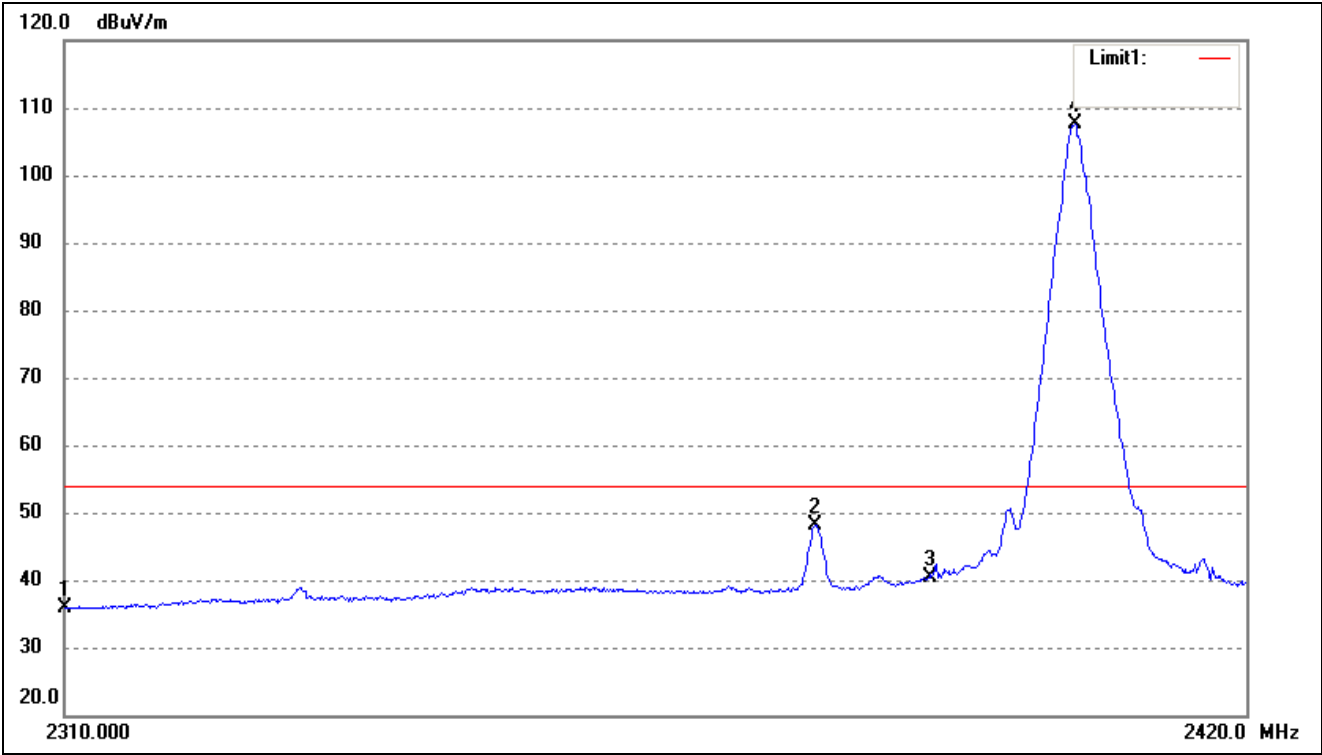
Test Channel	High	Polarity:	Horizontal (worst case)
--------------	------	-----------	-------------------------



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2475.832	117.48	-9.33	108.15	/	/	Average Detector
	2476.077	120.05	-9.33	110.72	/	/	Peak Detector
2	2483.500	53.55	-9.31	44.24	54.00	-9.76	Average Detector
	2483.500	64.69	-9.31	55.38	74.00	-18.62	Peak Detector
3	2487.904	55.17	-9.30	45.87	54.00	-8.13	Average Detector
	2487.834	65.24	-9.30	55.94	74.00	-18.06	Peak Detector
4	2493.945	54.33	-9.29	45.04	54.00	-8.96	Average Detector
	2493.593	64.20	-9.29	54.91	74.00	-19.09	Peak Detector
5	2500.000	55.38	-9.28	46.10	54.00	-7.90	Average Detector
	2500.000	64.33	-9.28	55.05	74.00	-18.95	Peak Detector

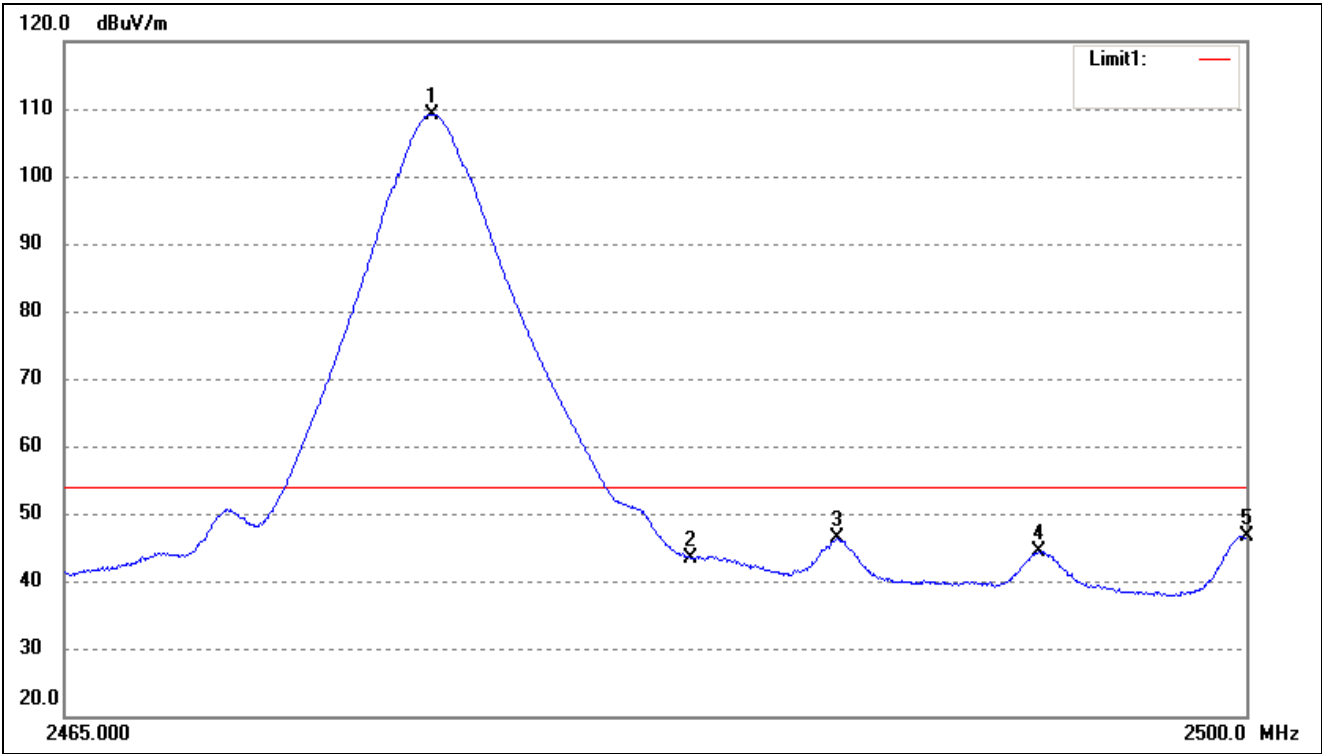
➤ Antenna B

Test Channel	Low	Polarity:	Horizontal (worst case)
--------------	-----	-----------	-------------------------

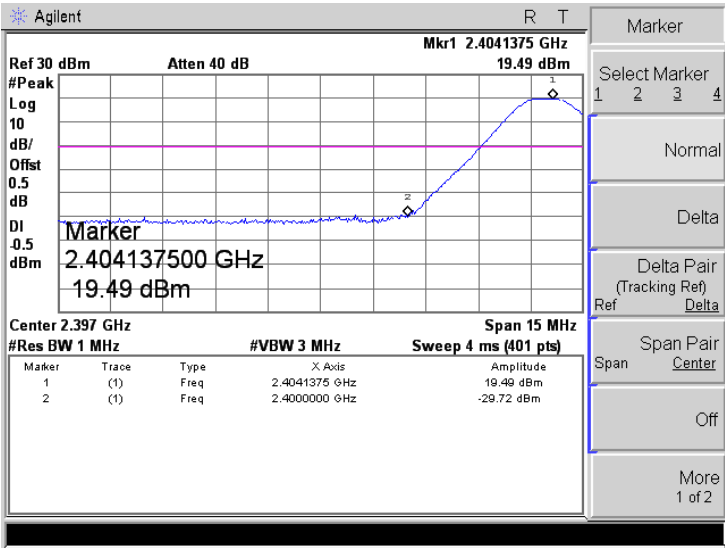
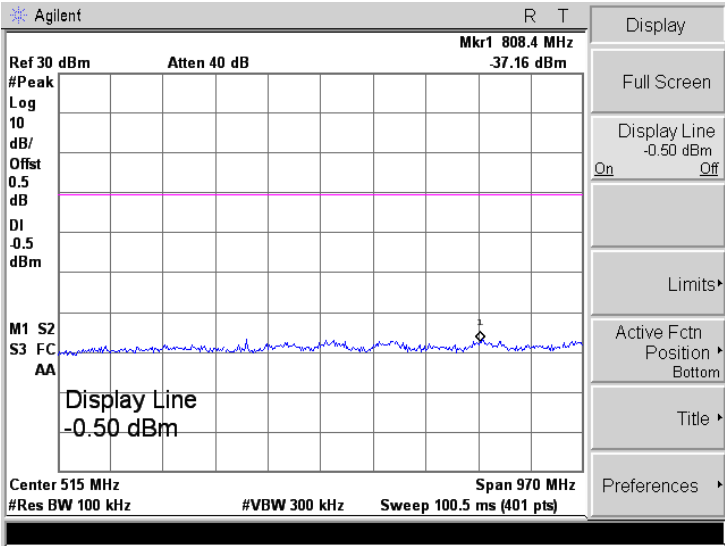
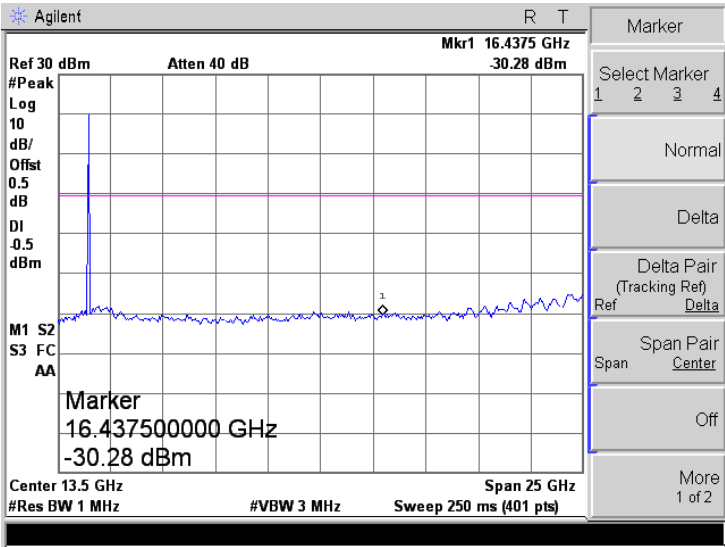


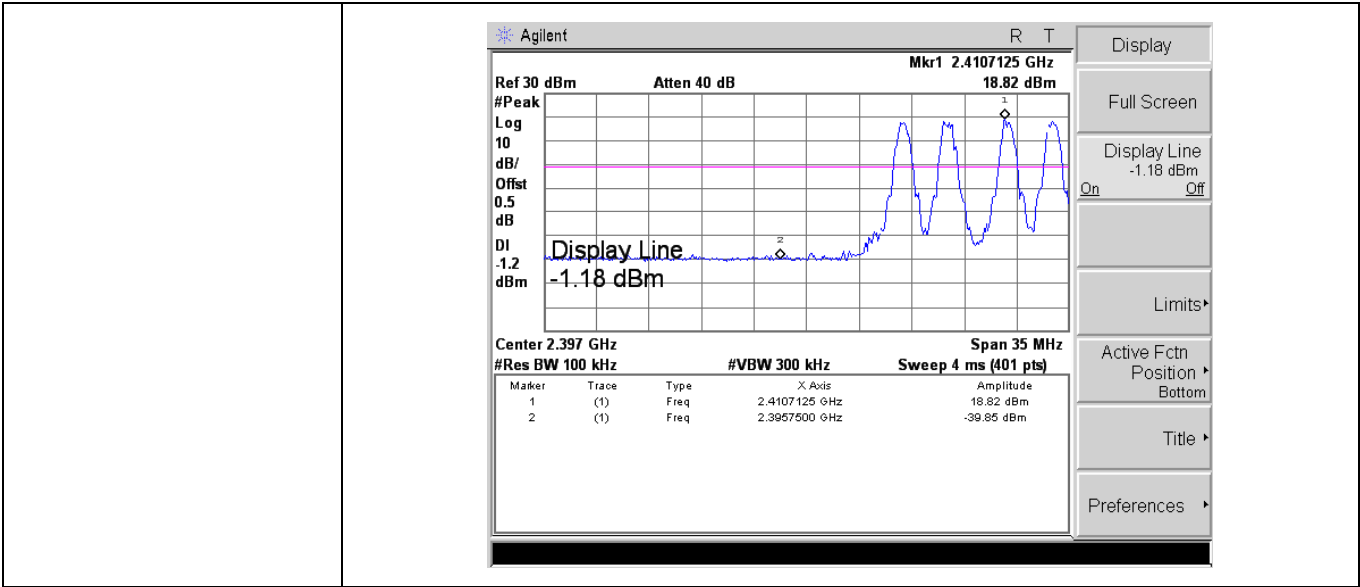
No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	45.57	-9.66	35.91	54.00	-18.09	Average Detector
	2310.000	58.06	-9.66	48.40	74.00	-25.60	Peak Detector
2	2379.256	57.70	-9.52	48.18	54.00	-5.82	Average Detector
	2379.366	67.63	-9.52	58.11	74.00	-15.89	Peak Detector
3	2390.000	49.95	-9.50	40.45	54.00	-13.55	Average Detector
	2390.000	62.27	-9.50	52.77	74.00	-21.23	Peak Detector
4	2403.731	117.00	-9.48	107.52	/	/	Average Detector
	2403.619	120.68	-9.48	111.20	/	/	Peak Detector

Test Channel	High	Polarity:	Horizontal (worst case)
--------------	------	-----------	-------------------------

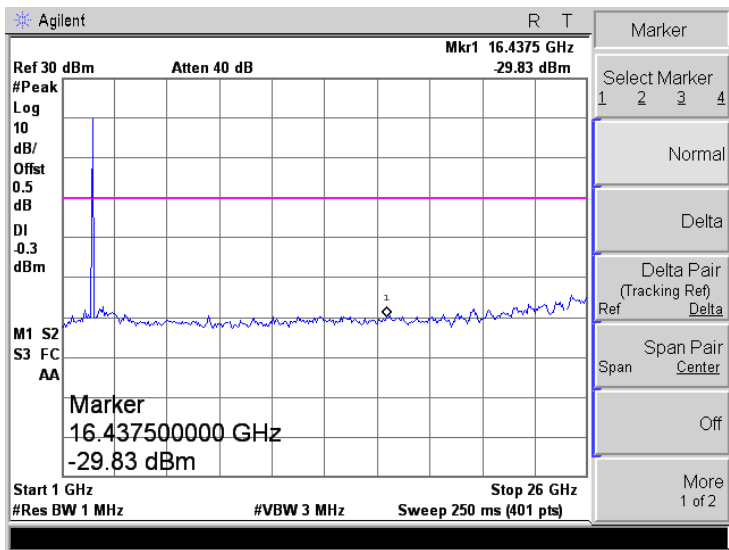
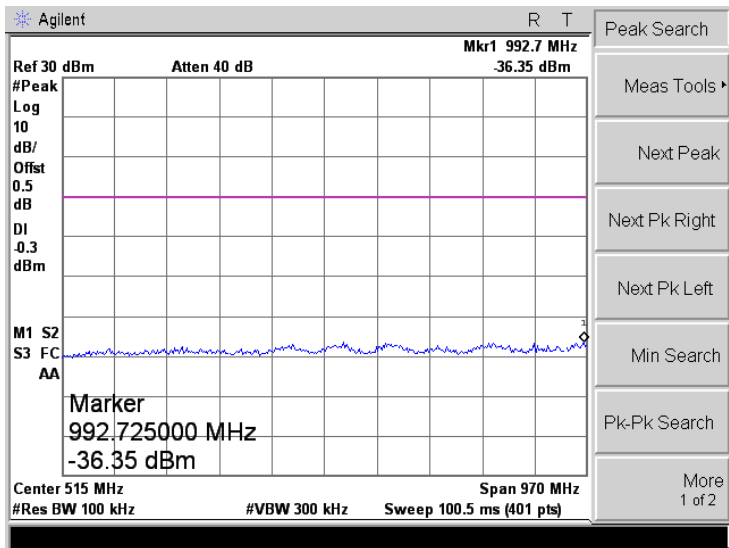
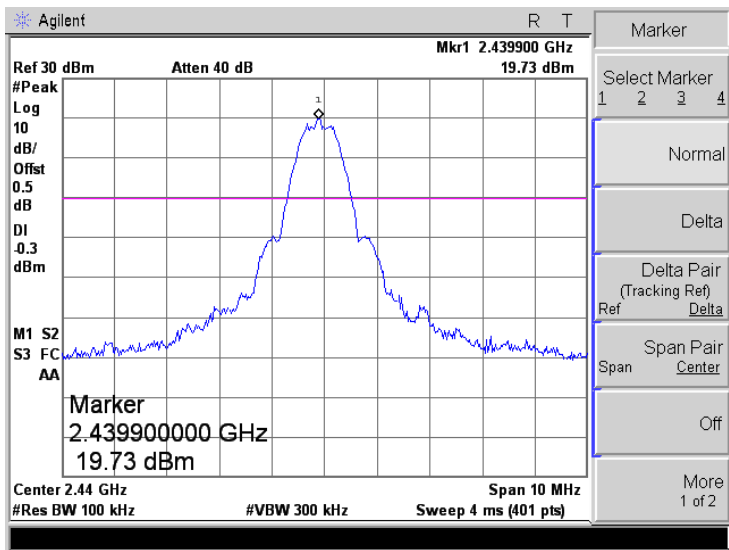


No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2475.832	118.51	-9.33	109.18	/	/	Average Detector
	2475.832	121.68	-9.33	112.35	/	/	Peak Detector
2	2483.500	52.77	-9.31	43.46	54.00	-10.54	Average Detector
	2483.500	64.50	-9.31	55.19	74.00	-18.81	Peak Detector
3	2487.834	55.61	-9.30	46.31	54.00	-7.69	Average Detector
	2487.694	64.29	-9.30	54.99	74.00	-19.01	Peak Detector
4	2493.804	53.76	-9.29	44.47	54.00	-9.53	Average Detector
	2494.086	62.99	-9.29	53.70	74.00	-20.30	Peak Detector
5	2500.000	55.81	-9.28	46.53	54.00	-7.47	Average Detector
	2500.000	64.05	-9.28	54.77	74.00	-19.23	Peak Detector

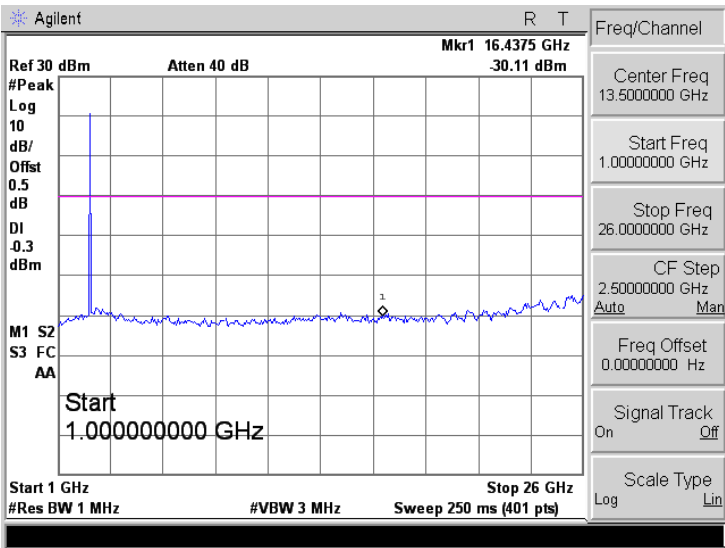
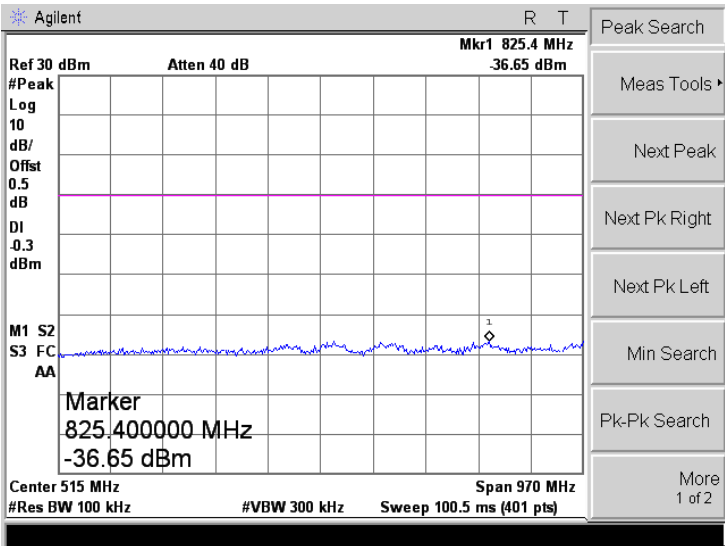
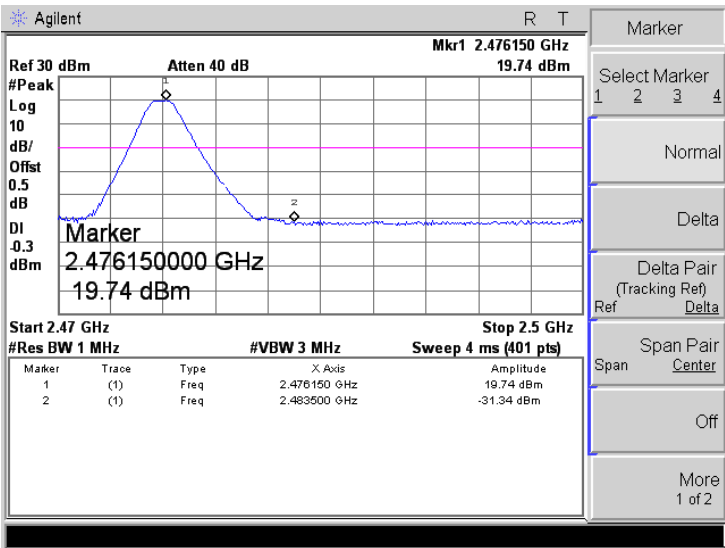
Antenna A	
Low channel	
	
	

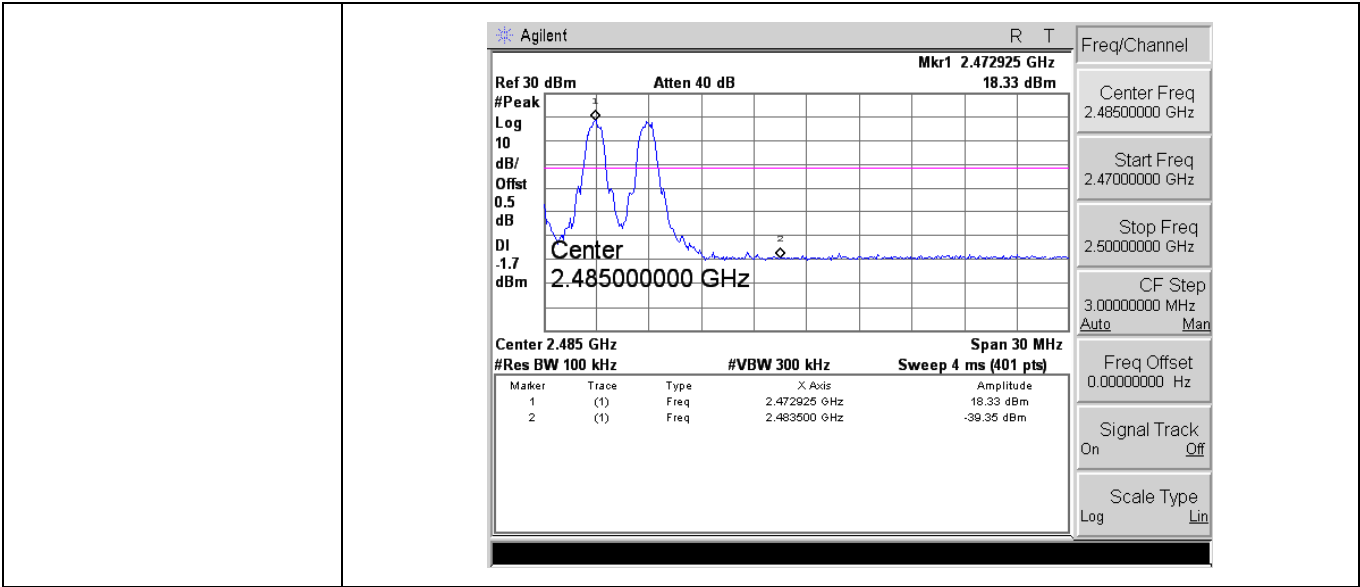


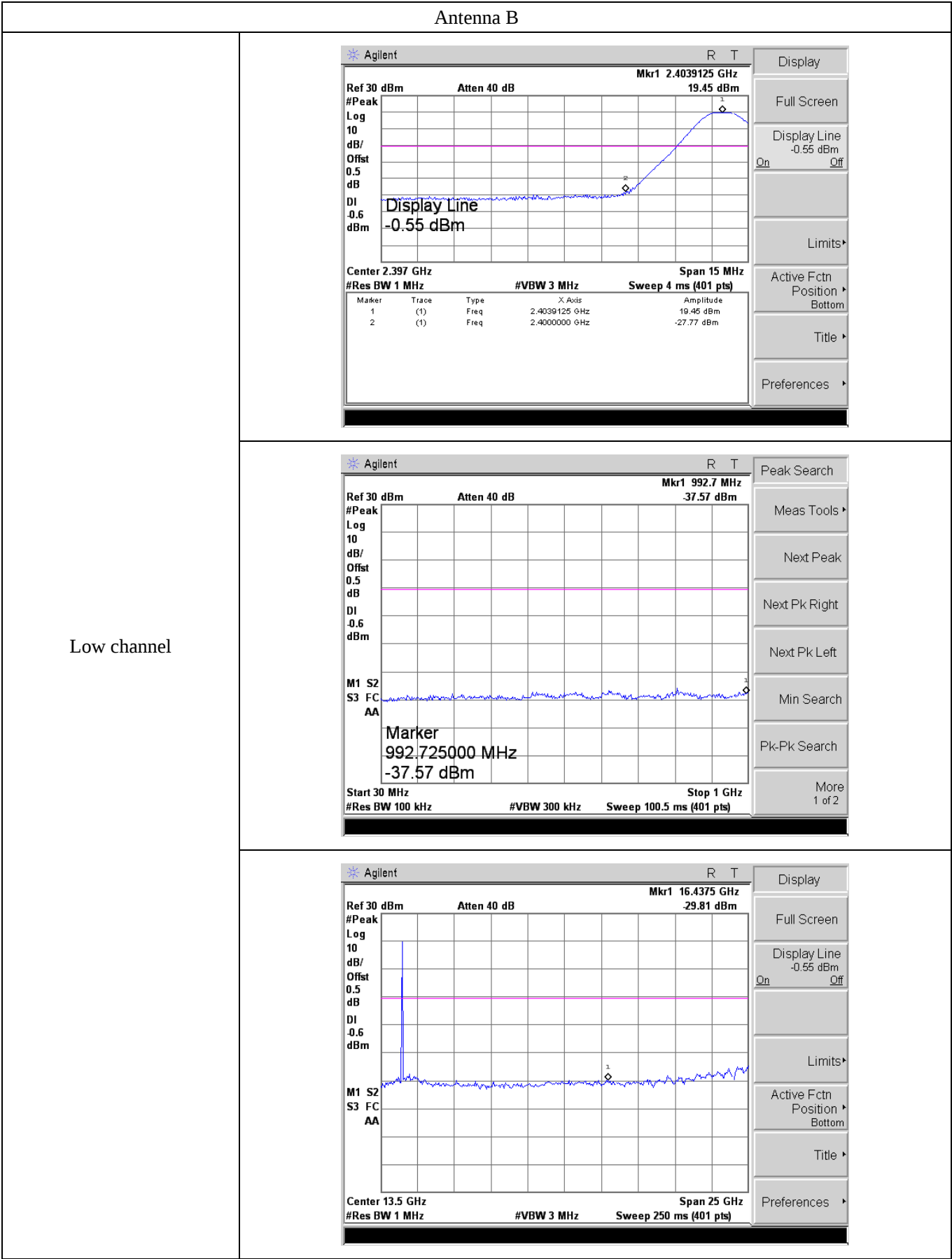
Middle channel

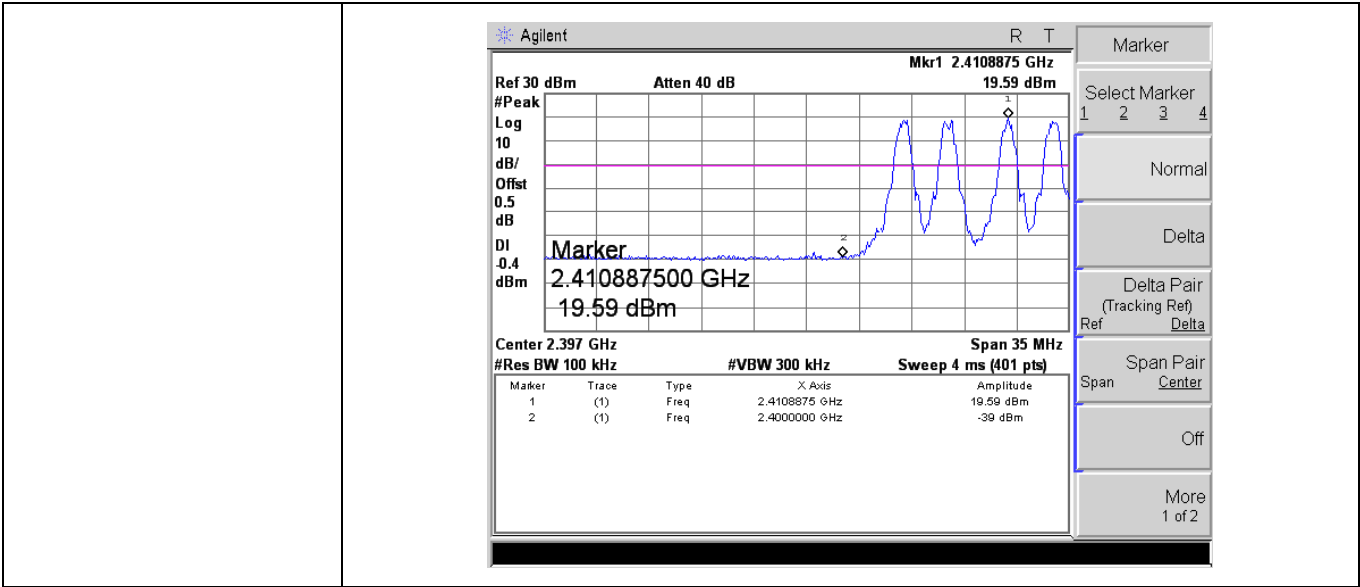


High channel

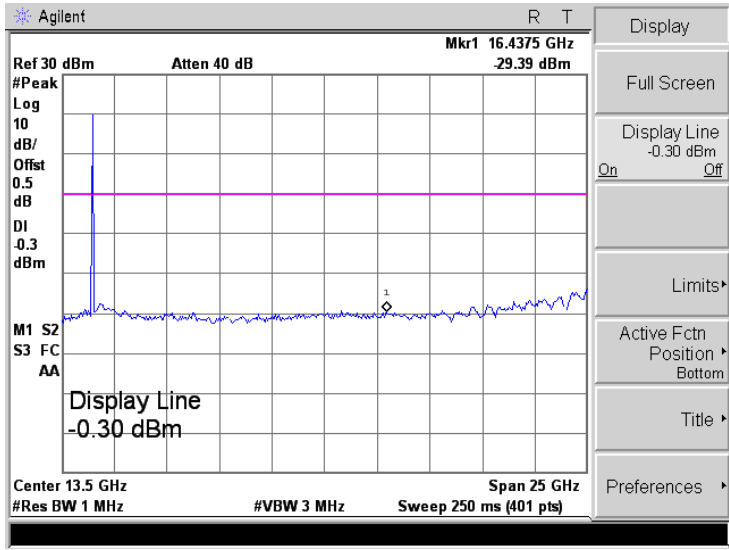
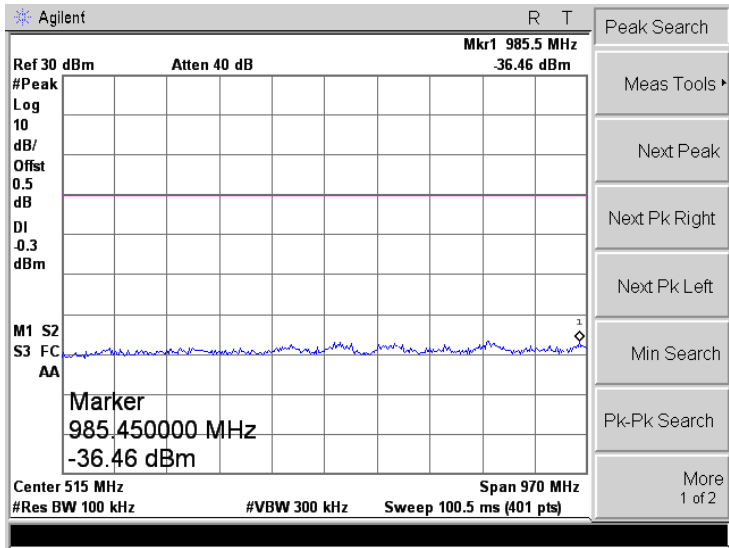
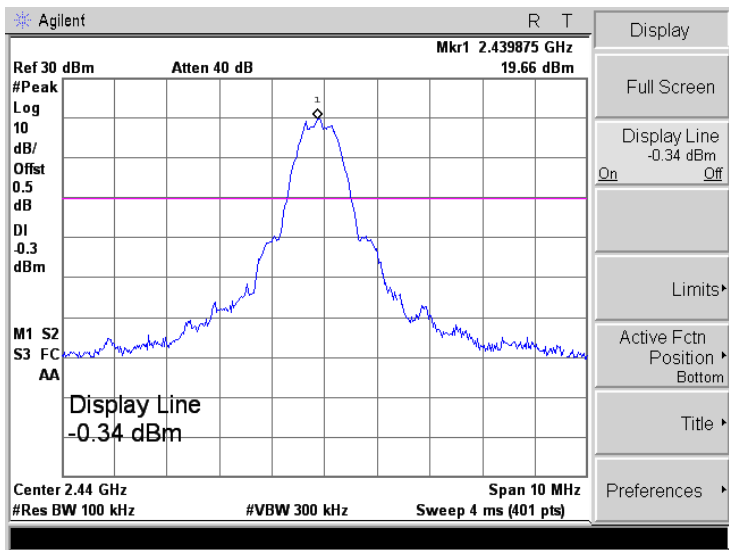




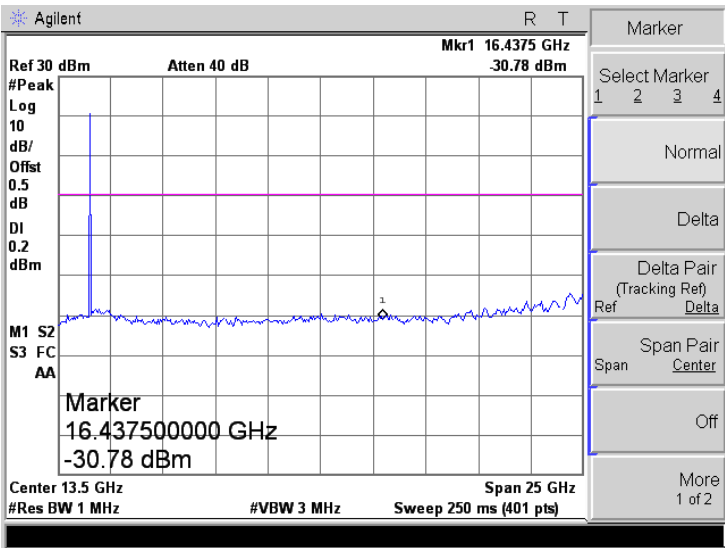
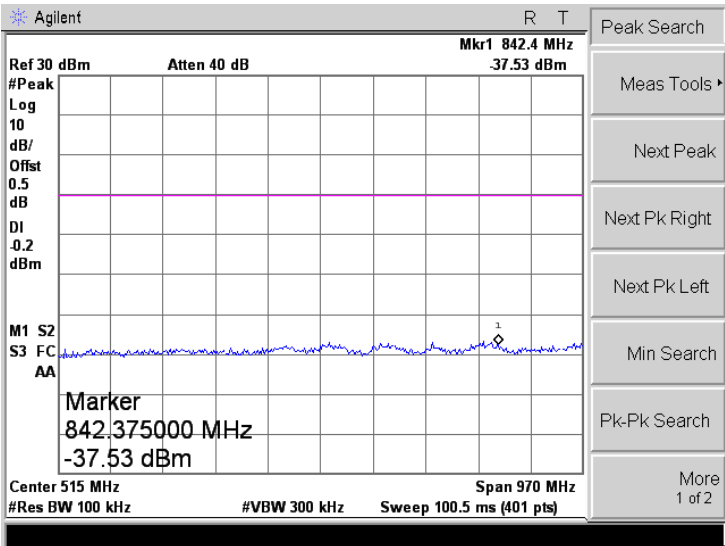
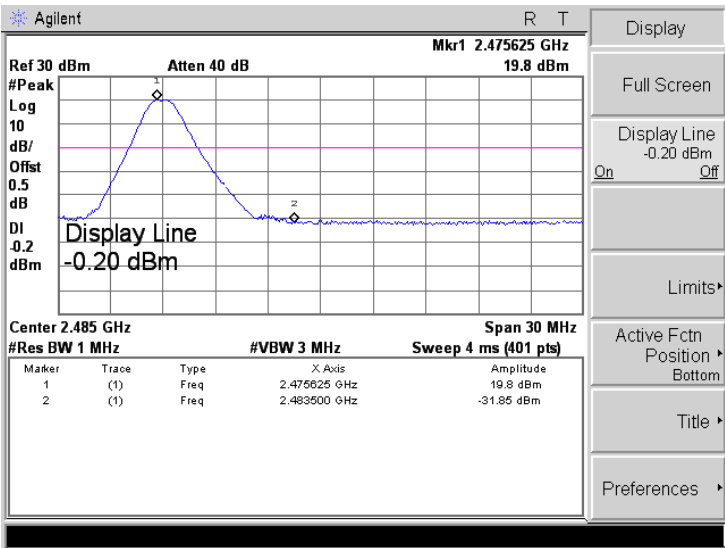


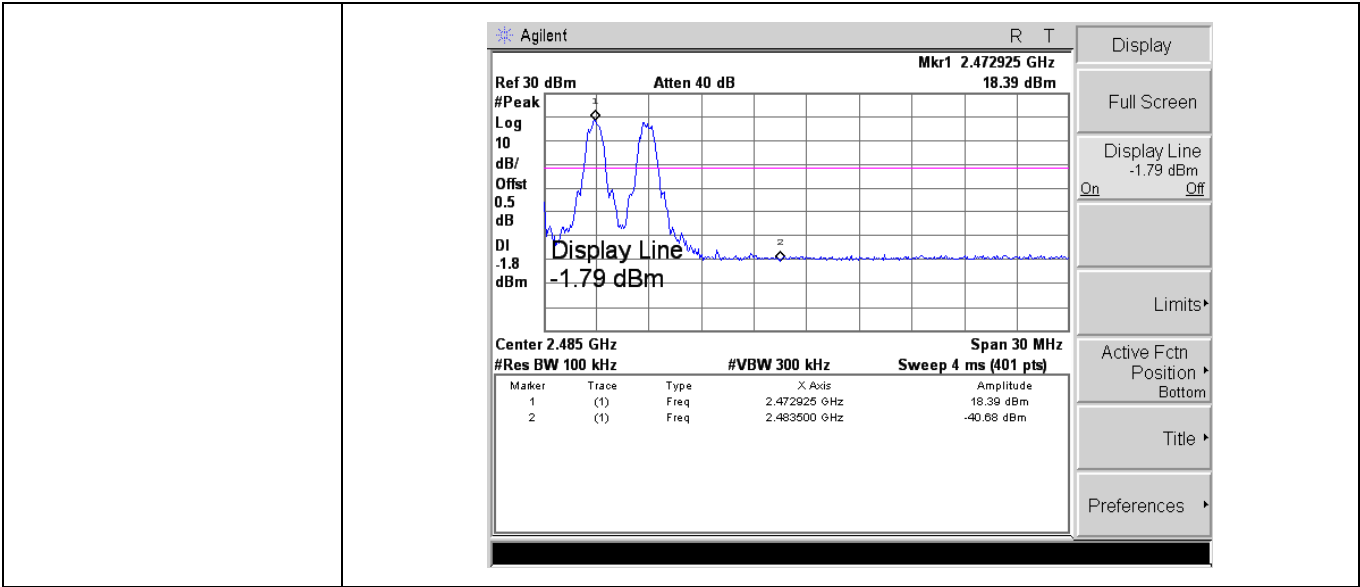


Middle channel



High channel





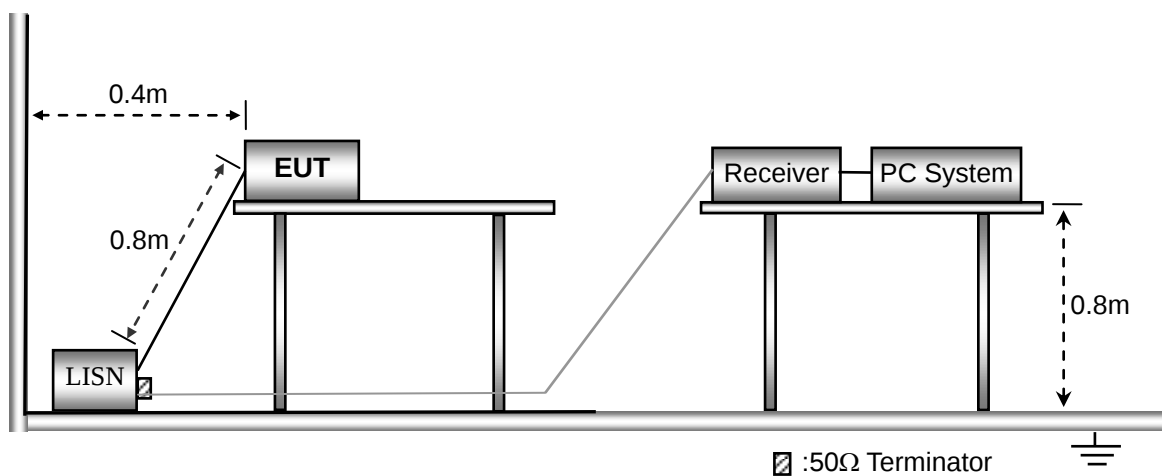
12. Conducted Emissions

12.1 Test Procedure

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

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.

12.2 Basic Test Setup Block Diagram



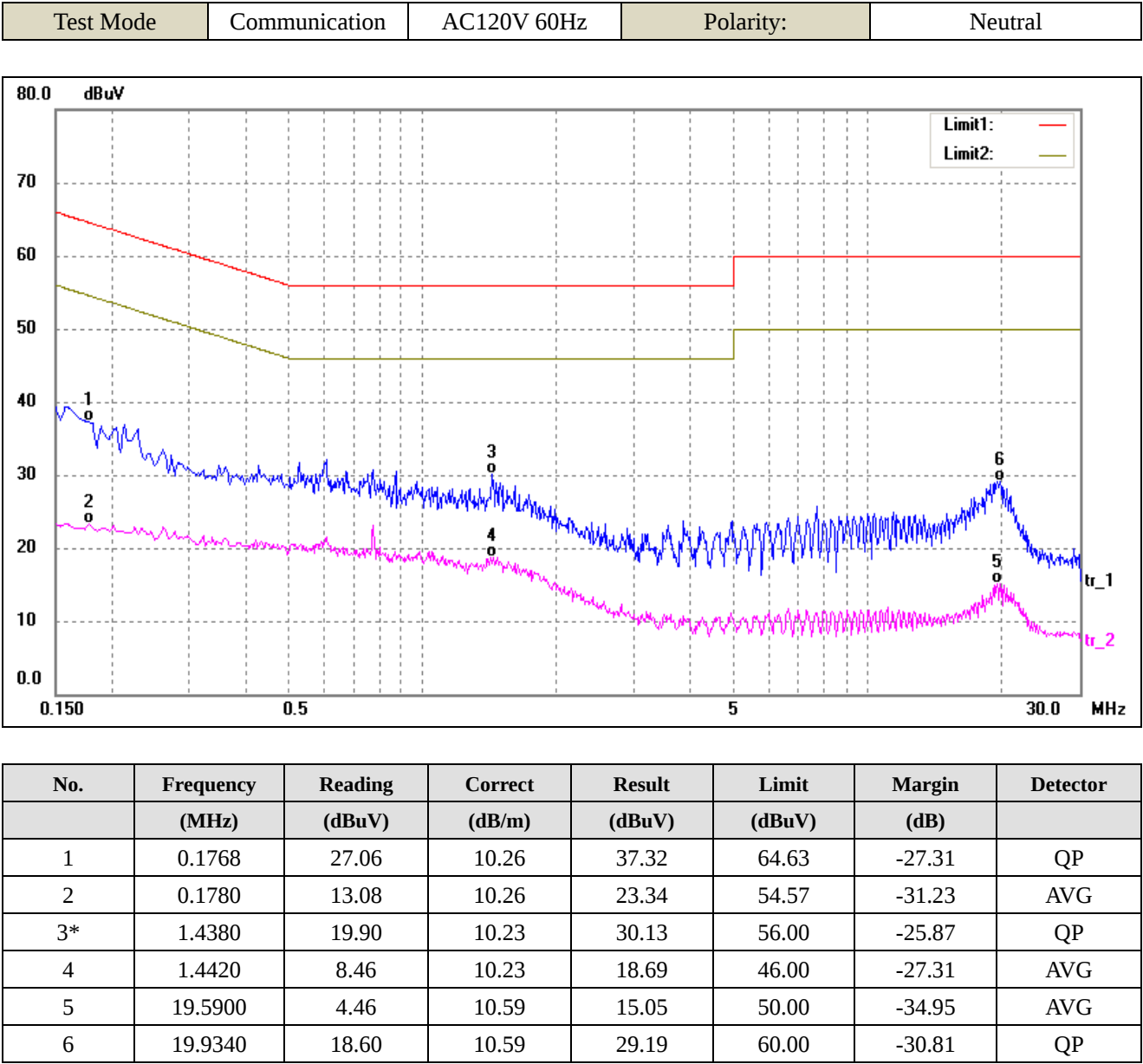
12.3 Test Receiver Setup

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

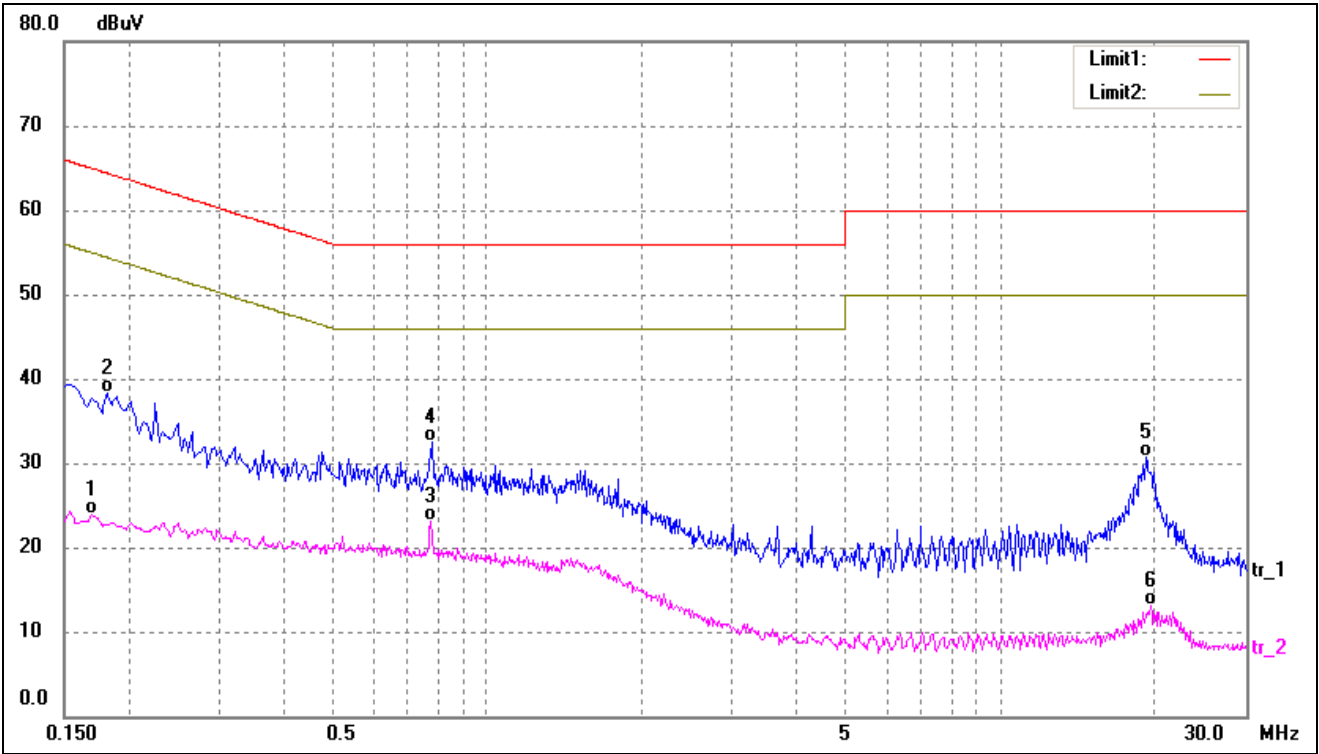
Start Frequency	150 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth.....	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

12.4 Summary of Test Results/Plots

➤ Antenna A

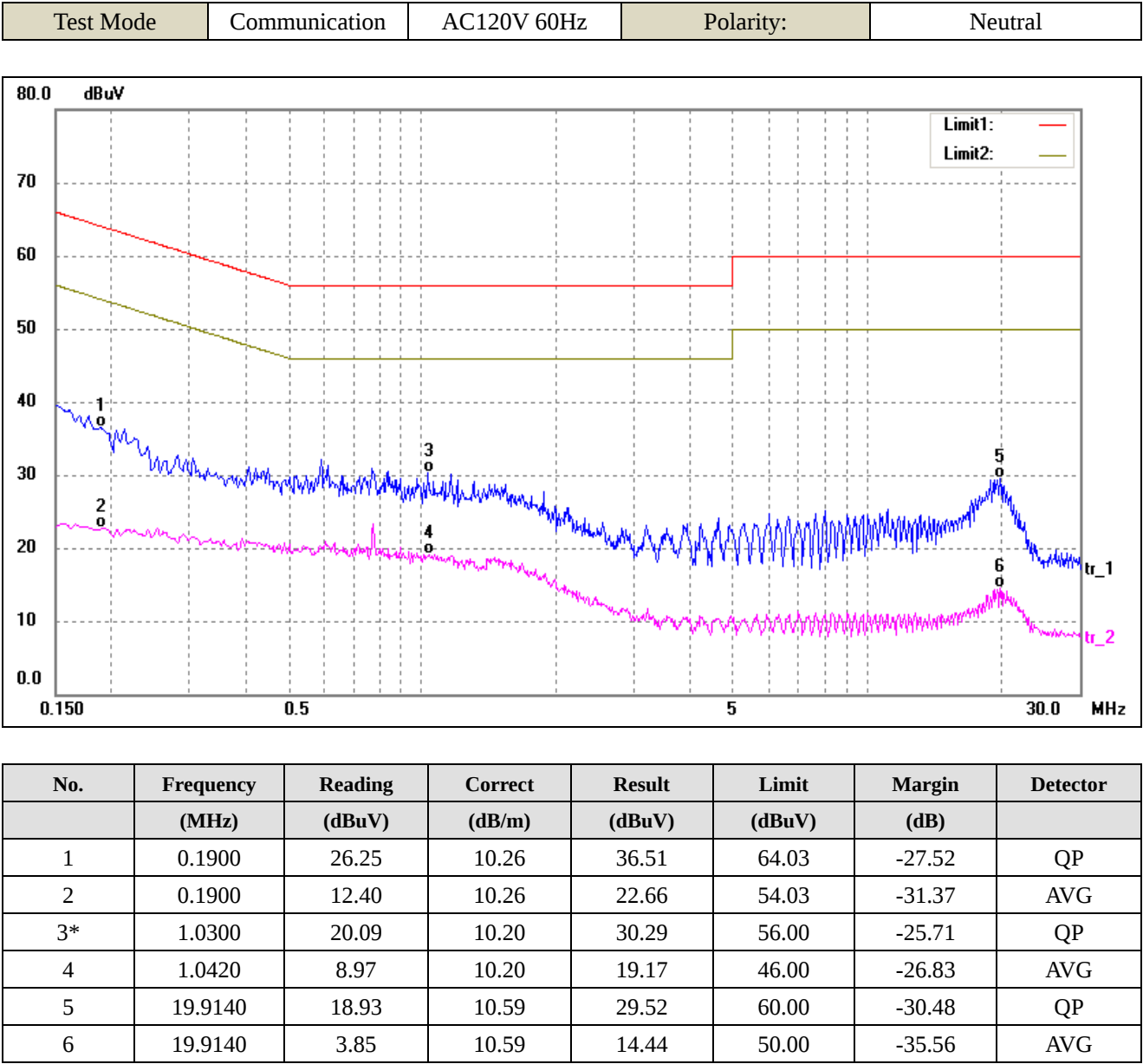


Test Mode	Communication	AC120V 60Hz	Polarity:	Line
-----------	---------------	-------------	-----------	------

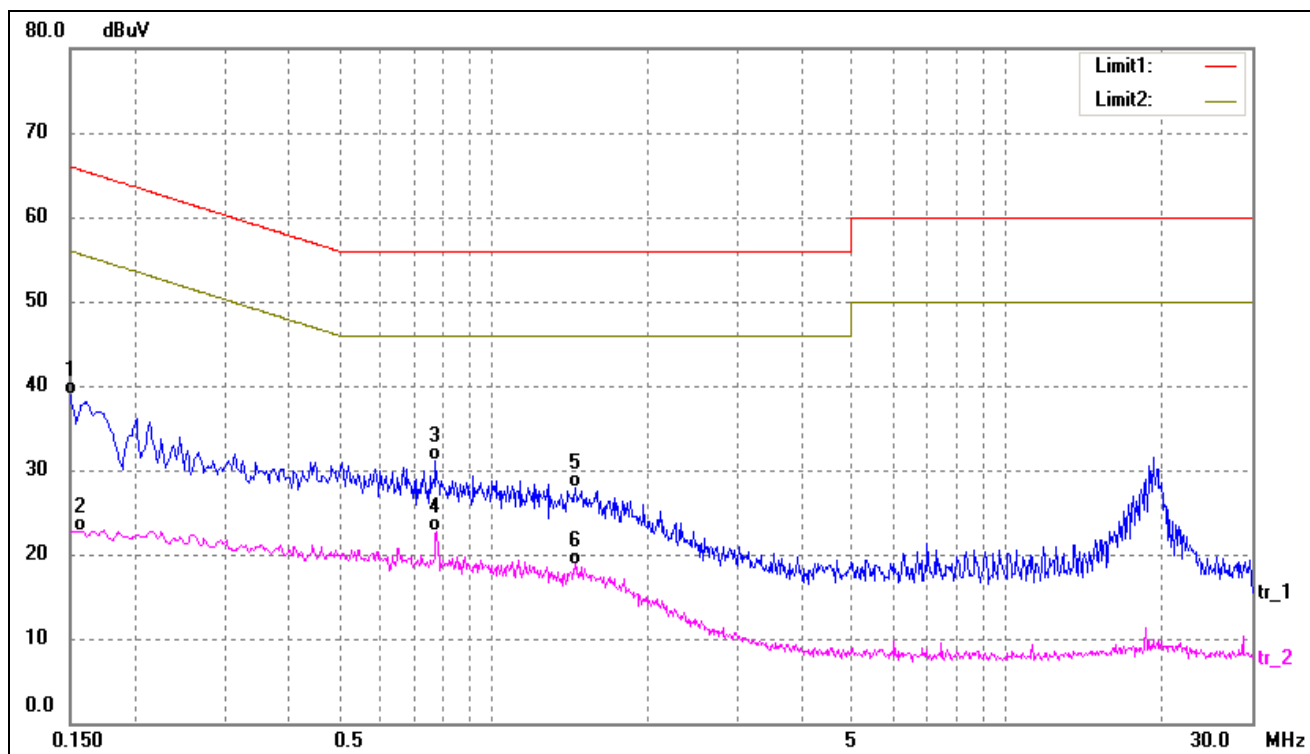


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1700	13.56	10.25	23.81	54.96	-31.15	AVG
2	0.1819	28.11	10.26	38.37	64.39	-26.02	QP
3*	0.7780	12.96	10.18	23.14	46.00	-22.86	AVG
4	0.7820	22.40	10.18	32.58	56.00	-23.42	QP
5	19.2020	20.15	10.59	30.74	60.00	-29.26	QP
6	19.6100	2.52	10.59	13.11	50.00	-36.89	AVG

➤ Antenna B



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



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.1500	28.64	10.25	38.89	65.99	-27.10	QP
2	0.1580	12.51	10.25	22.76	55.56	-32.80	AVG
3	0.7740	20.90	10.17	31.07	56.00	-24.93	QP
4*	0.7780	12.52	10.18	22.70	46.00	-23.30	AVG
5	1.4460	17.58	10.23	27.81	56.00	-28.19	QP
6	1.4460	8.57	10.23	18.80	46.00	-27.20	AVG

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