FCC Part 15C
Measurement and Test Report

For

Human Health Organization

11345 Ventura Blvd Studio City, CA 91604 United States

FCC ID: 2AGMD-IO3

FCC Rules:	FCC Part 15.247
Product Description:	Jupiter
Tested Model:	IO 3
Report No.:	STR15118121I-2
Tested Date:	2015-11-09 to 2015-11-18
Issued Date:	2015-11-19
Tested By:	Vigoss Liang / Engineer
Reviewed By:	Silin Chen / EMC Manager
Approved & Authorized By:	Jandy So / PSQ Manager

Prepared By:

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Human Health Organization
Address of applicant: 11345 Ventura Blvd Studio City, CA 91604 United States

Manufacturer: Shenzhen Fengteng Weiye Technology Co., Ltd.
Address of manufacturer: 2F A1, Silicon Valley Power Qinghu Park, Longhua, Baoan, Shenzhen, China

General Description of EUT	
Product Name:	Jupiter
Brand Name:	Vaporcade
Model No.:	IO 3
Adapter Model:	vf-02
	INPUT:100-240V,50/60Hz; OUTPUT:5V, 1.5A
Hardware version:	K747_MB_V1.1 2015-06-11
Software version:	ALPS.KK1.MP1.V2.46
Rated Voltage:	DC 3.7V Li-ion Battery
Battery Capacity:	4000mAh
Device Category:	Portable Device
The EUT Main board support GSM850/900/DCS1800/PCS1900, WCDMA Band 2/5 function. It is intended for speech, Multimedia Message Service (MMS) transmission and IO 3. It is equipped with GPRS class 12 for GSM850/900/DCS1800/PCS1900, GPS, Bluetooth and Wi-Fi functions. For more information see the following datasheet	
Note: The test data is gathered from a production sample provided by the manufacturer.	

Technical Characteristics of EUT	
Bluetooth Version:	V4.0(EDR)
Frequency Range:	2402-2480MHz
RF Output Power:	3.739dBm (Conducted)
Data Rate:	1Mbps, 2Mbps, 3Mbps
Modulation:	GFSK, Pi/4 QDPSK, 8DPSK
Quantity of Channels:	79
Channel Separation:	1MHz
Type of Antenna:	Integral Antenna
Antenna Gain:	0dBi
Lowest Internal frequency of EUT:	32.768kHz

1.2 Test Standards

The following report is prepared on behalf of the Human Health Organization in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

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, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. The measurement guide DA 00-705 for frequency hopping spread spectrum systems shall be performed also.

1.4 Test Facility

FCC – Registration No.: 934118
Shenzhen SEM.Test Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Registration is 934118.

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.

CNAS Registration No.: L4062
Shenzhen SEM.Test Technology Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao’an District, Shenzhen, P.R.C (518101).

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	2402MHz
TM2	Middle Channel	2441MHz
TM3	High Channel	2480MHz
TM4	Hopping	2402-2480MHz

Modulation Configure			
Modulation	Packet	Packet Type	Packet Size
GFSK	DH1	4	27
	DH3	11	183
	DH5	15	339
Pi/4 DQPSK	2DH1	20	54
	2DH3	26	367
	2DH5	30	679
8DPSK	3DH1	24	83
	3DH3	27	552
	3DH5	31	1021
Normal mode: the Bluetooth has been tested on the modulation of GFSK, (Pi/4)DQPSK and 8DPSK, compliance test and record the worst case.			

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB Cable	1.15	Unshielded	Without Ferrite

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
Earphone	1.2	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E10	LR-63C8R

1.6 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Spectrum Analyzer	Agilent	E4407B	MY41440400	2015-06-17	2016-06-16
Spectrum Analyzer	Agilent	N9020A	US47140102	2015-06-17	2016-06-16
Spectrum Analyzer	Rohde & Schwarz	FSP	836079/035	2015-06-17	2016-06-16
EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2015-06-17	2016-06-16
Amplifier	Agilent	8447F	3113A06717	2015-06-17	2016-06-16
Amplifier	C&D	PAP-1G18	2002	2015-06-17	2016-06-16
Broadband Antenna	Schwarz beck	VULB9163	9163-333	2015-06-17	2016-06-16
Horn Antenna	ETS	3117	00086197	2015-06-17	2016-06-16
Horn Antenna	ETS	3116B	00088203	2015-06-17	2016-06-16
Loop Antenna	Schwarz beck	FMZB 1516	9773	2015-06-17	2016-06-16
EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2015-06-17	2016-06-16
L.I.S.N	Schwarz beck	NSLK8126	8126-224	2015-06-17	2016-06-16
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2015-06-17	2016-06-16

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
§ 15.209(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 § 2.1093, 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 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 an integral antenna, 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 Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

5.3 EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:
Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45 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.

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 Procedure

According to the DA 00-705, the number of hopping frequencies 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.
Set span = the frequency band of operation (2400MHz to 2483.5MHz)
RBW = 100kHz, VBW = 100kHz
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize, observed the band of 2400MHz to 2483.5MHz, than count it out the number of channels for comparing with the FCC rules.

The channel spacing test method as follows:

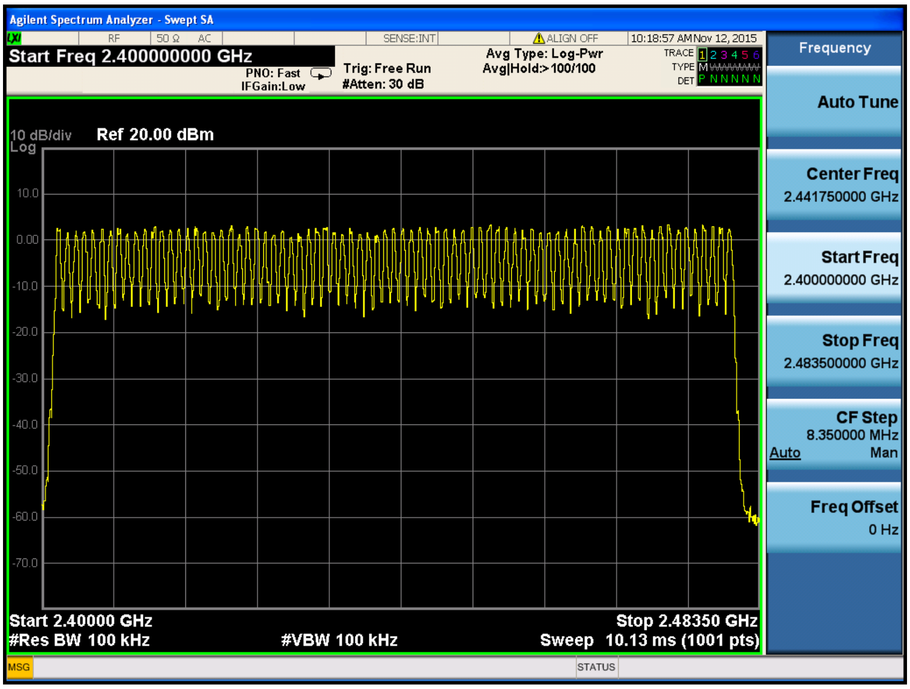
Set span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ RBW
Sweep = auto; Detector function = peak; Trace = max hold
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

6.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

6.4 Summary of Test Results/Plots

No. of Channel = 79



For GFSK mode

Channel Spacing (Low CH=1MHz)

Channel Spacing (Middle CH=1MHz)

Channel Spacing (High CH=1MHz)

For 8DPSK mode

Channel Spacing (Low CH=1MHz)

Channel Spacing (Middle CH=1MHz)

Channel Spacing (High CH=1MHz)

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 Procedure

According to the DA 00-705, the dwell time of a hopping channel 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.
Set span = zero span, centered on a hopping channel
RBW = 1MHz, VBW = 1MHz
Sweep = auto
Detector function = peak
Trace = max hold
Use the marker-delta function to determine the dwell time

7.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

7.4 Summary of Test Results/Plots

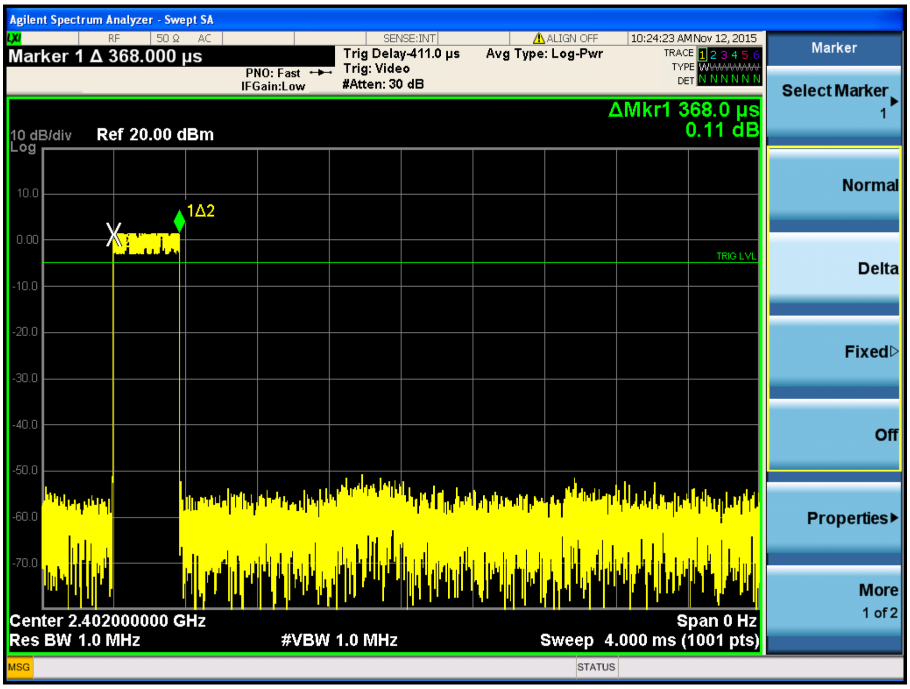
The dwell time within a period in data mode is independent from the packet type (packet length).
Test data is corrected with the worse case, which the packet length is DH1, DH3, and DH5.

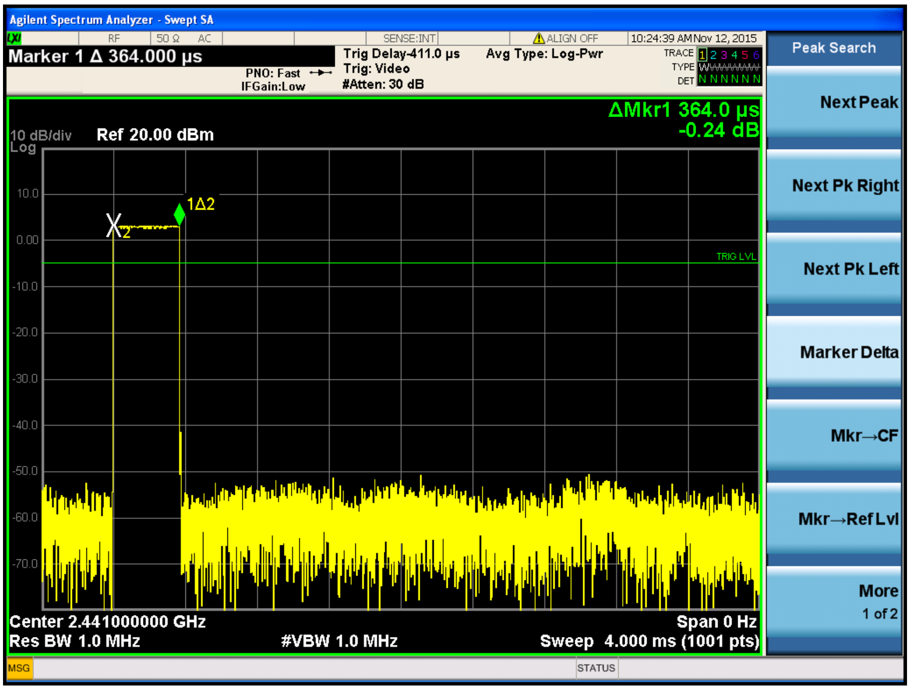
The test period: T = 0.4 Second * 79 Channel = 31.6 s
Dwell time = time slot length * (1600/79) * Period/N
(N=2 which DH1, 2DH1, 3DH1, 4 which DH3, 2DH3, 3DH3, 6 which DH5, 2DH5, 3DH5)

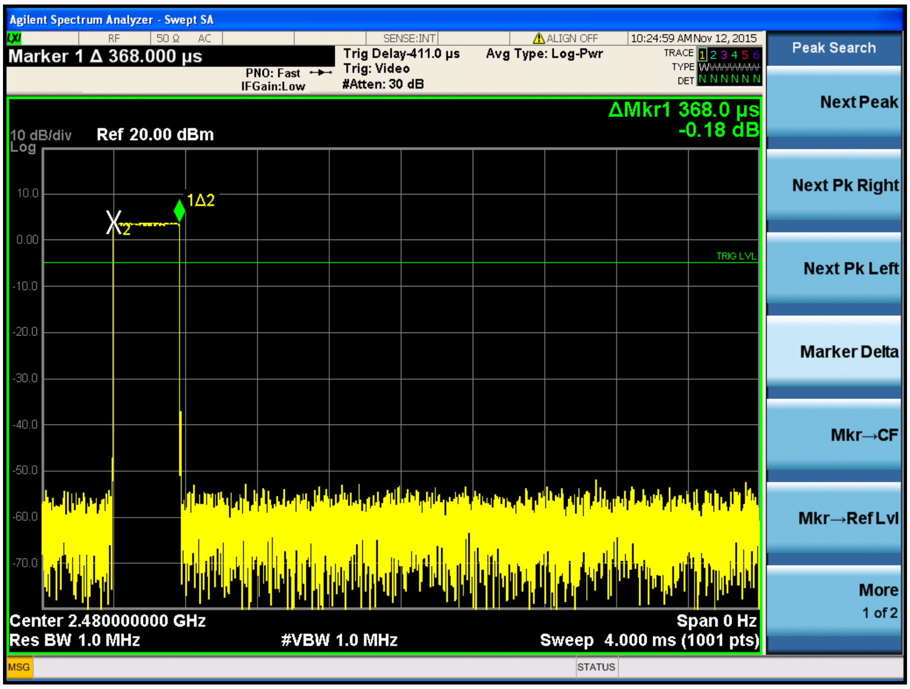
Modulation	Test Channel	Packet	Time Slot Length	Dwell Time	Limit
			ms	ms	ms
GFSK	2402MHz	DH1	0.368	117.760	400
		DH3	1.624	259.840	400
		DH5	2.872	306.347	400
	2441MHz	DH1	0.364	116.480	400
		DH3	1.624	259.840	400
		DH5	2.872	306.347	400
	2480MHz	DH1	0.368	117.760	400
		DH3	1.624	259.840	400
		DH5	2.872	306.347	400
8DPSK	2402MHz	3DH1	0.376	120.320	400
		3DH3	1.624	259.840	400
		3DH5	2.872	306.347	400
	2441MHz	3DH1	0.380	121.600	400
		3DH3	1.632	261.120	400
		3DH5	2.880	307.200	400
	2480MHz	3DH1	0.376	120.320	400
		3DH3	1.624	259.840	400
		3DH5	2.880	307.200	400

Please refer to the test plots as below:

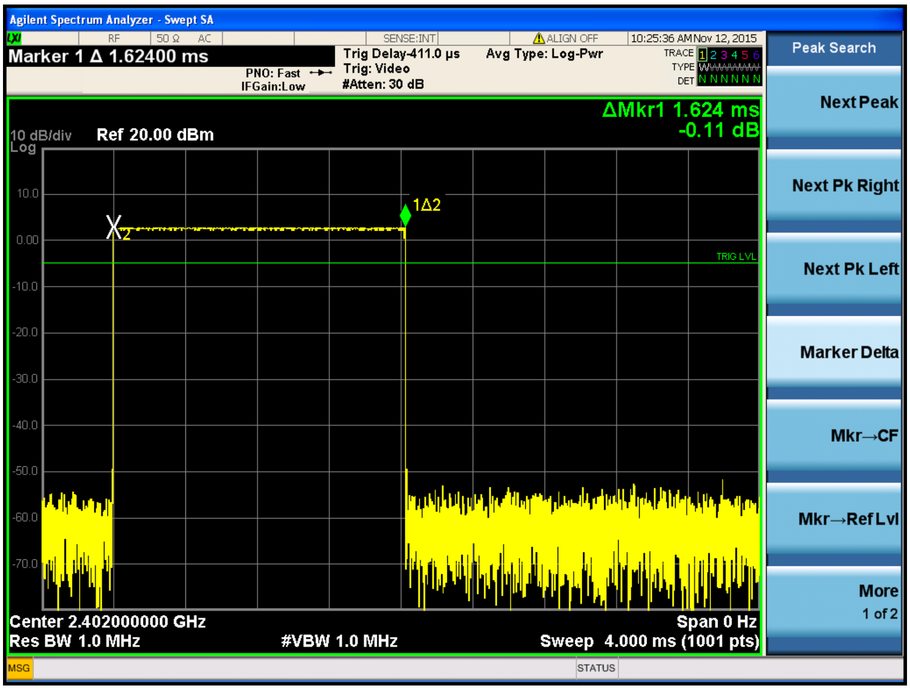
DH1 time slot (Low, Middle, High Channels)

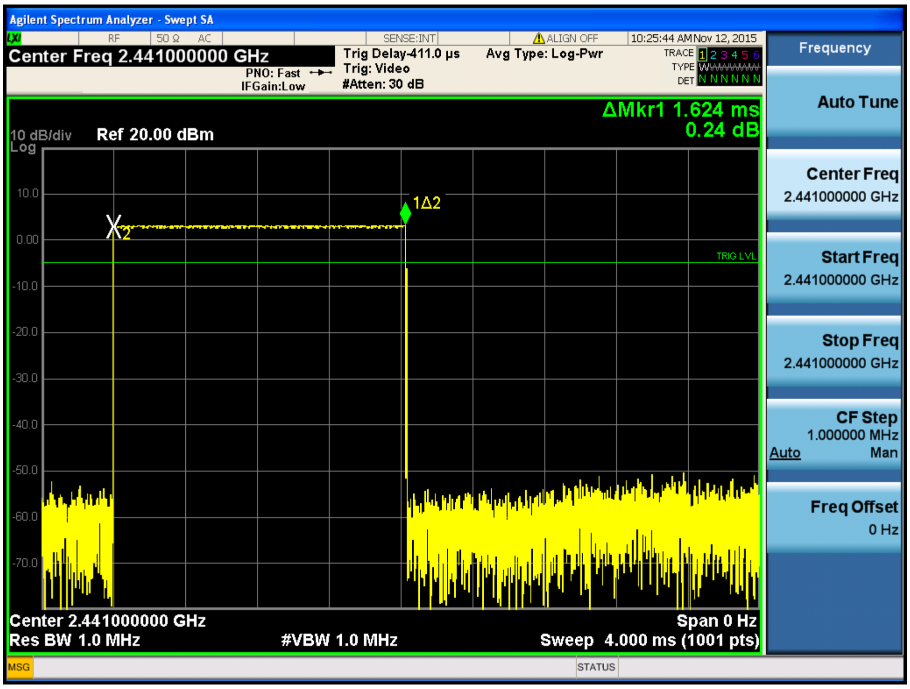


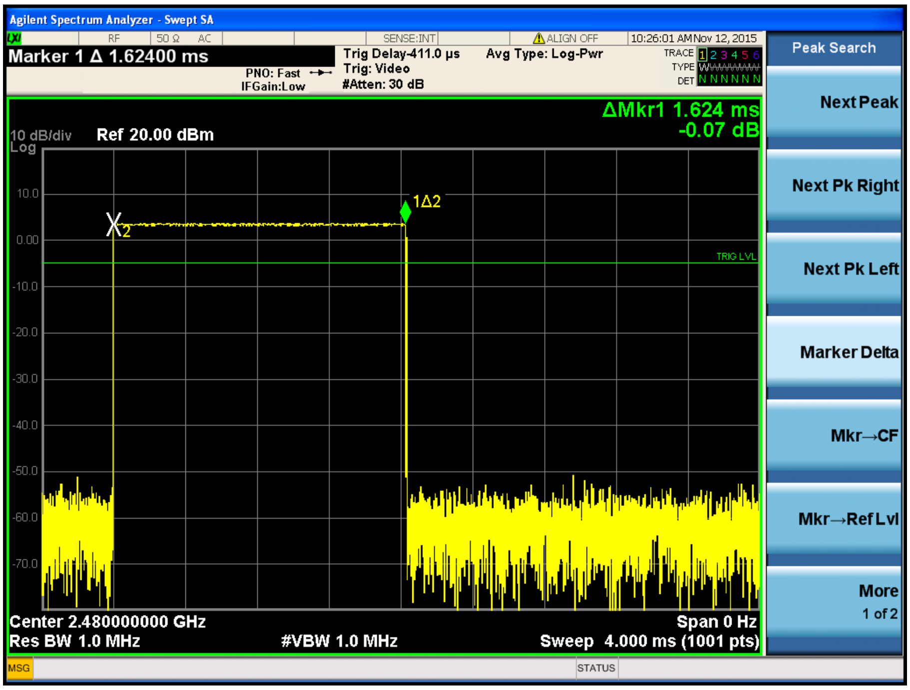




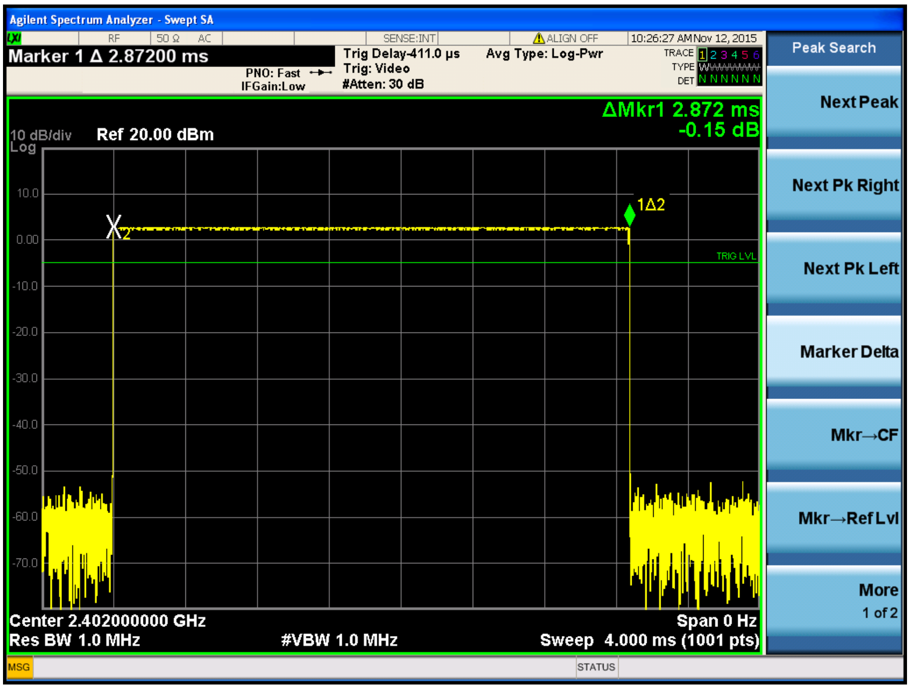
DH3 time slot (Low, Middle, High Channels)

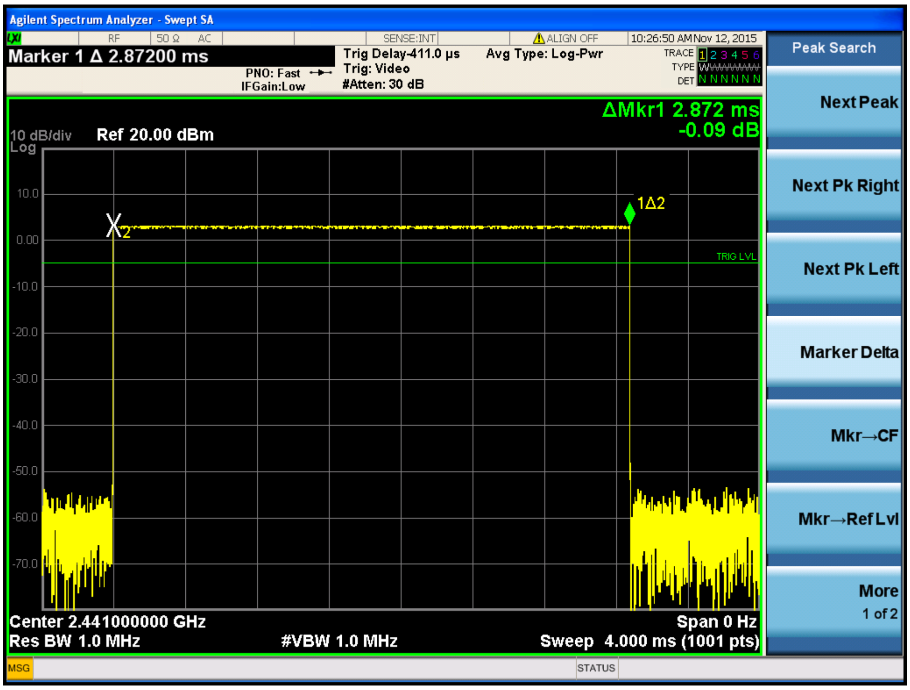


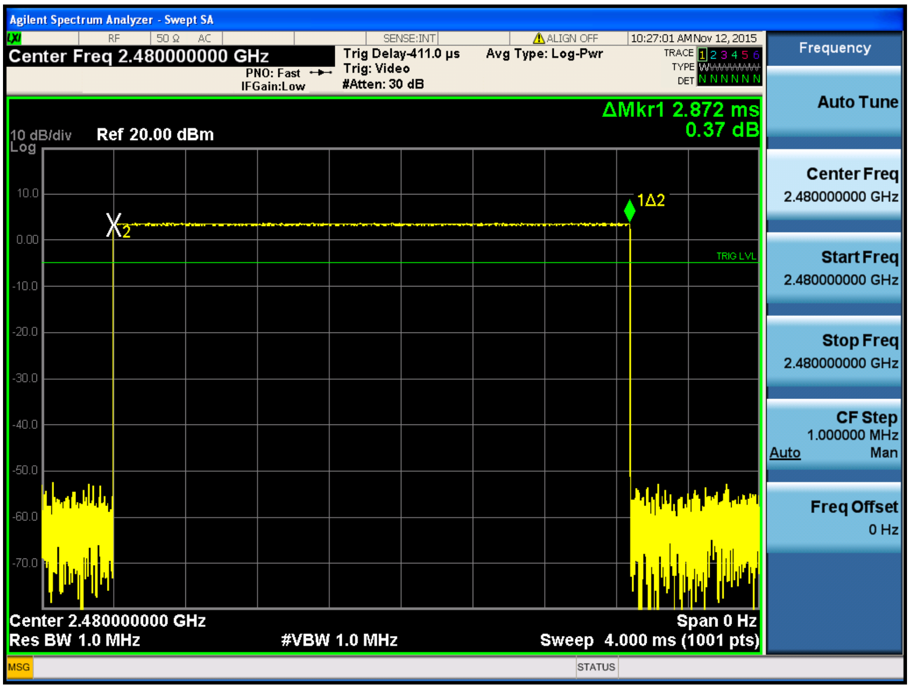

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
Trig Delay-411.0 µs
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
PNO: Fast
IFGain:Low
10:25:44 AM Nov 12, 2015
ΔMkr1 1.624 ms
0.24 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
Center 2.441000000 GHz
Span 0 Hz
Res BW 1.0 MHz
#VBW 1.0 MHz
Sweep 4.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.441000000 GHz
Start Freq
2.441000000 GHz
Stop Freq
2.441000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 1.62400 ms
Trig Delay-411.0 µs
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
PNO: Fast
IFGain:Low
10:26:01 AM Nov 12, 2015
ΔMkr1 1.624 ms
-0.07 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
Center 2.480000000 GHz
Span 0 Hz
Res BW 1.0 MHz
#VBW 1.0 MHz
Sweep 4.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

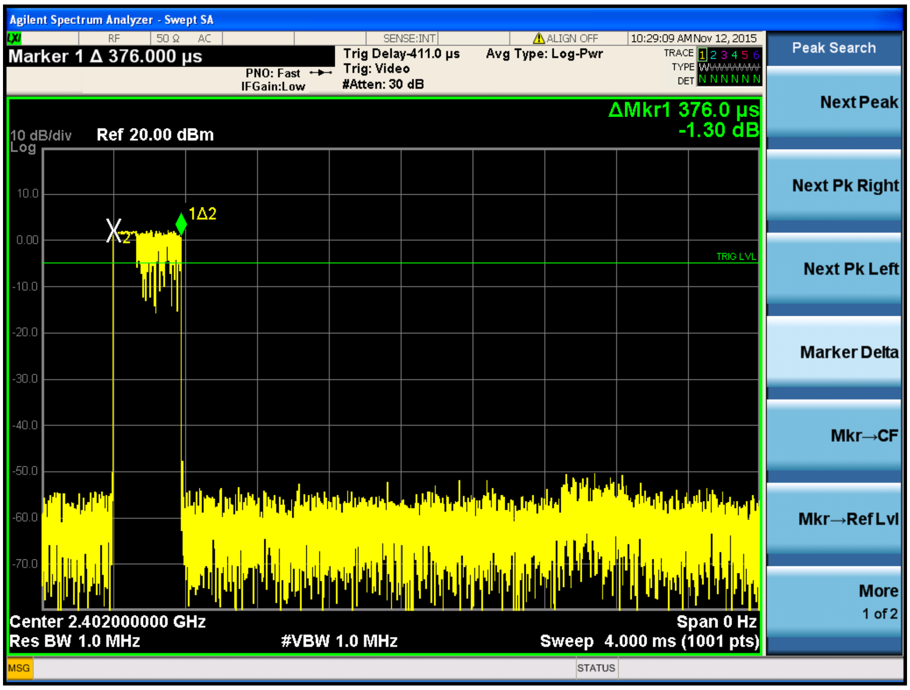
DH5 time slot (Low, Middle, High Channels)

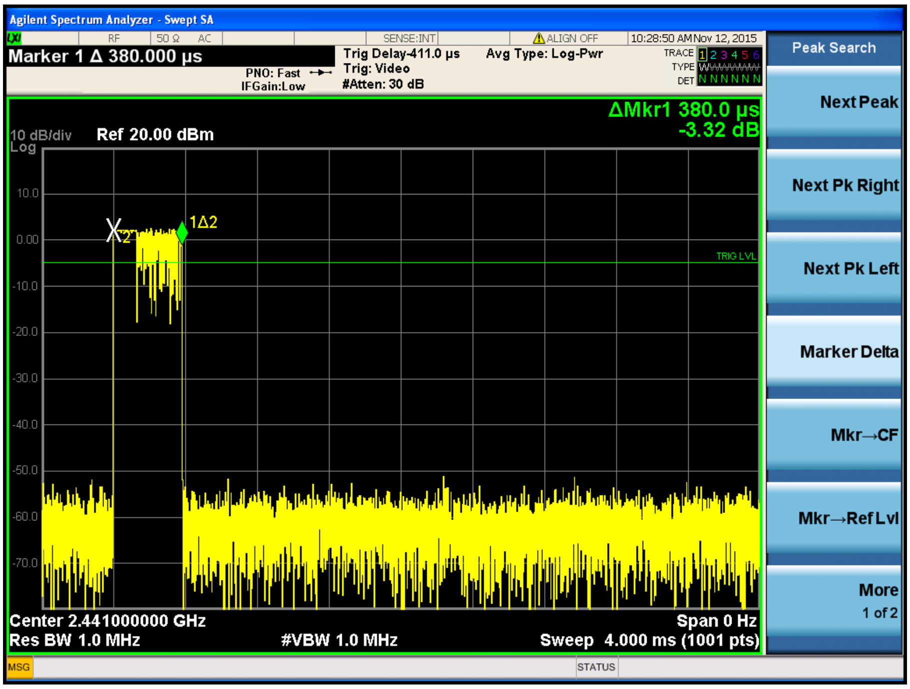


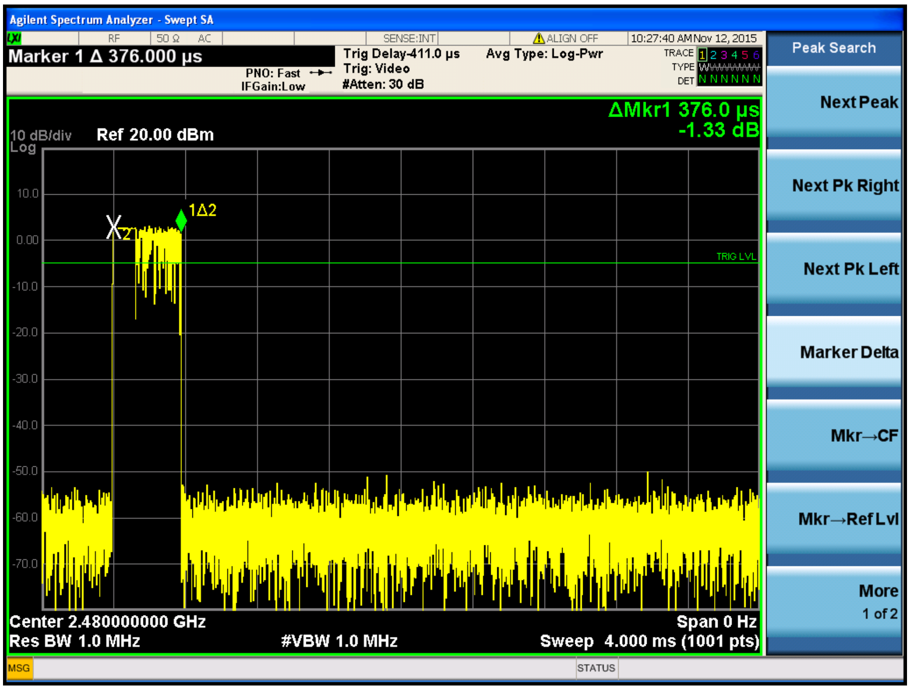




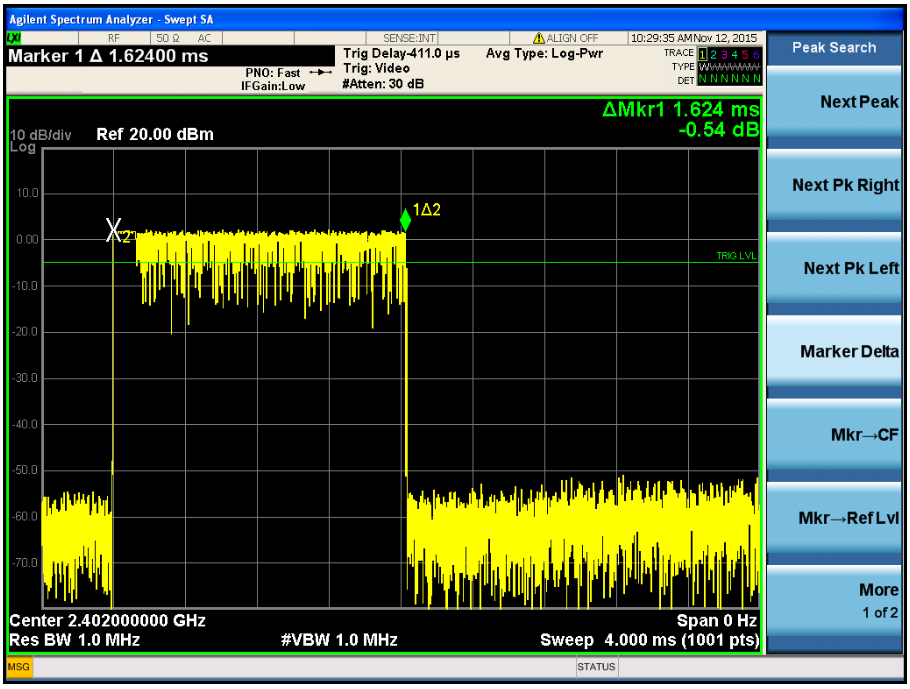
3DH1 time slot (Low, Middle, High Channels)

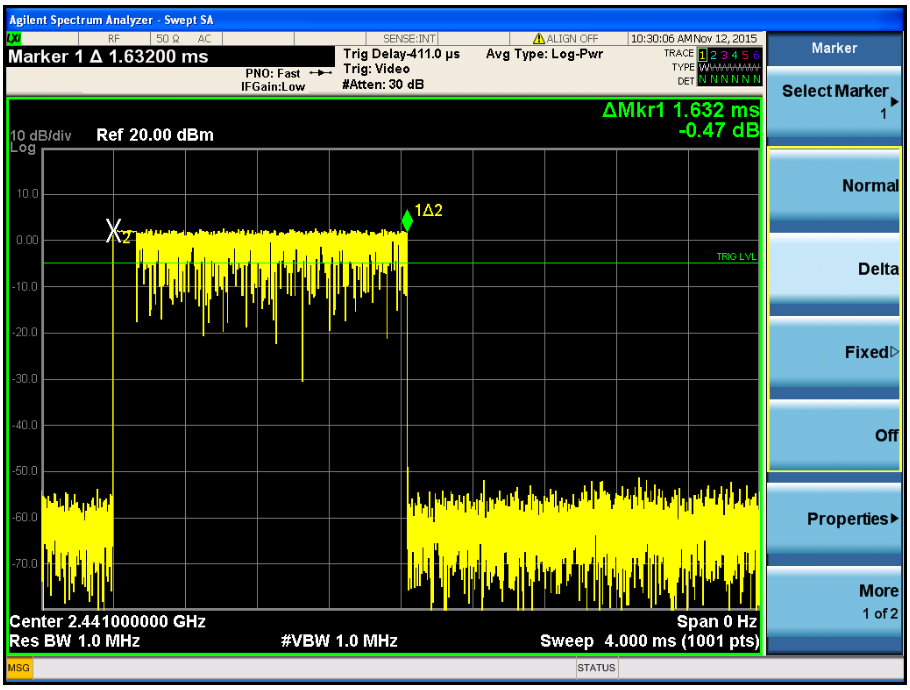


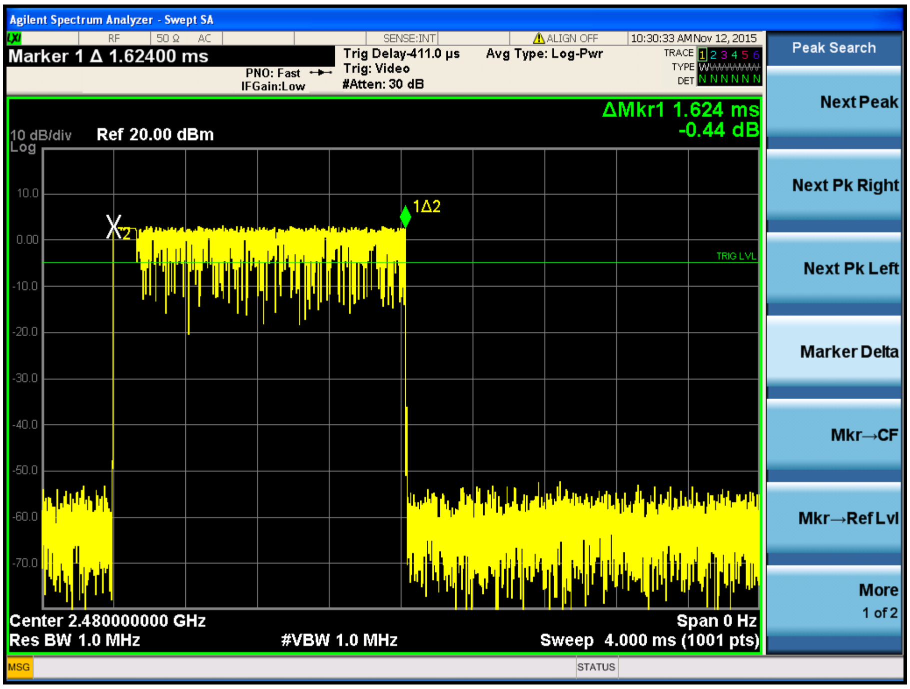

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 380.000 μs
PNO: Fast
IFGain:Low
Trig Delay-411.0 μs
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
10:28:50 AM Nov 12, 2015
ΔMkr1 380.0 μs
-3.32 dB
10 dB/div
Log
Ref 20.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 4.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 376.000 μs
PNO: Fast
IFGain:Low
Trig Delay-411.0 μs
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
10:27:40 AM Nov 12, 2015
ΔMkr1 376.0 μs
-1.33 dB
10 dB/div
Log
Ref 20.00 dBm
Center 2.480000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 4.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2

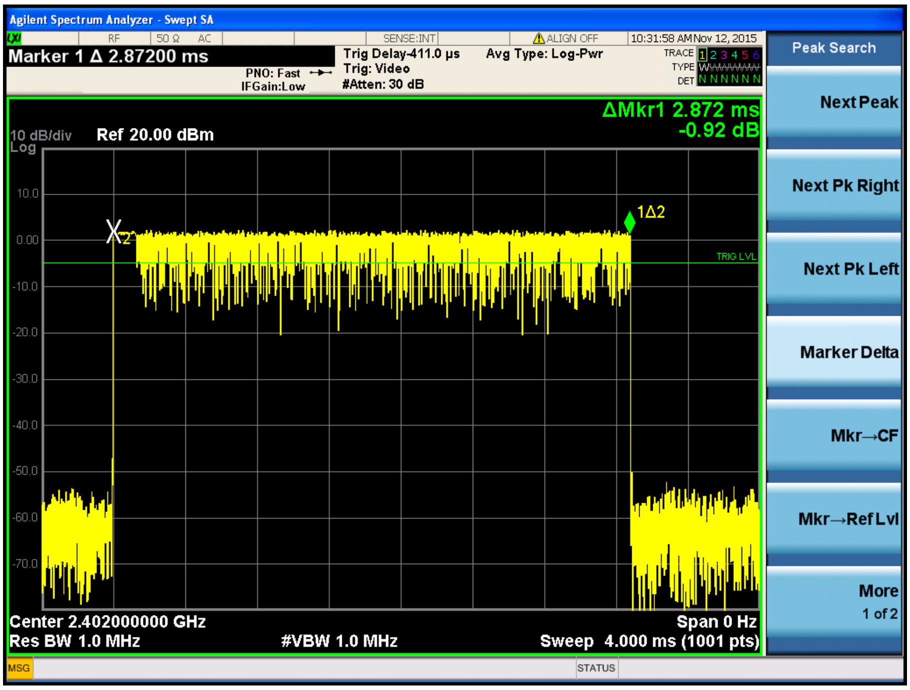
3DH3 time slot (Low, Middle, High Channels)

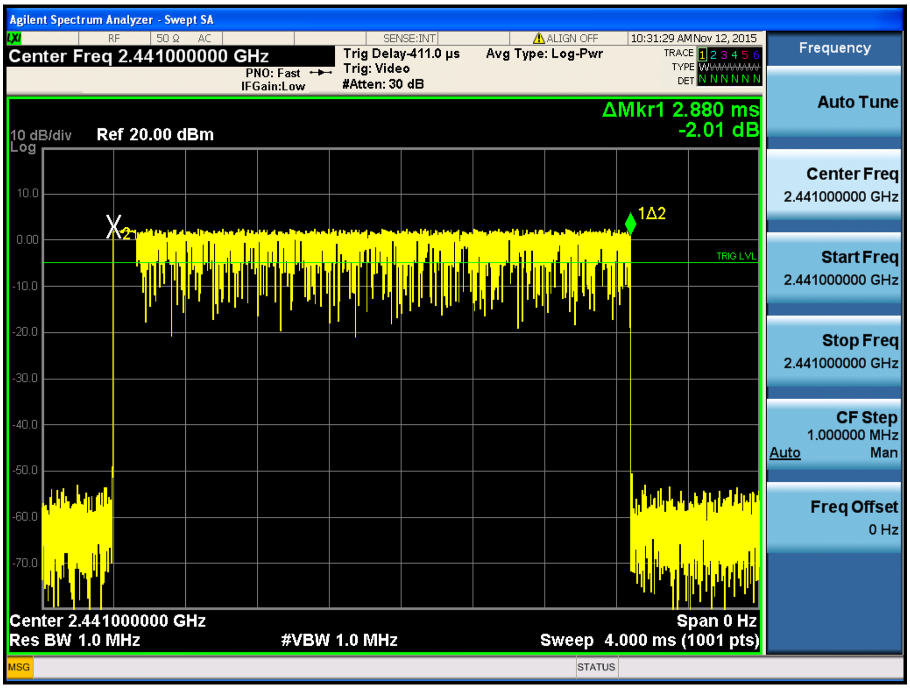


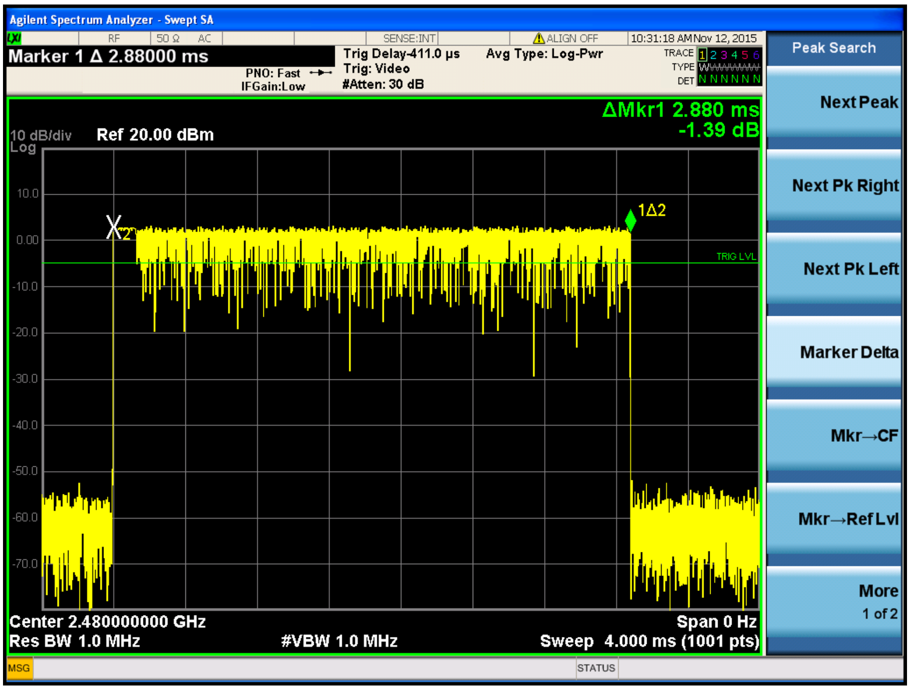




3DH5 time slot (Low, Middle, High Channels)




Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
Trig Delay-411.0 µs
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
10:31:29 AM Nov 12, 2015
ΔMkr1 2.880 ms
-2.01 dB
10 dB/div Ref 20.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 4.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq 2.441000000 GHz
Start Freq 2.441000000 GHz
Stop Freq 2.441000000 GHz
CF Step 1.000000 MHz
Freq Offset 0 Hz


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 2.88000 ms
Trig Delay-411.0 µs
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
10:31:18 AM Nov 12, 2015
ΔMkr1 2.880 ms
-1.39 dB
10 dB/div Ref 20.00 dBm
Center 2.480000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 4.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More 1 of 2

8. 20dB Bandwidth

8.1 Standard Applicable

According to 15.247(a)(1)(iii). For frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

8.2 Test Procedure

According to the DA 00-705, the 20dB bandwidth 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.
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto; Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down bandwidth of the emission.

8.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

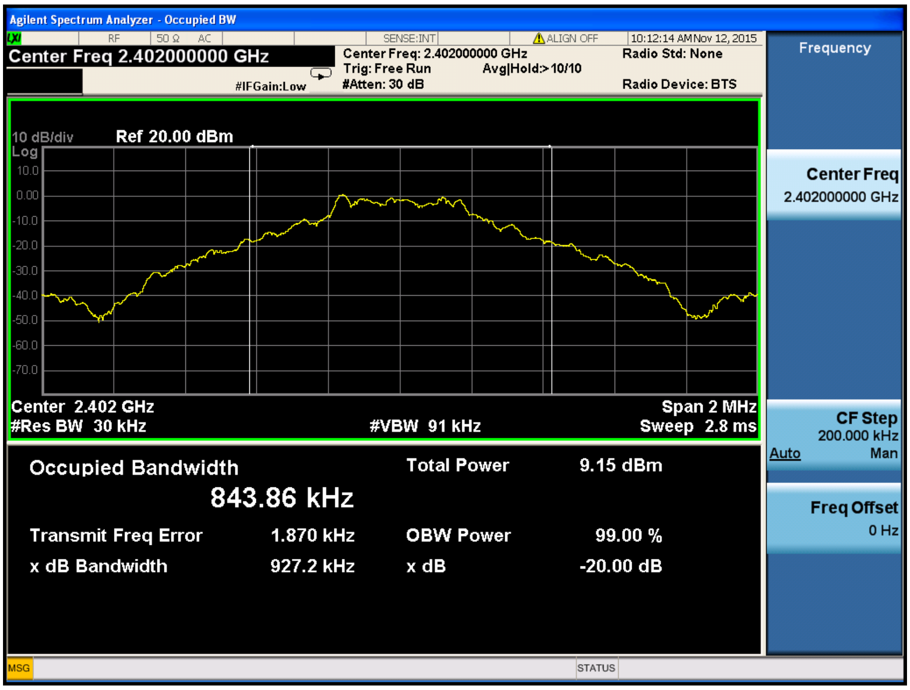
8.4 Summary of Test Results/Plots

Test Mode	Test Channel MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz
GFSK	2402	927.2	843.86	---
	2441	924.5	842.28	---
	2480	924.9	842.54	---
Pi/4 DQPSK	2402	1253	1158.6	---
	2441	1250	1166.4	---
	2480	1241	1154.4	---
8DPSK	2402	1257	1160.0	---
	2441	1261	1155.9	---
	2480	1260	1158.1	---

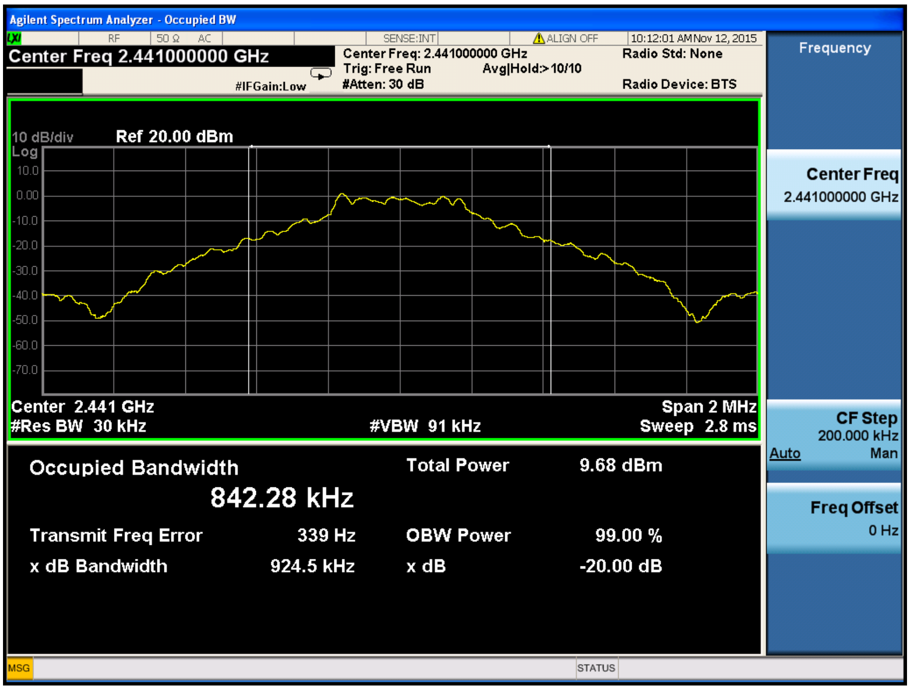
Please refer to the test plots as below:

For GFSK

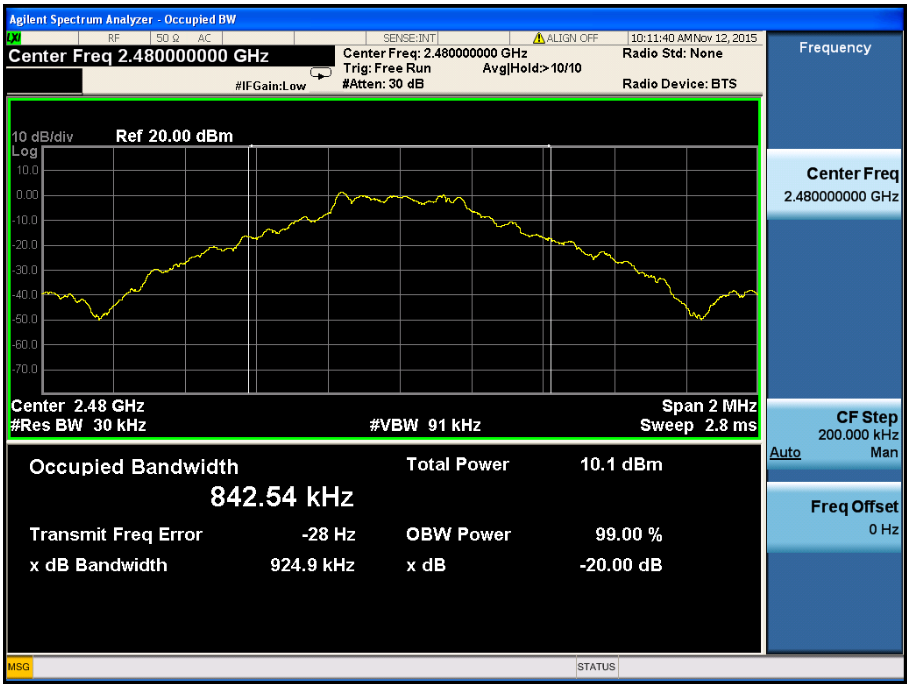
Low Channel:



Middle Channel:

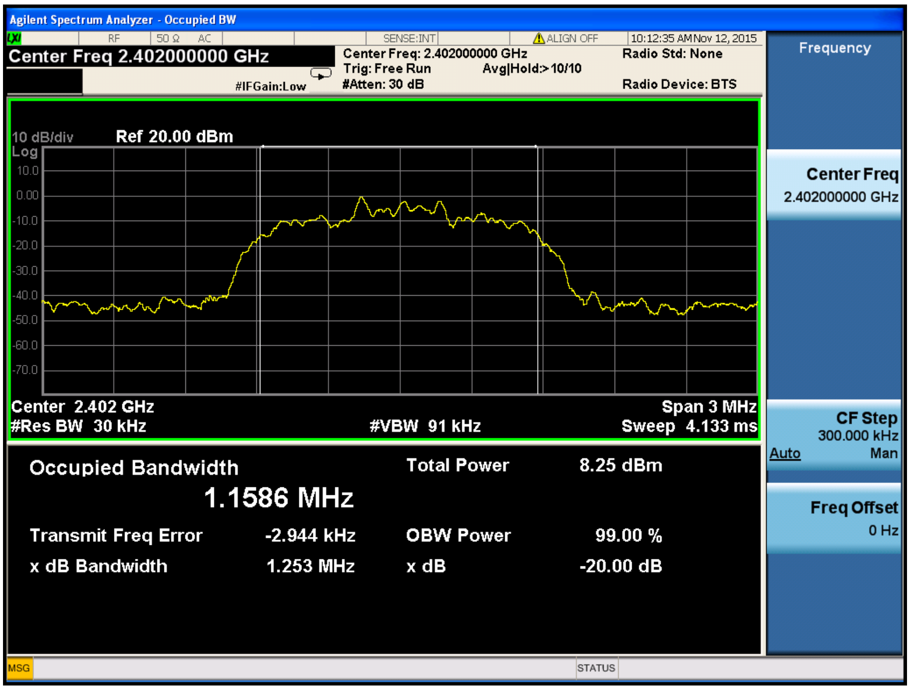


High Channel:

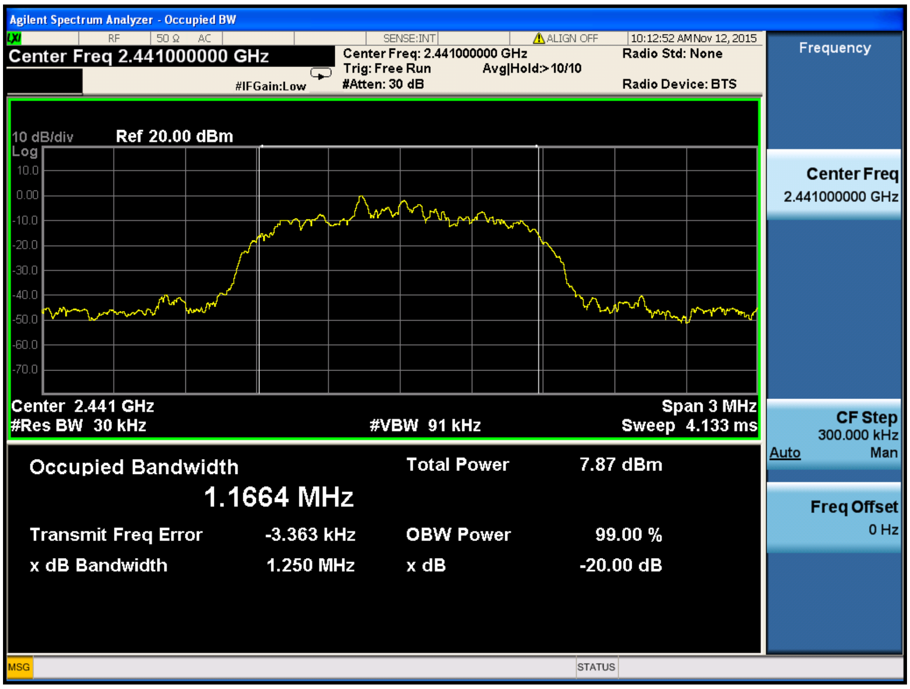


For Pi/4 DQPSK

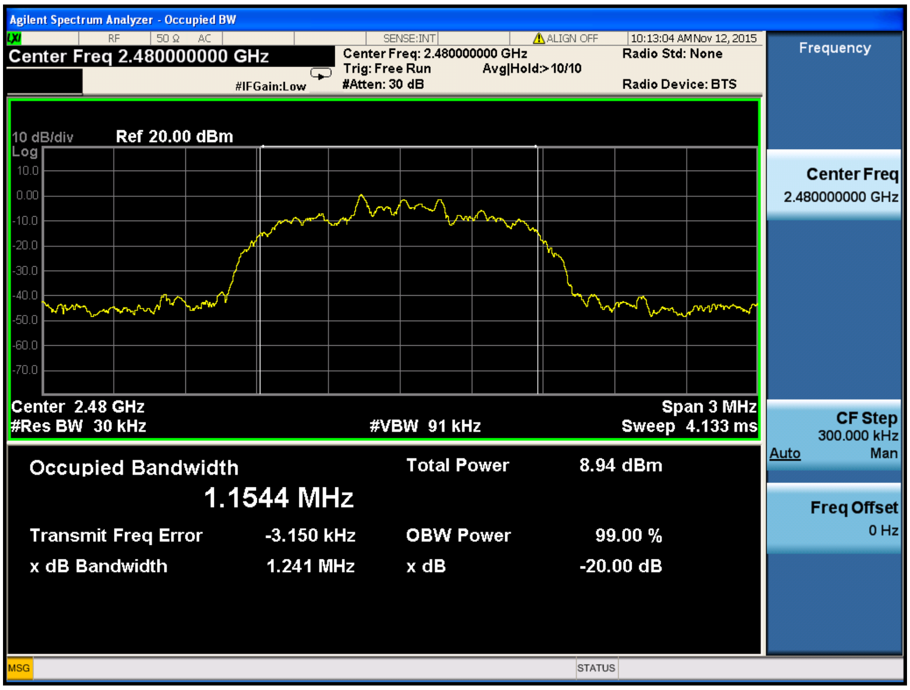
Low Channel:



Middle Channel:

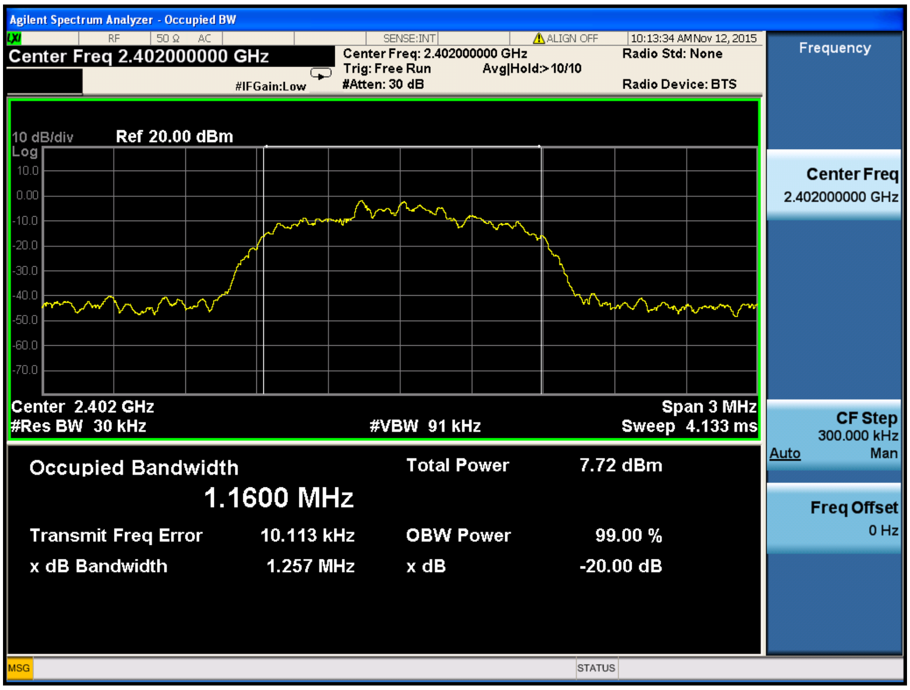


High Channel:

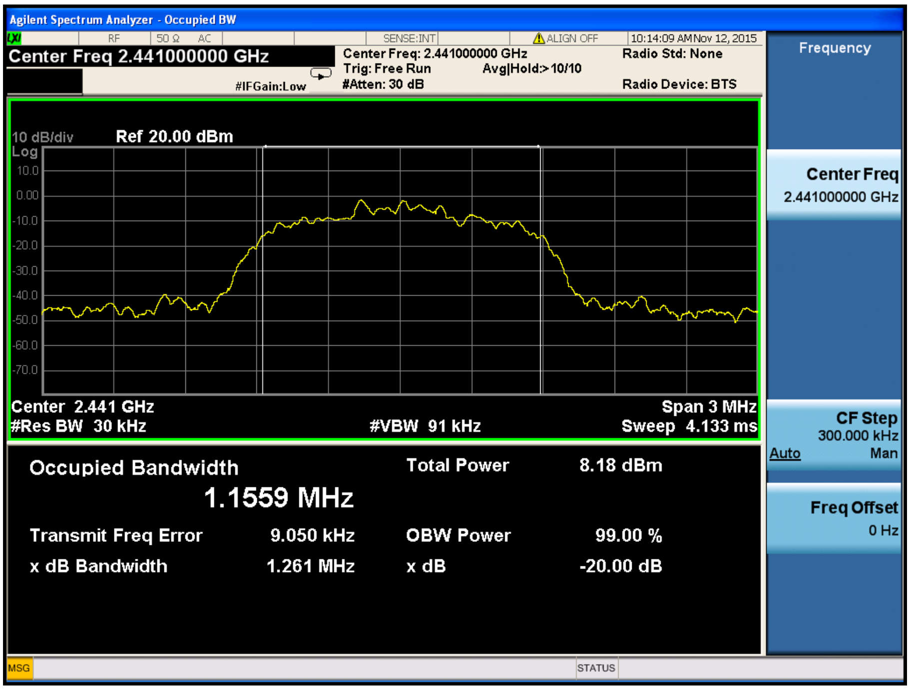


For 8DPSK

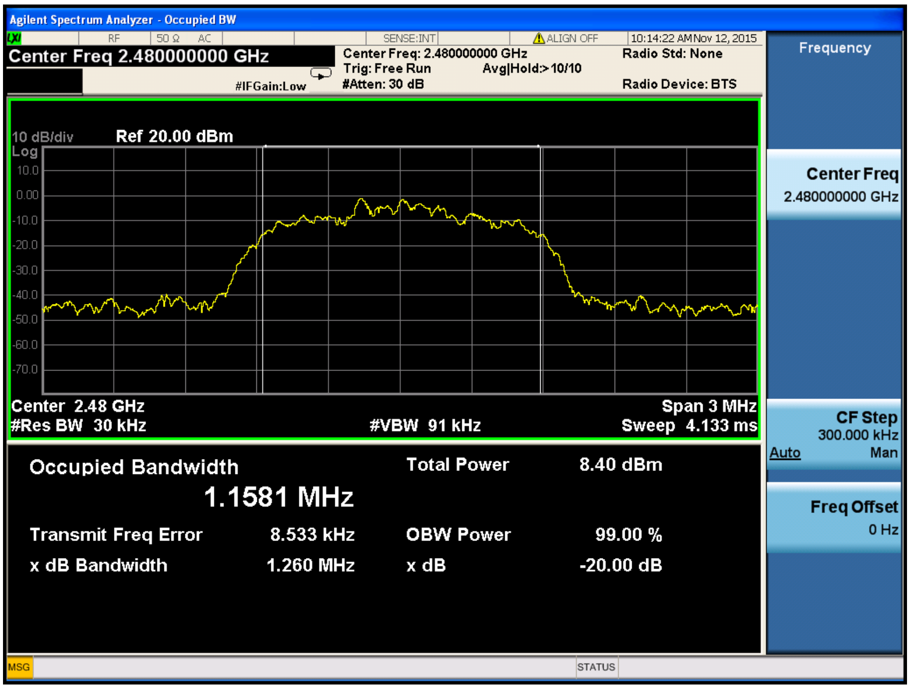
Low Channel:



Middle Channel:



High Channel:



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 Procedure

According to the DA 00-705, the peak 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.
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, the indicated level is the peak output power (the external attenuation and cable loss shall be considered).

9.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	55%
ATM Pressure:	1011 mbar

9.4 Summary of Test Results/Plots

For GFSK

Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	2.885	1.943	1000
Middle Channel	2441	3.221	2.099	1000
High Channel	2480	3.739	2.365	1000

For Pi/4 QDPSK

Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	2.326	1.708	1000
Middle Channel	2441	2.614	1.826	1000
High Channel	2480	3.148	2.064	1000

For 8DPSK

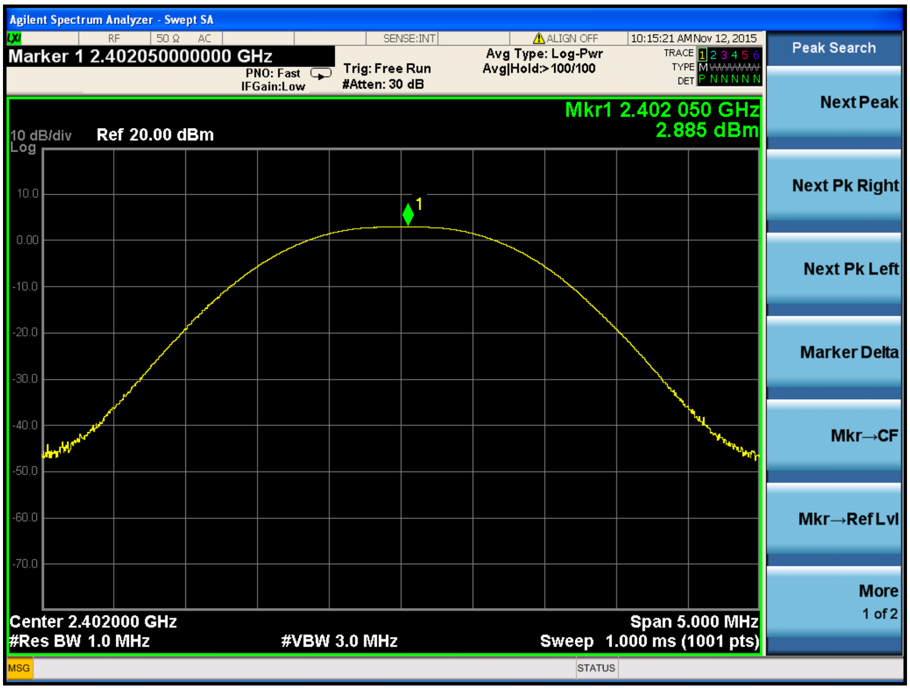
Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	2.754	1.885	1000
Middle Channel	2441	3.093	2.038	1000
High Channel	2480	3.616	2.299	1000

Note: the antenna gain of 0dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

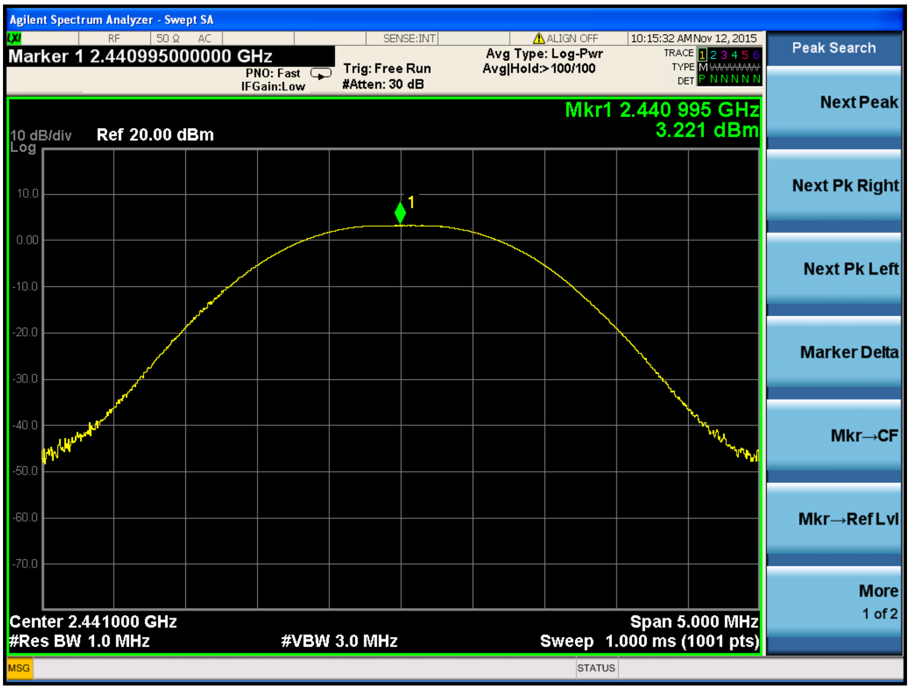
Please refer to the test plots as below:

For GFSK (DH1)

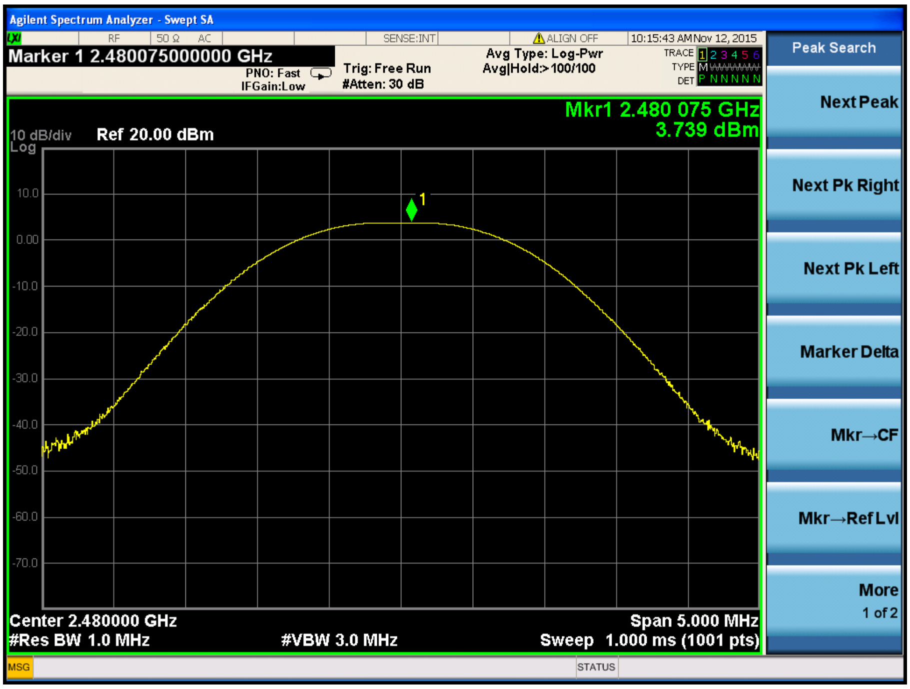
Low Channel:



Middle Channel:

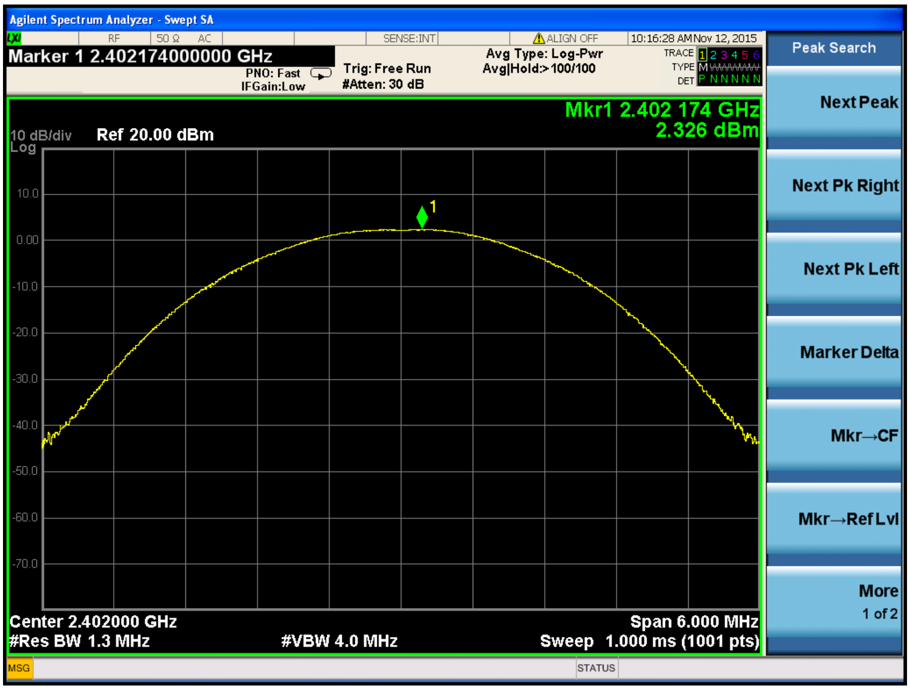


High Channel:

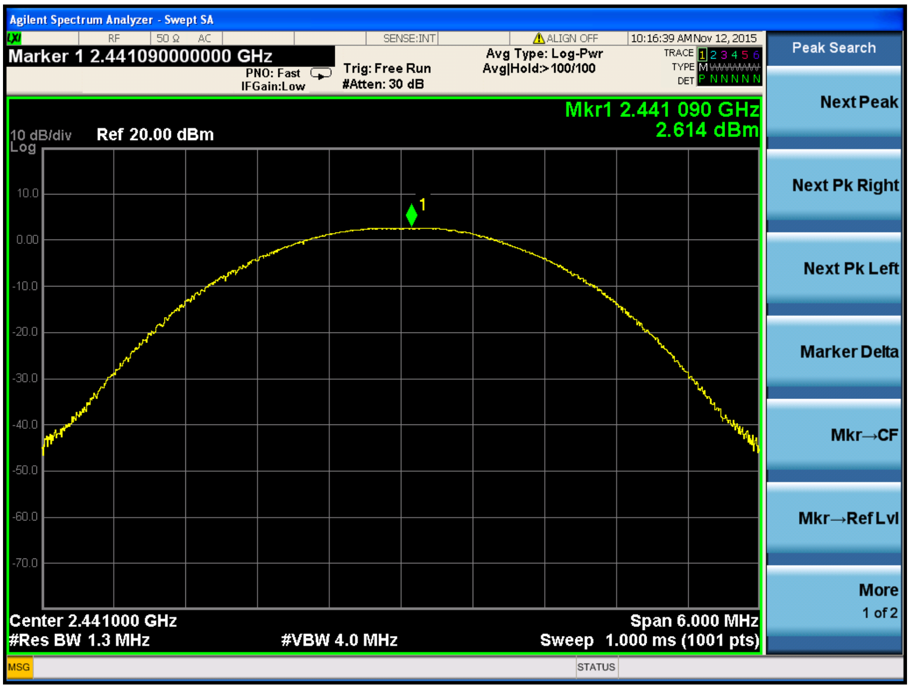


For Pi/4 DQPSK (2DH1)

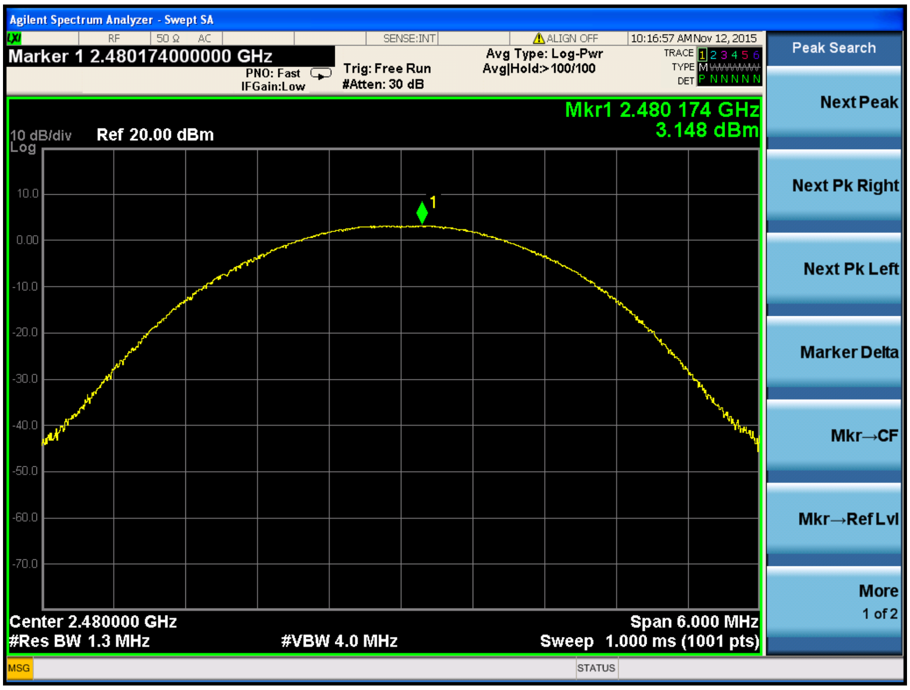
Low Channel:



Middle Channel:

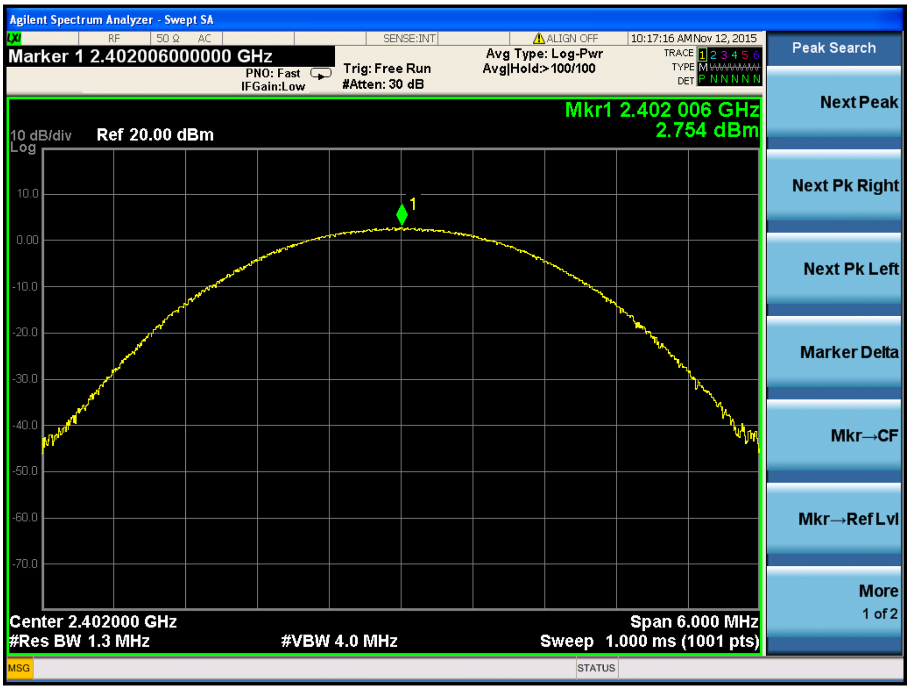


High Channel:

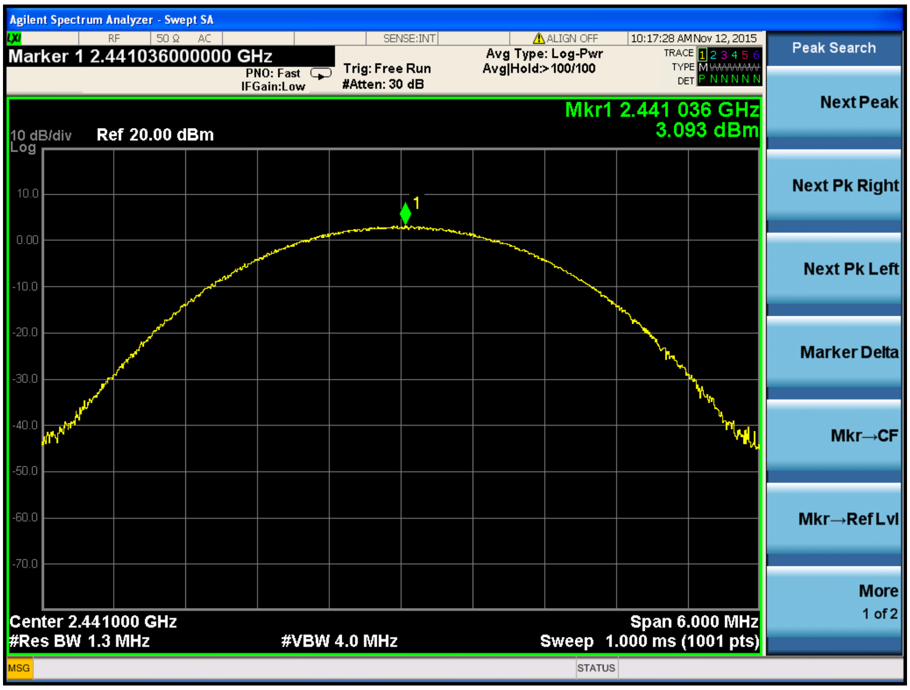


For 8DPSK (3DH1)

Low Channel:



Middle Channel:



High Channel:

10. Field Strength of Spurious Emissions

10.1 Measurement Uncertainty

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±5.10 dB.

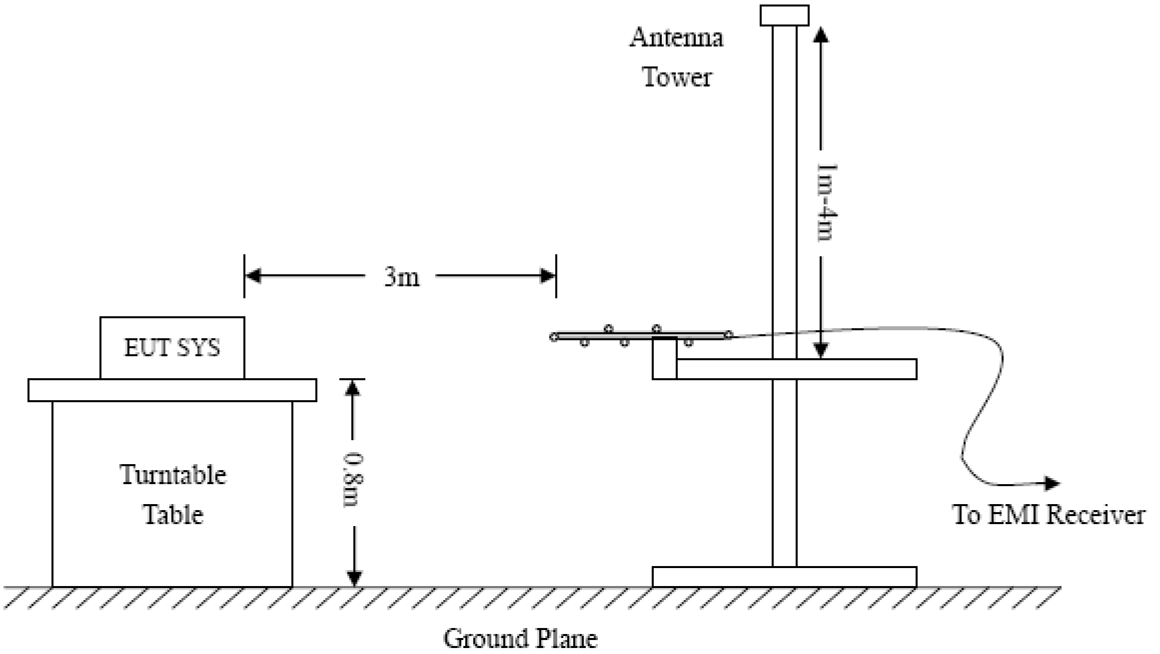
10.2 Standard Applicable

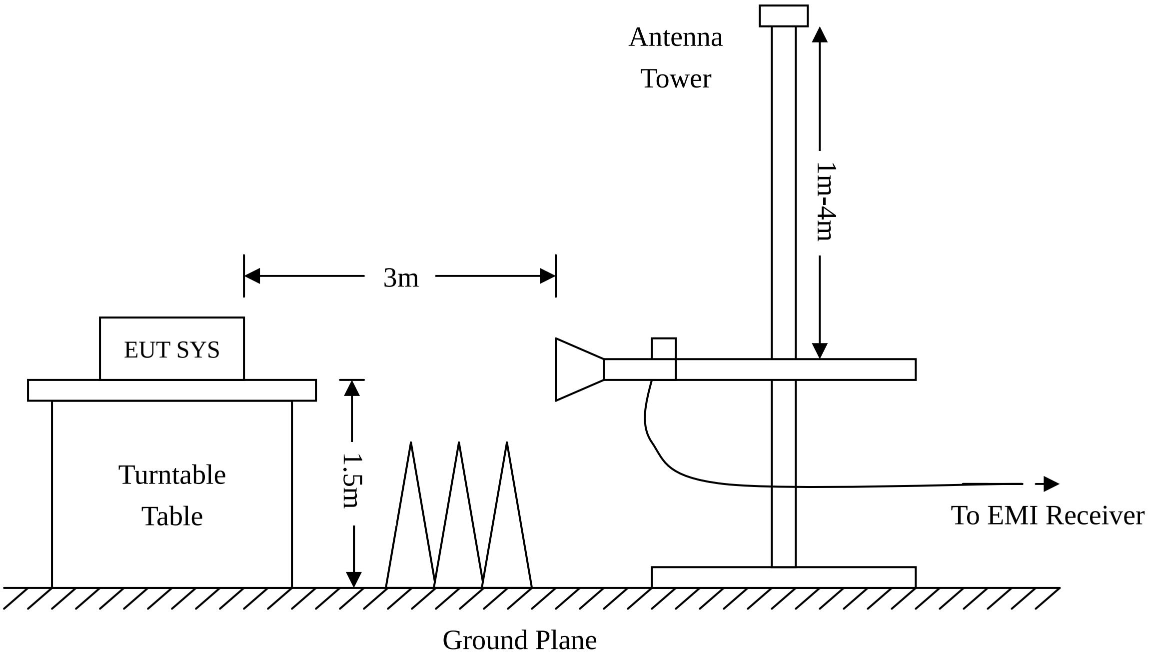
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within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

10.3 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.205 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

10.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

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

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

Margin = Corr. Ampl. – FCC Part 15 Limit

10.5 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

10.6 Summary of Test Results/Plots

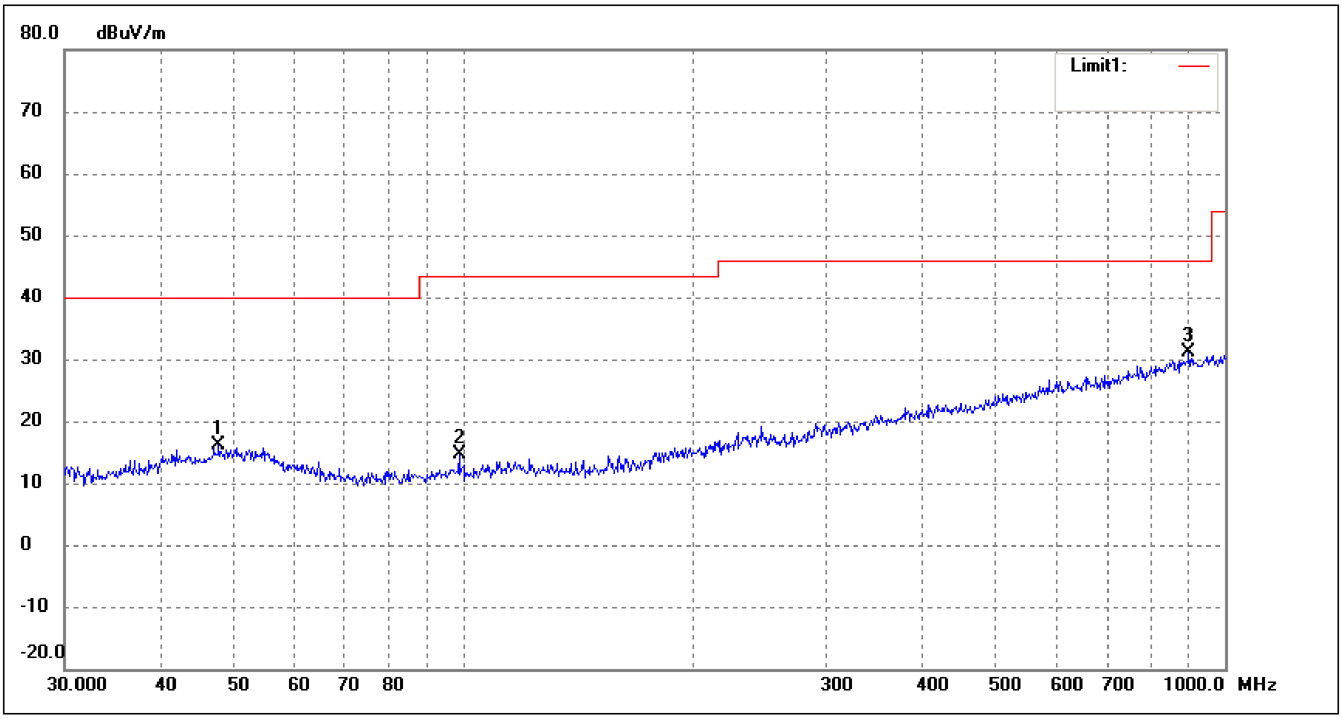
According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst cases:

Note: this EUT was tested in 3 orthogonal positions, the ***antenna vertically*** *is worst case position and the data was reported.*

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

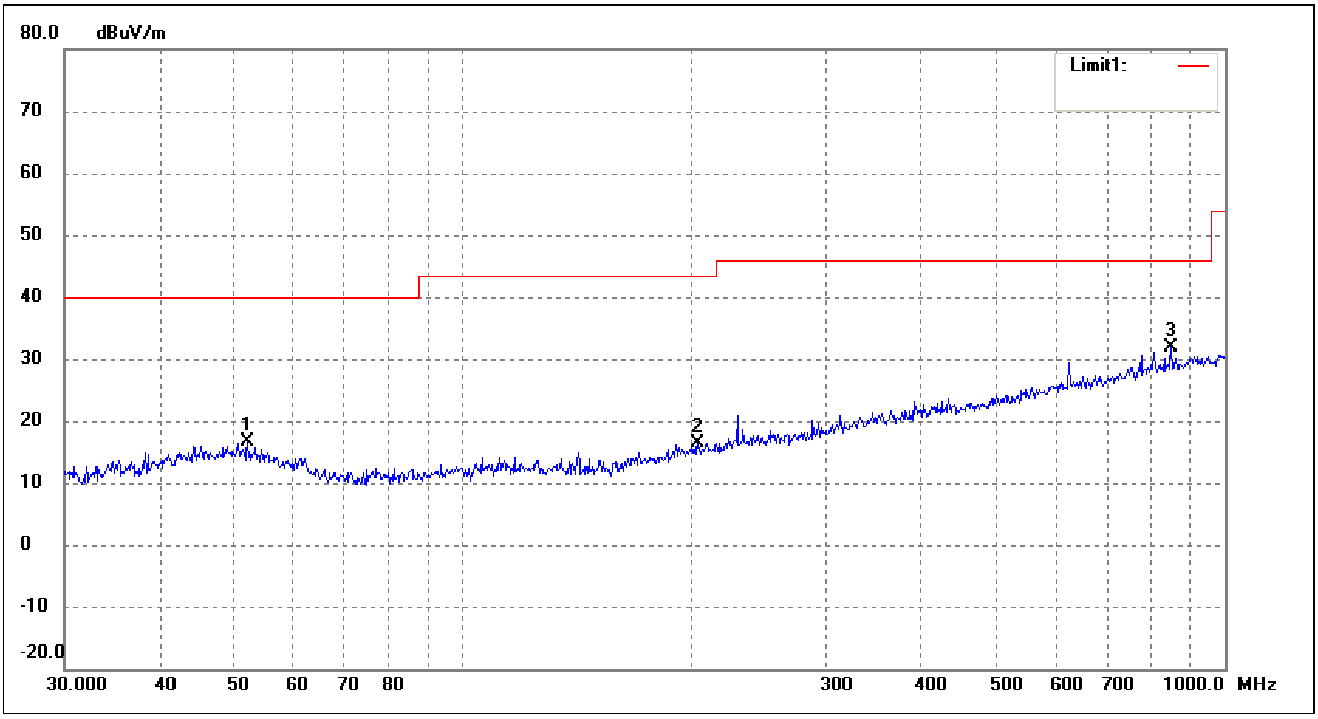
EUT: *Jupiter*
Tested Model: *IO 3*
Operating Condition: *Transmitting Low Channel (2402MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	47.8260	24.87	-8.68	16.19	40.00	-23.81	43	100	QP
2	98.8326	25.83	-11.30	14.53	43.50	-28.97	232	100	QP
3	896.9965	25.59	5.62	31.21	46.00	-14.79	5	100	QP

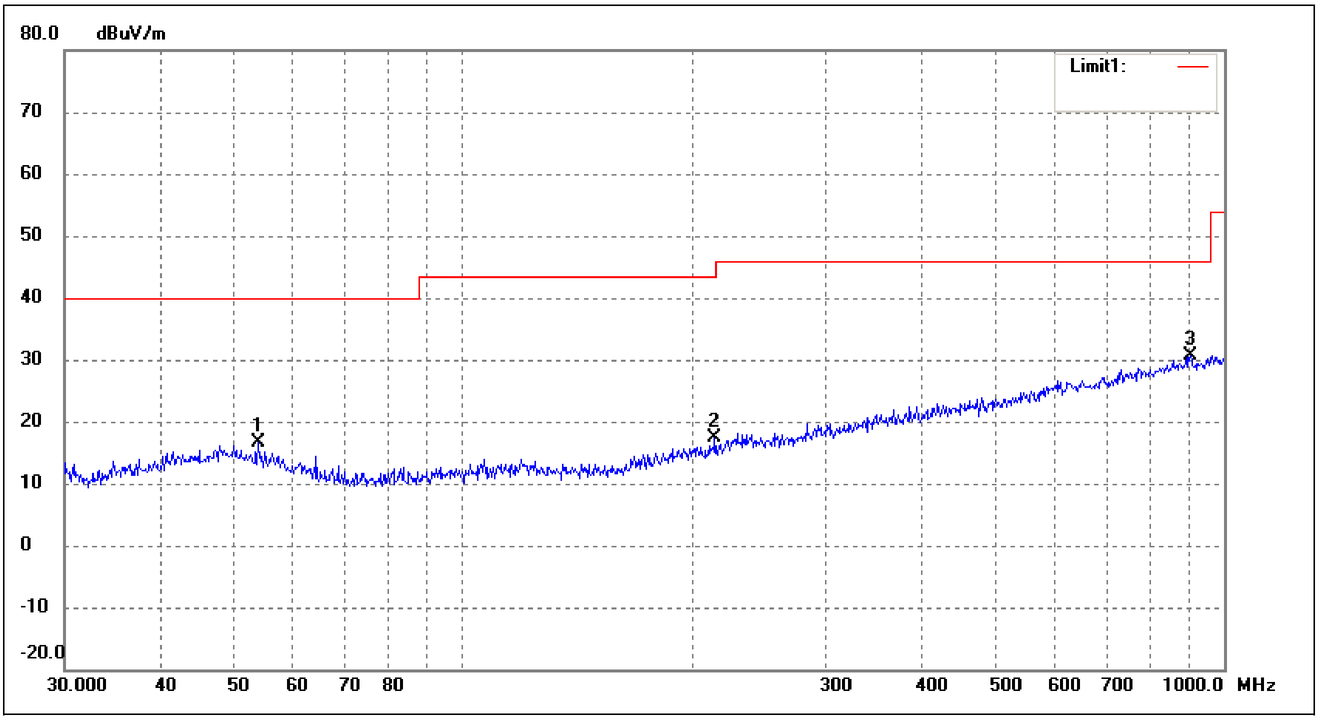
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	52.2079	25.46	-8.81	16.65	40.00	-23.35	45	100	QP
2	203.5228	24.45	-8.04	16.41	43.50	-27.09	242	100	QP
3	851.0353	27.05	4.92	31.97	46.00	-14.03	56	100	QP

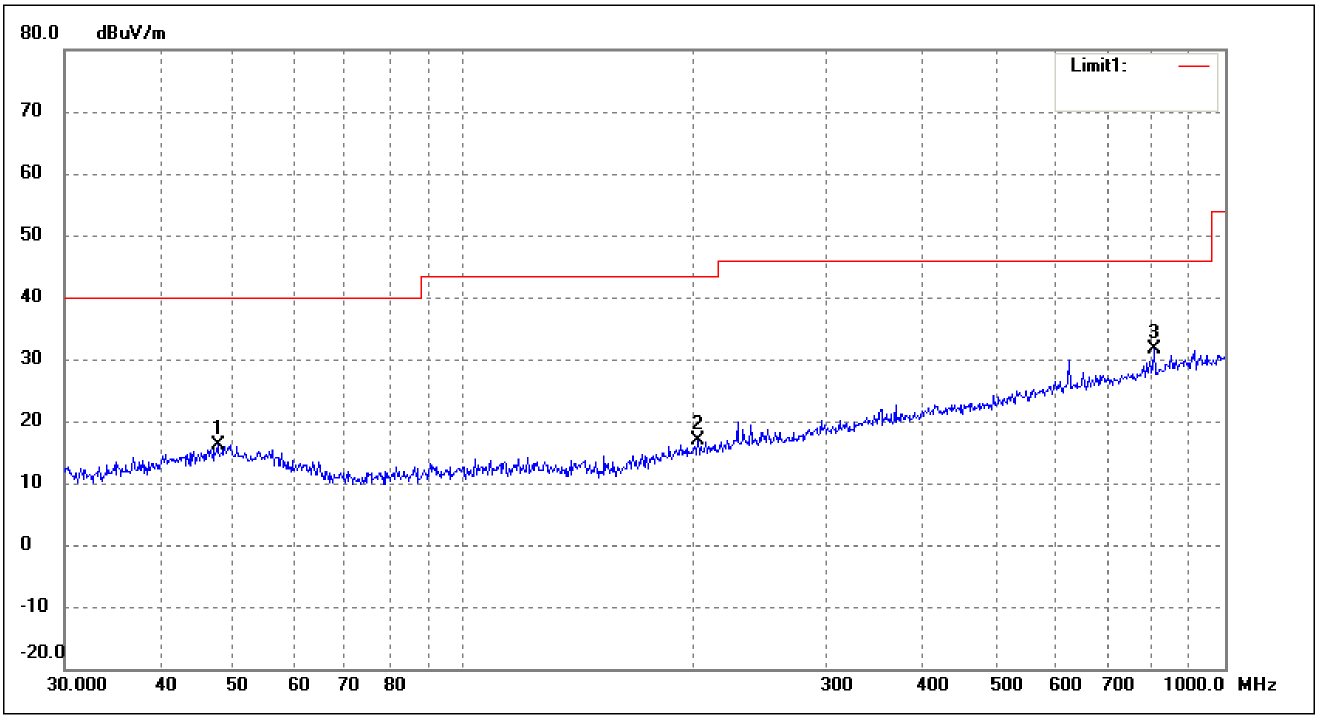
Operating Condition: *Transmitting Middle Channel (2441MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	53.8818	25.89	-9.17	16.72	40.00	-23.28	64	100	QP
2	214.5143	24.99	-7.60	17.39	43.50	-26.11	75	100	QP
3	903.3094	24.95	5.66	30.61	46.00	-15.39	1	100	QP

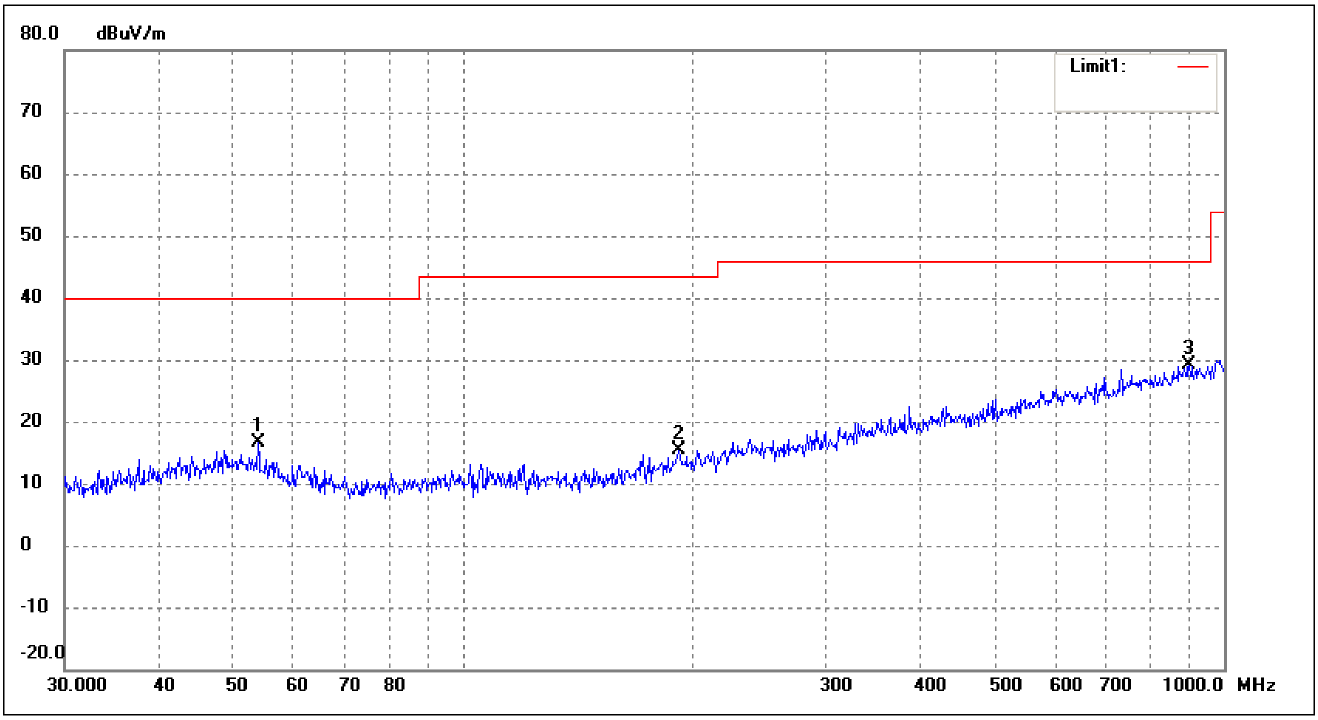
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	47.6586	24.75	-8.70	16.05	40.00	-23.95	85	100	QP
2	203.5228	24.88	-8.04	16.84	43.50	-26.66	332	100	QP
3	807.4291	27.30	4.35	31.65	46.00	-14.35	23	100	QP

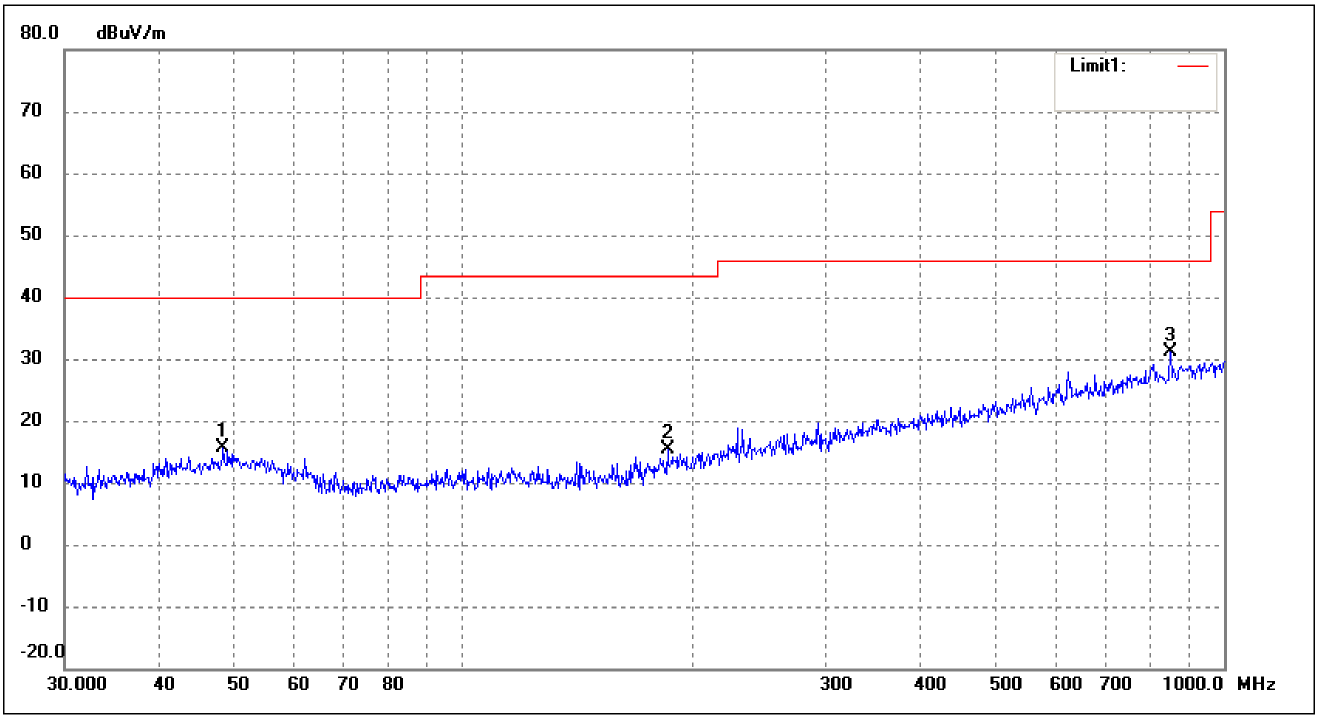
Operating Condition: *Transmitting High Channel (2480MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	53.8818	25.89	-9.17	16.72	40.00	-23.28	277	100	QP
2	192.4186	23.63	-8.37	15.26	43.50	-28.24	55	100	QP
3	900.1474	23.49	5.65	29.14	46.00	-16.86	135	100	QP

Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	48.5016	24.29	-8.58	15.71	40.00	-24.29	65	100	QP
2	185.7882	24.19	-8.78	15.41	43.50	-28.09	43	100	QP
3	851.0353	26.12	4.92	31.04	46.00	-14.96	234	100	QP

Note: Margin= (Reading+ Correct)- Limit

Spurious Emissions Above 1GHz

Transmitting: GFSK mode:

Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar H/V	Detector
Low Channel-2402MHz							
4804	43.82	12.33	56.15	74	-17.85	H	PK
4804	33.48	12.33	45.81	54	-8.19	H	AV
7206	35.16	15.46	50.62	74	-23.38	H	PK
7206	25.35	15.46	40.81	54	-13.19	H	AV
4804	45.57	12.33	57.90	74	-16.10	V	PK
4804	33.90	12.33	46.23	54	-7.77	V	AV
7206	37.02	15.46	52.48	74	-21.52	V	PK
7206	28.21	15.46	43.67	54	-10.33	V	AV
Middle Channel-2441MHz							
4882	43.31	12.46	55.77	74	-18.23	H	PK
4882	32.87	12.46	45.33	54	-8.67	H	AV
7323	37.53	15.56	53.09	74	-20.91	H	PK
7323	27.77	15.56	43.33	54	-10.67	H	AV
4882	44.56	12.46	57.02	74	-16.98	V	PK
4882	32.92	12.46	45.38	54	-8.62	V	AV
7323	40.37	15.56	55.93	74	-18.07	V	PK
7323	27.93	15.56	43.49	54	-10.51	V	AV
High Channel-2480MHz							
4960	43.65	12.57	56.22	74	-17.78	H	PK
4960	33.34	12.57	45.91	54	-8.09	H	AV
7440	38.95	15.65	54.6	74	-19.4	H	PK
7440	27.42	15.65	43.07	54	-10.93	H	AV
4960	45.78	12.57	58.35	74	-15.65	V	PK
4960	33.48	12.57	46.05	54	-7.95	V	AV
7440	40.13	15.65	55.78	74	-18.22	V	PK
7440	28.57	15.65	44.22	54	-9.78	V	AV

Note: Margin= (Reading+ Correct)- Limit

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, which above 3th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
The measurements greater than 20dB below the limit from 9kHz to 30MHz.

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 the DA 00-705, the band-edge radiated test method as follows.

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2410MHz for low bandedge, 2470MHz 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; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation porduct outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the DA 00-705, the band-edge conducted test method as follows:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2380MHz to 2410MHz for low bandedge, 2470MHz to 2500MHz for the high bandedge)
RBW = 100kHz, VBW = 300kHz
Sweep = auto; Detector function = peak; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation porduct 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 limit specified in this section (at least 20dB attenuation).

11.3 Environmental Conditions

Temperature:	23°C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

11.4 Summary of Test Results/Plots

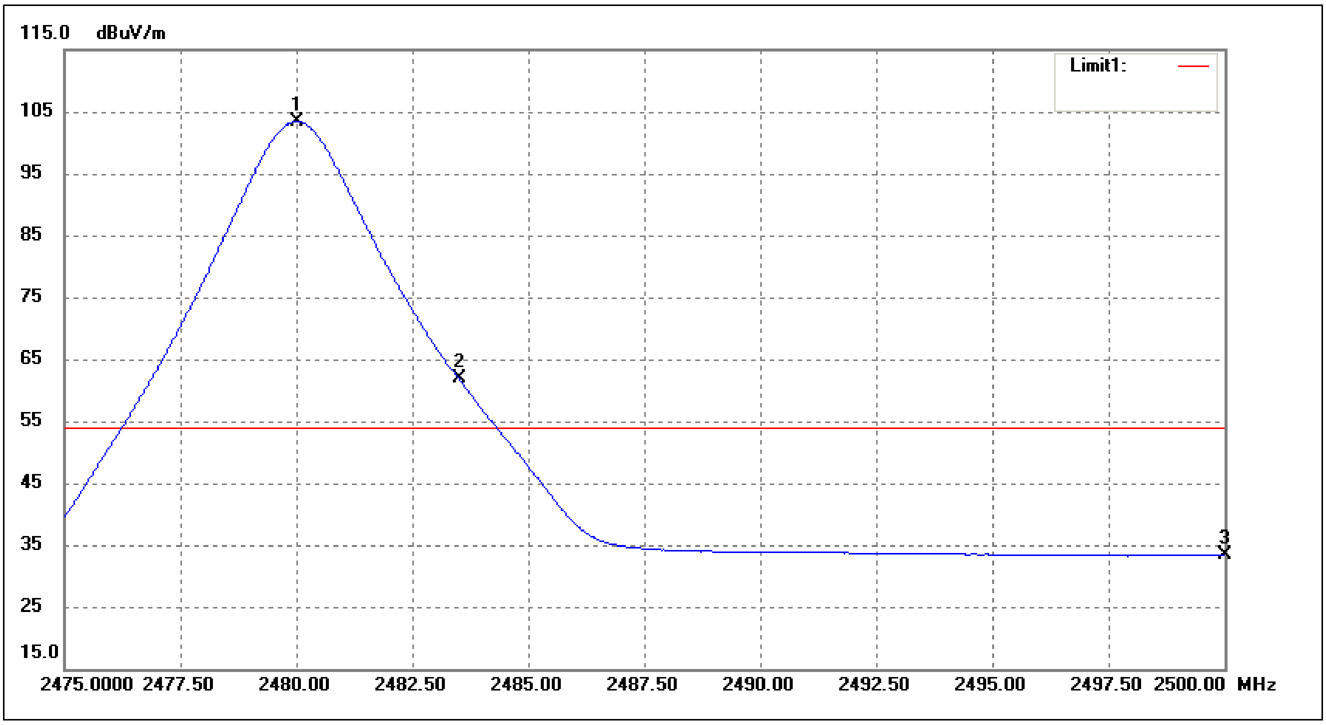
Please refer to the test plots as below.

Bandedge (Radiated)
Lowest Bandedge
Horizontal (Worst case)

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	36.88	-4.98	31.90	54.00	-22.10	Average Detector
	2310.000	48.24	-4.98	43.26	74.00	-30.74	Peak Detector
2	2390.000	37.48	-4.26	33.22	54.00	-20.78	Average Detector
	2390.000	49.29	-4.26	45.03	74.00	-28.97	Peak Detector
3	2400.000	80.65	-4.18	76.47	Delta=26.19dBc		Average Detector
4	2402.100	106.83	-4.17	102.66			Average Detector

Highest Bandedge

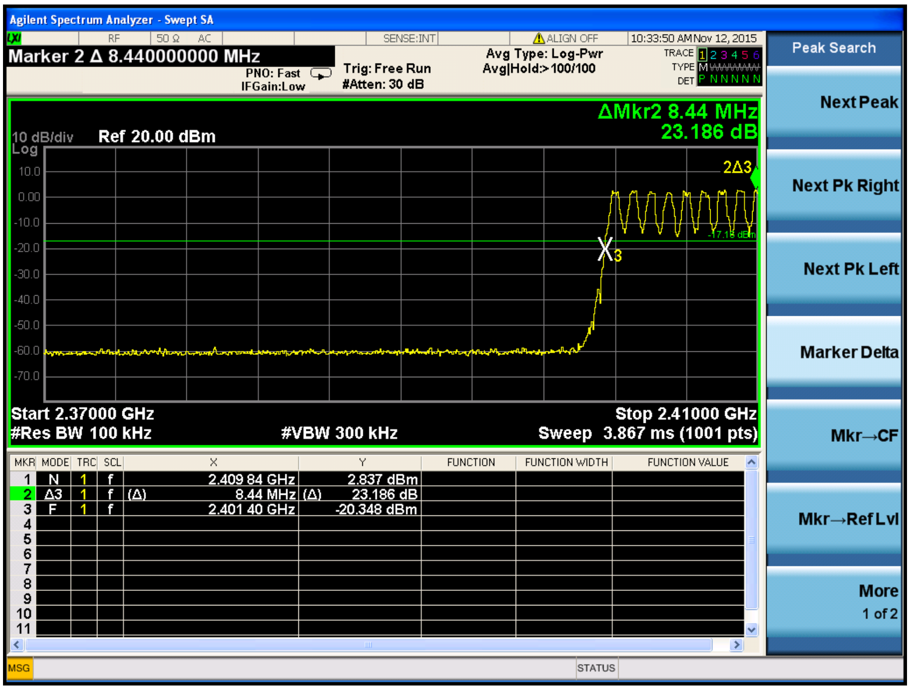
Horizontal (Worst case)



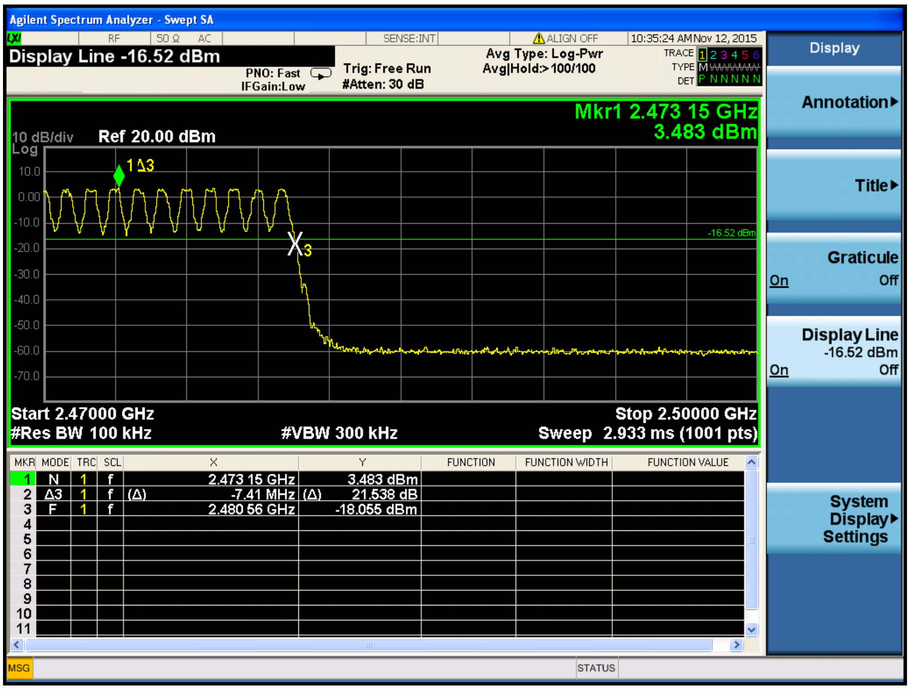
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.000	106.99	-3.55	103.44	/	/	Average Detector
	2479.975	107.17	-3.55	103.62	/	/	Peak Detector
2	2483.500	Delta=66.88dBc		35.56	54.00	-18.44	Average Detector
	2483.500			36.74	74.00	-37.26	Peak Detector
3	2500.000	36.74	-3.39	33.35	54.00	-20.65	Average Detector
	2500.000	49.07	-3.39	45.68	74.00	-28.32	Peak Detector

Bandedge with Hopping on:

Lowest Bandedge



Highest Bandedge



12. Conducted Emissions

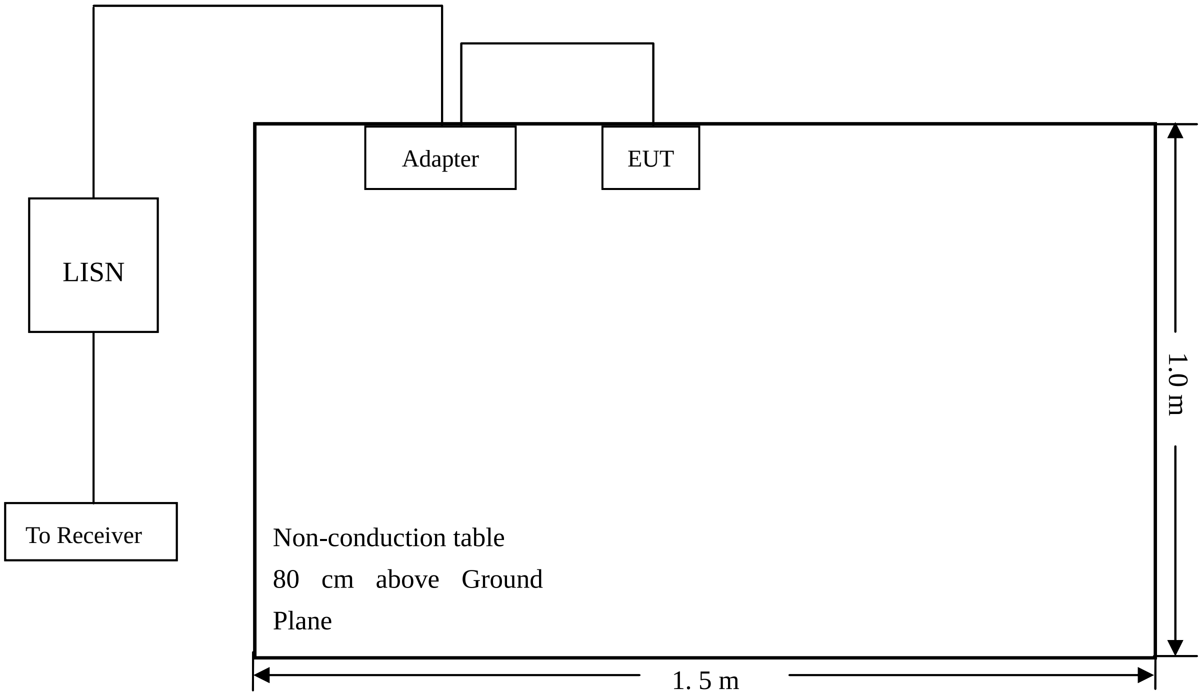
12.1 Measurement Uncertainty

Base on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement is $\pm$ 2.88 dB.

12.2 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.

12.3 Basic Test Setup Block Diagram



12.4 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

12.5 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

12.6 Summary of Test Results/Plots

According to the data in section 12.7, the EUT complied with the FCC Part 15.207 Conducted margin for this device, with the *worst* margin reading of:

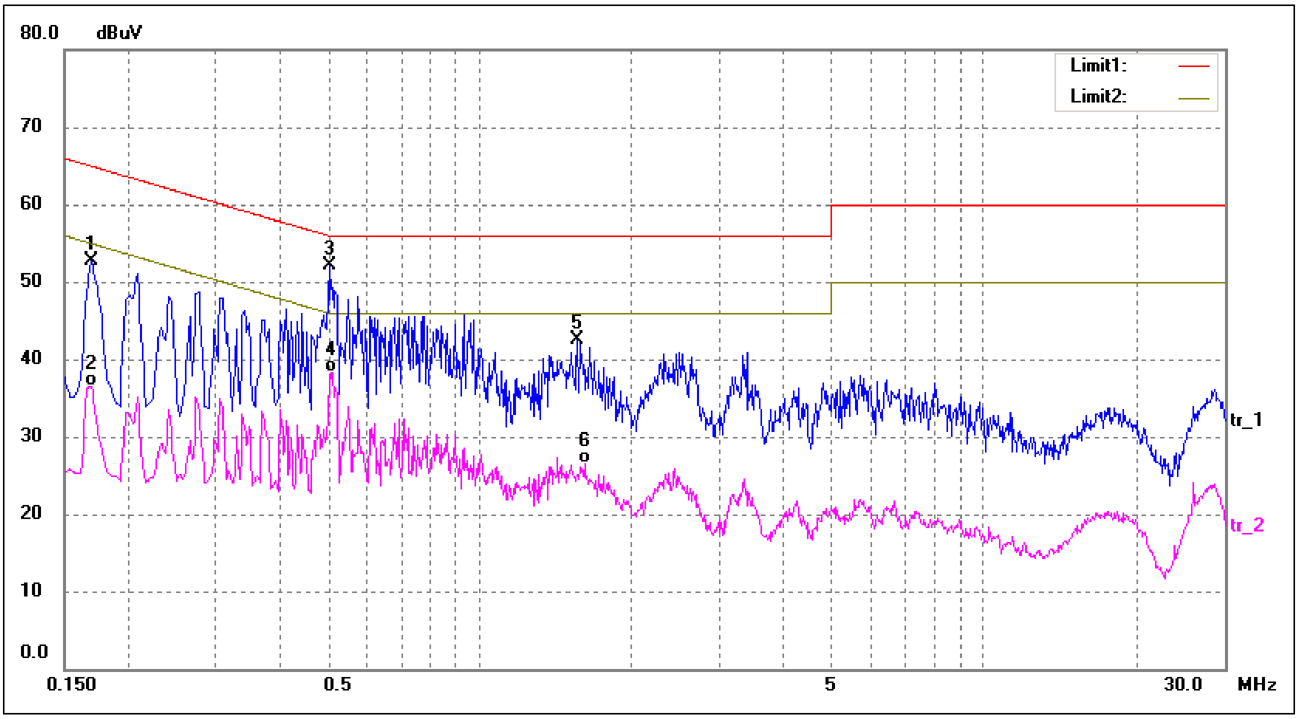
-2.80 dB at **0.4980 MHz** in the **Line, Peak** detector, 0.15-30MHz

12.7 Conducted Emissions Test Data

Plot of Conducted Emissions Test Data

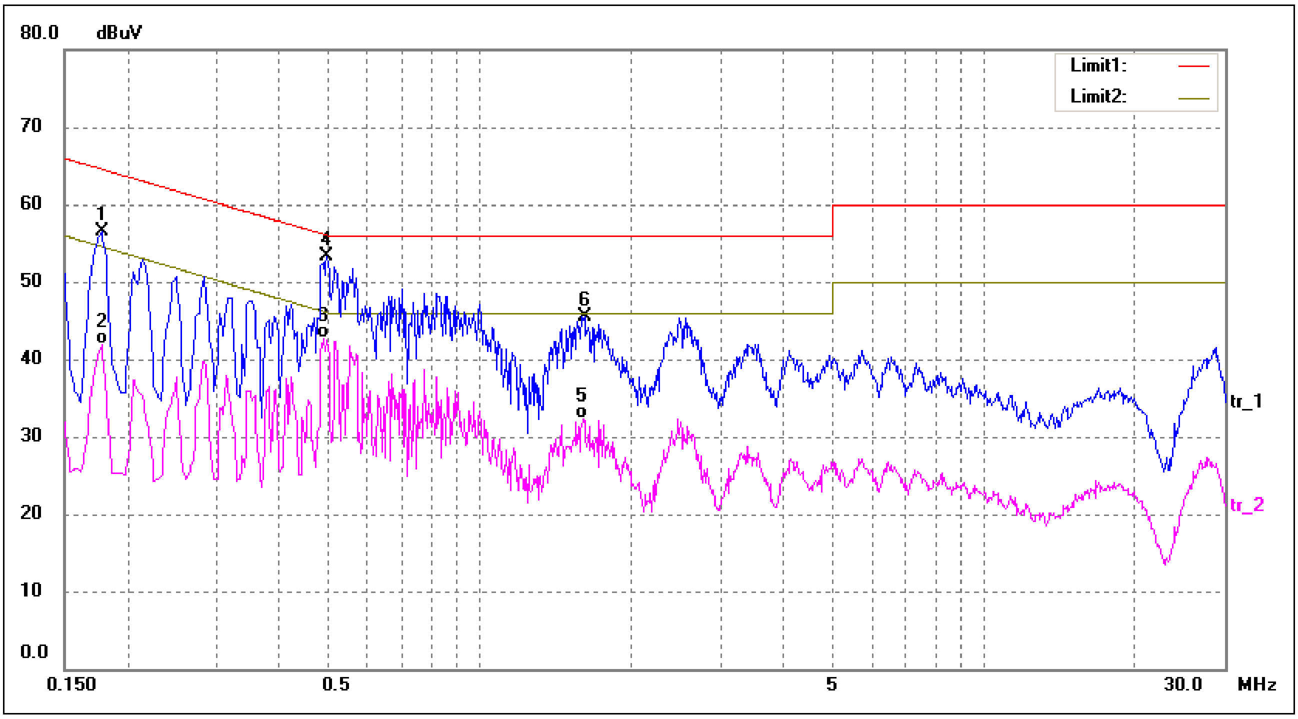
EUT: *Jupiter*
Tested Model: *IO 3*
Operating Condition: *(BT)Transmitting*
Comment: *AC 120V/60Hz; Adapter DC 5V*

Test Specification: *Neutral*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.1700	40.16	12.50	52.66	64.96	-12.30	peak
2	0.1700	23.99	12.50	36.49	54.96	-18.47	AVG
3*	0.5020	39.53	12.50	52.03	56.00	-3.97	peak
4	0.5100	25.83	12.51	38.34	46.00	-7.66	AVG
5	1.5660	29.58	13.00	42.58	56.00	-13.42	peak
6	1.6140	13.41	13.00	26.41	46.00	-19.59	AVG

Test Specification: *Line*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.1780	43.98	12.50	56.48	64.58	-8.10	peak
2	0.1780	29.37	12.50	41.87	54.58	-12.71	AVG
3	0.4900	30.24	12.50	42.74	46.17	-3.43	AVG
4*	0.4980	40.73	12.50	53.23	56.03	-2.80	peak
5	1.6060	19.31	13.00	32.31	46.00	-13.69	AVG
6	1.6140	32.57	13.00	45.57	56.00	-10.43	peak

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