FCC TEST REPORT
No. 161000982SHA-002

Applicant	:	Shanghai Allocacoc Industrial Design Co., Ltd. Room 624, No.2, Lane1518, Jinshajiang Road, Putuo District, Shanghai, China
Manufacturer	:	Shanghai Allocacoc Industrial Design Co., Ltd. Room 624, No.2, Lane1518, Jinshajiang Road, Putuo District, Shanghai, China
Product Name	:	Audio Cube
Type/Model	:	3701/USACWD, 3801/USACUB, 3800/WOACUB, 3901/USACPT, 3900/WOACPT
TEST RESULT	**:**	**PASS**

SUMMARY

The equipment complies with the requirements according to the following standard(s) or specification:

47CFR Part 15 (2015): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Date of issue: April 5, 2017

Prepared by: Reviewed by:

Nemo Li (*Project Engineer*) Daniel Zhao (*Reviewer*)

Description of Test Facility

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FCC Registration Number: 236597
IC Assigned Code: 2402B-1

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Tel: 86 21 61278271
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1 GENERAL INFORMATION

1.1 Description of Client

Applicant	:	Shanghai Allocacoc Industrial Design Co., Ltd. Room 624, No.2, Lane1518, Jinshajiang Road, Putuo District, Shanghai, China
Manufacturer site	:	Shanghai Allocacoc Industrial Design Co., Ltd. Room 624, No.2, Lane1518, Jinshajiang Road, Putuo District, Shanghai, China

1.2 Identification of the EUT

Product Name	:	Audio Cube
Type/model	:	3701/USACWD, 3801/USACUB, 3800/WOACUB, 3901/USACPT, 3900/WOACPT
FCC ID	:	2AKHT-ACUB

1.3 Technical Specification

Operation Frequency Band	:	2400 – 2483.5 MHz
Protocol	:	Bluetooth Base Rate + EDR
Type of Modulation	:	GFSK, π/4-DQPSK, 8DPSK
Channel Number	:	79 channels
Description of EUT	:	EUT is an audio cube, and has five models. They are have the same electrical construction except the colour of the product.
Antenna		PCB antenna, 0dBi max
Rating		100-250V~, 50-60Hz
Category of EUT	:	Class B
EUT type	:	☒ Table top ☐ Floor standing
Sample received date	:	October 18, 2016
Date of test	:	October 18, 2016 ~ March 24, 2017

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2015)
ANSI C63.10 (2013)

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

Due to the fact that the modulations of π/4-DQPSK and 8DPSK are similar, so the modulations of GFSK and 8DPSK are chosen to perform the full tests as representative. The lowest, middle and highest channel were tested.

Freq. Band (MHz)	Modulation	Lowest (MHz)	Middle (MHz)	Highest (MHz)
2400-2483.5	GFSK	2402	2441	2480
	8DPSK	2402	2441	2480

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	Laptop computer	HP, EliteBook 2530P	-

2.5 Instrument list

Selected	Instrument	EC no.	Model	Valid until date
☒	Shielded room	EC 2838	GB88	2018-1-8
☒	EMI test receiver	EC 2107	ESCS 30	2017-10-19
☒	A.M.N.	EC 3119	ESH2-Z5	2017-12-16
☐	A.M.N.	EC 3394	ENV 216	2017-8-1
☒	Semi anechoic chamber	EC 3048	-	2017-5-11
☒	EMI test receiver	EC 3045	ESIB26	2017-10-19
☒	Broadband antenna	EC 4206	CBL 6112D	2017-4-27
☒	Horn antenna	EC 3049	HF906	2017-4-27
☐	Horn antenna	EC 4792-1	3117	2017-4-21
☐	Horn antenna	EC 4792-3	HAP18-26W	2017-6-11
☒	Pre-amplifier	EC 5262	pre-amp 18	2017-5-25
☐	Pre-amplifier	EC 4792-2	TPA0118-40	2017-4-10
☐	Test Receiver	EC 4501	ESCI 7	2018-1-13
☒	PXA Signal Analyzer	EC5338	N9030A	2017-11-17
☒	Power sensor/Power meter	EC4318	N1911A/N1921A	2017-4-8
☐	Power sensor	EC5338-1	U2021XA	2018-3-5
☐	MXG Analog Signal Generator	EC5338-2	N5181A	2018-3-5
☐	MXG Vector Signal Generator	EC5175	N51812B	2018-1-8

2.6 Test Summary

This report applies to tested sample only. The test results have been compared directly with the limits, and the measurement uncertainty is recorded. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	RESULT
20 dB Bandwidth	15.247(a)(1)	Tested
Carrier Frequency Separation	15.247(a)(1)	Pass
Maximum peak output power	15.247(b)(1)	Pass
Radiated Emissions in restricted frequency bands	15.205 & 15.209	Pass
Emission outside the frequency band	15.247(d)	Pass
Number of Hopping Frequencies	15.247(a)(1)(iii)	Pass
Dwell time	15.247(a)(1)(iii)	Pass
Power line conducted emission	15.207	Pass

Notes: 1: NA =Not Applicable

2: This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

3 20 dB Bandwidth

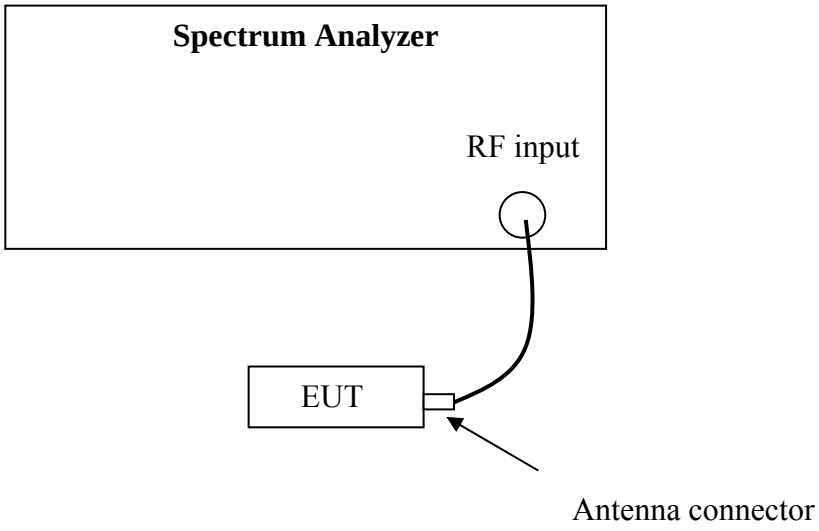
Test result: Pass

3.1 Limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ 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, whichever is greater, provided the systems operate with an output power no greater than 125mW.

3.2 Test Configuration



3.3 Test Procedure and test setup

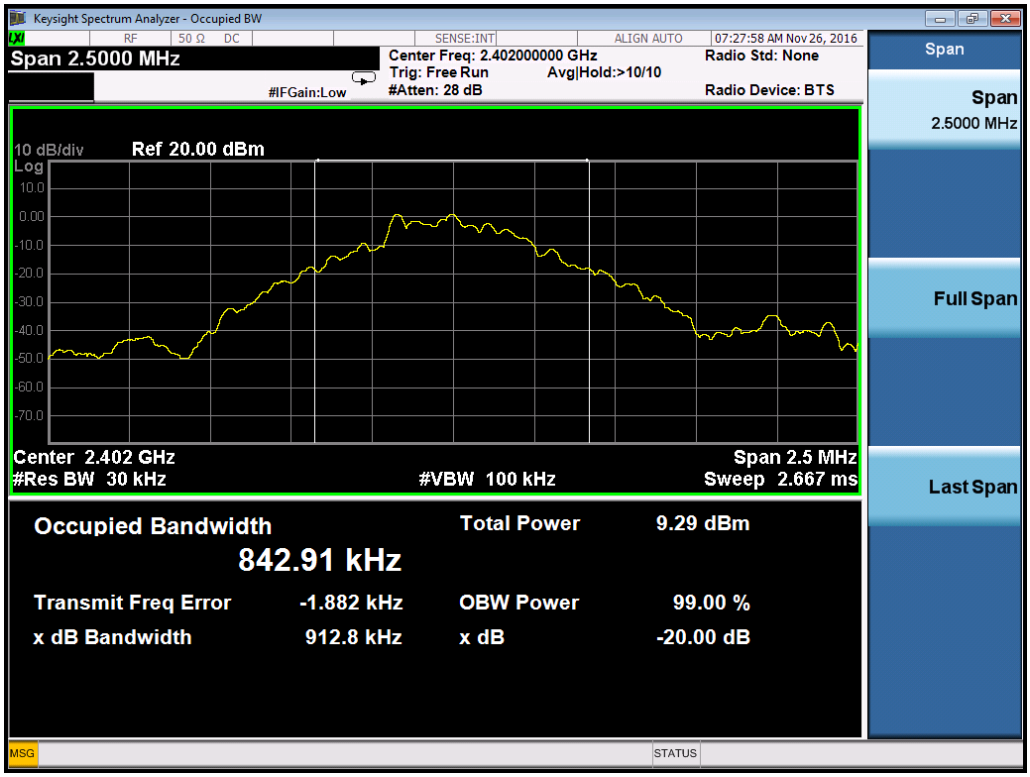
The 20 bandwidth per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span = 2 to 3 times the 20 dB bandwidth, RBW≥1% of the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

3.4 Test Protocol

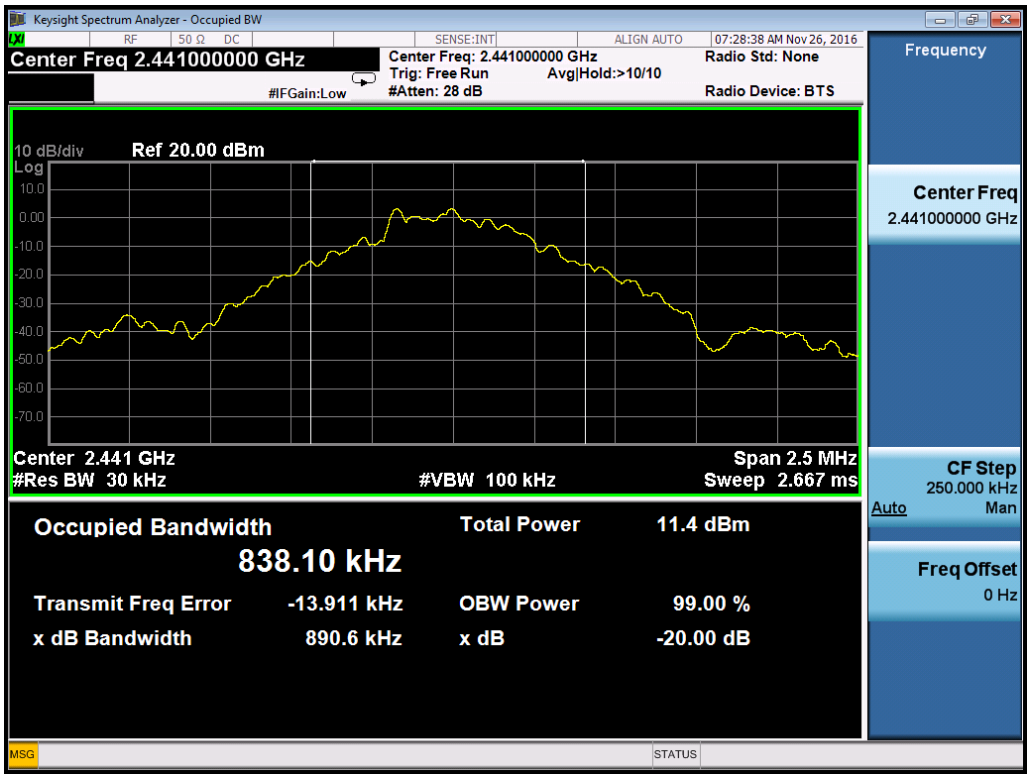
Temperature: 22°C
Relative Humidity: 54%

Modulation	Channel	20dB Bandwidth (kHz)	Two-thirds of Bandwidth (kHz)
GFSK	L	912.8	608.53
	M	890.6	593.73
	H	886.4	590.93

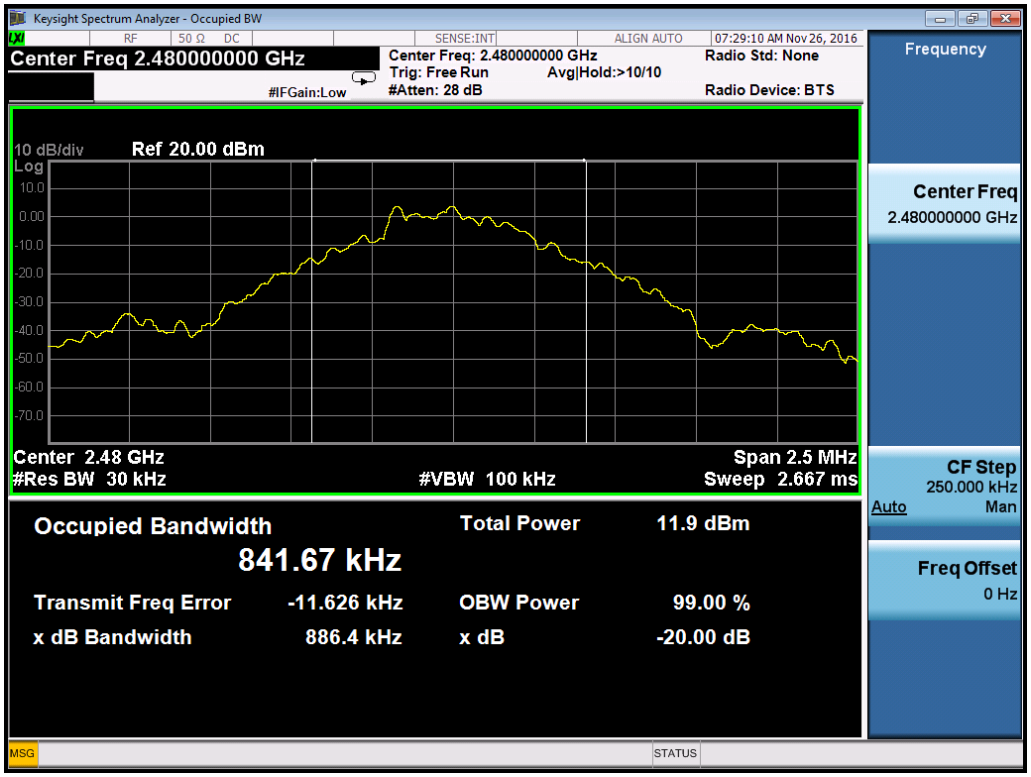
Channel L



Channel M



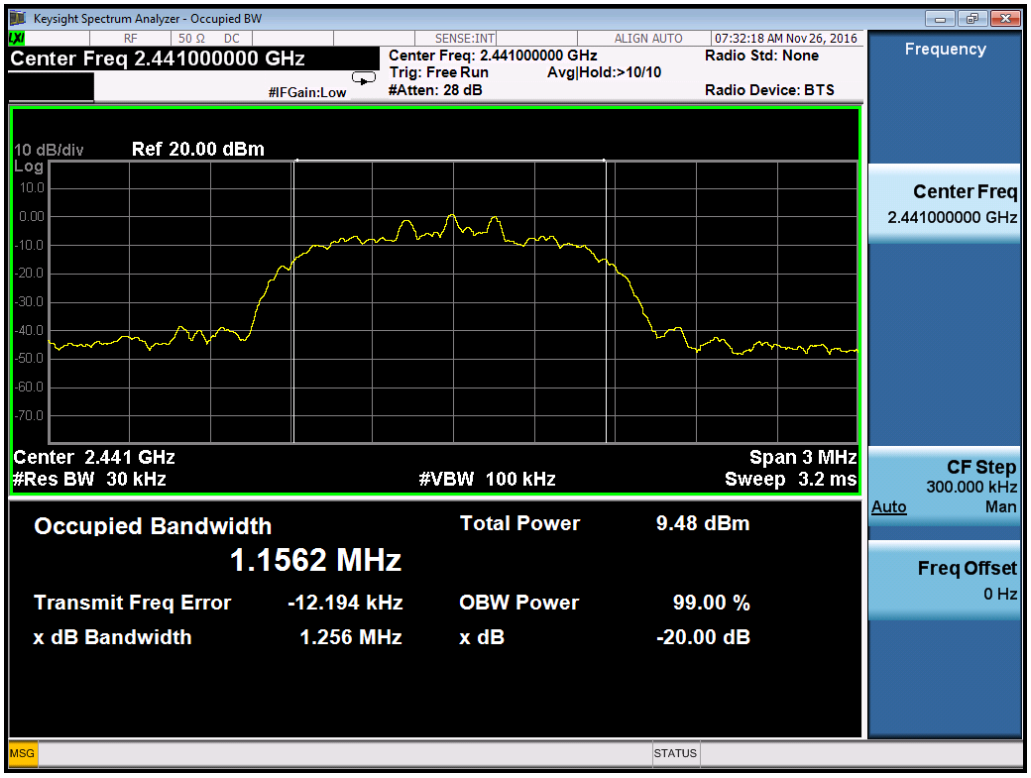
Channel H



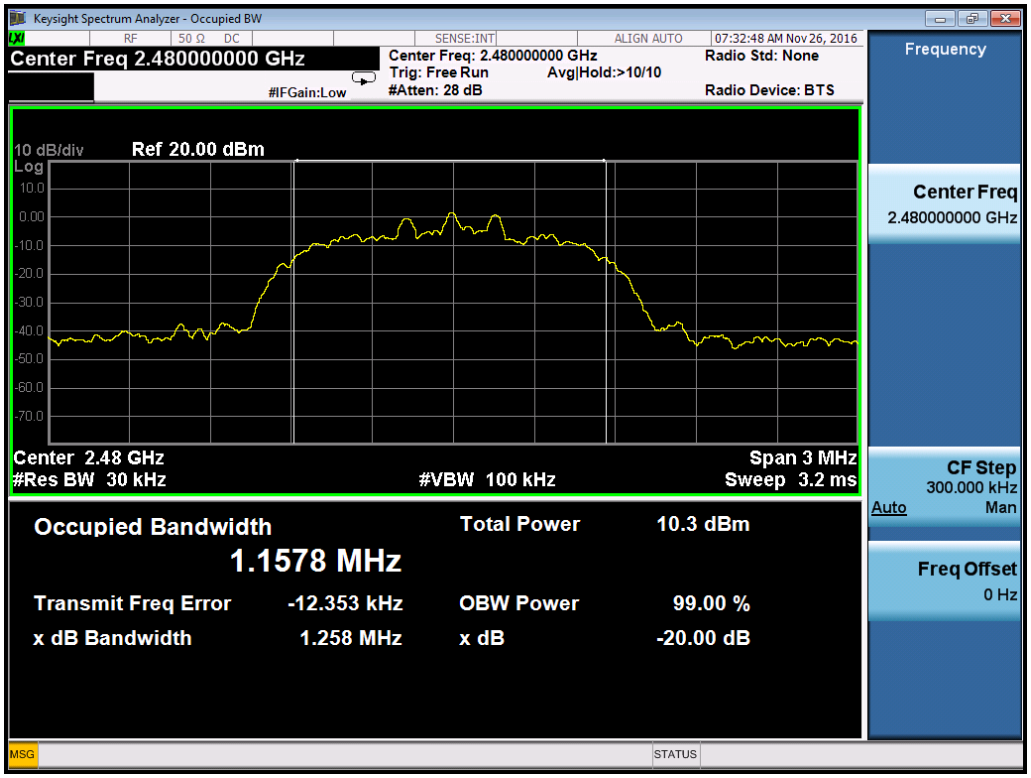
Modulation	Channel	20dB Bandwidth (kHz)	Two-thirds of Bandwidth (kHz)
8DPSK	L	1271	847.33
	M	1256	837.33
	H	1258	838.67

Channel L

Channel M



Channel H



4 Carrier Frequency Separation

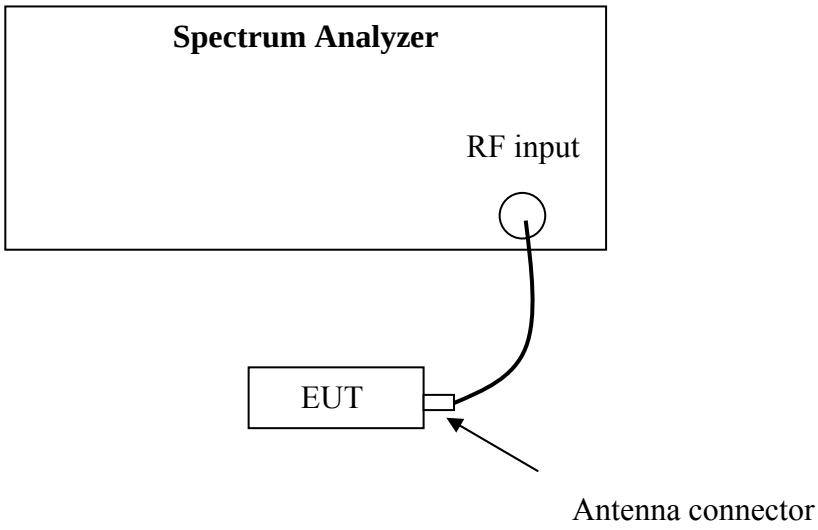
Test result: Pass

4.1 Test limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ 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, whichever is greater, provided the systems operate with an output power no greater than 125mW.

4.2 Test Configuration



4.3 Test procedure and test setup

The Carrier Frequency Separation per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels, RBW≥1% of the span, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

4.4 Test protocol

Temperature: 22 °C
Relative Humidity: 54 %

Modulation	Channel	Frequency Separation (kHz)	Limit (kHz)
GFSK	L	1012	≥ 608.53
	M	1011	≥ 593.73
	H	1011	≥ 590.93

Channel L

Channel M

Channel H

Modulation	Channel	Frequency Separation (kHz)	Limit (kHz)
8DPSK	L	996	≥ 847.33
	M	999	≥ 837.33
	H	999	≥ 838.67

Channel L

Channel M

Channel H

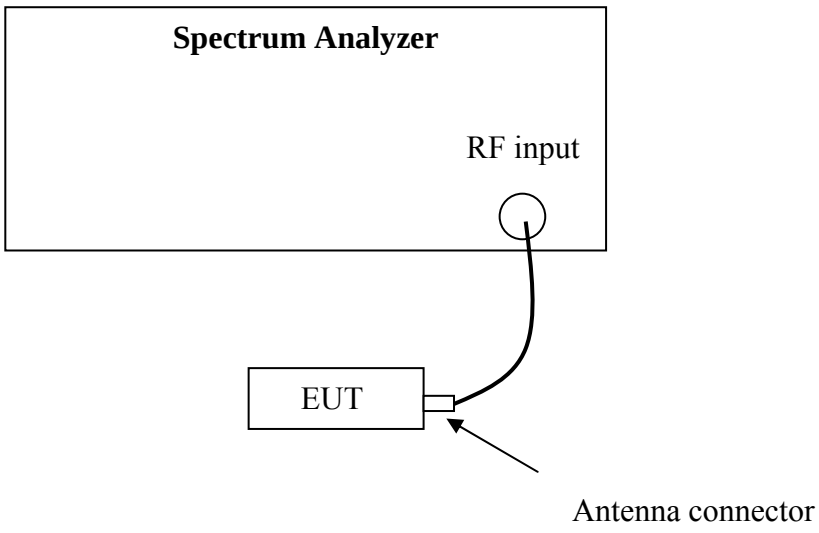
5 Maximum peak output power

Test result: Pass

5.1 Test limit

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
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

5.2 Test Configuration



5.3 Test procedure and test setup

The Maximum peak output power per FCC § 15.247(b) is measured using the Spectrum Analyzer with Span = 5 times the 20 dB bandwidth, RBW≥ the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

5.4 Test Protocol

Temperature: 22°C
Relative Humidity: 54%

Modulation	Channel	Conducted Power (dBm)	Limit (dBm)
GFSK	L	2.771	≤ 21.00
	M	4.817	≤ 21.00
	H	5.201	≤ 21.00

Modulation	Channel	Conducted Power (dBm)	Limit (dBm)
8DPSK	L	0.961	≤ 21.00
	M	3.703	≤ 21.00
	H	4.297	≤ 21.00

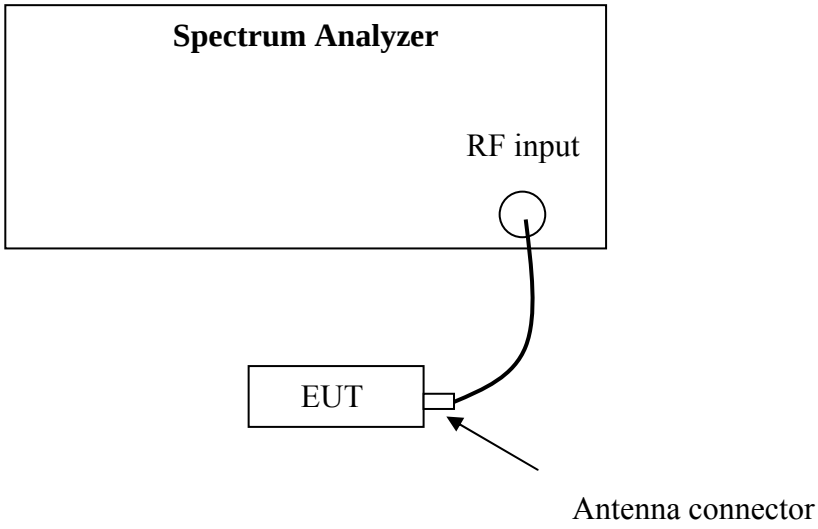
6 Emission outside the frequency band

Test result: **Pass**

6.1 Test limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

6.2 Test Configuration



6.3 Test procedure and test setup

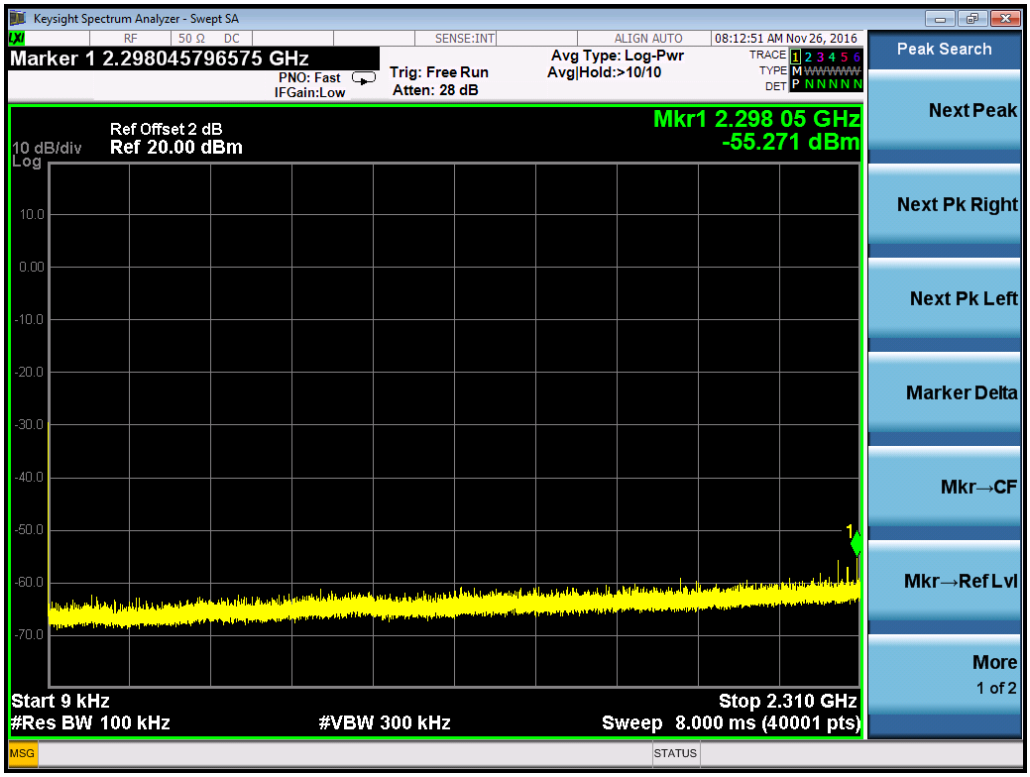
The Emission outside the frequency band per FCC § 15.247(d) is measured using the Spectrum Analyzer with Span wide enough capturing all spurious from the lowest emission frequency of the EUT up to 10th harmonics, RBW = 100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

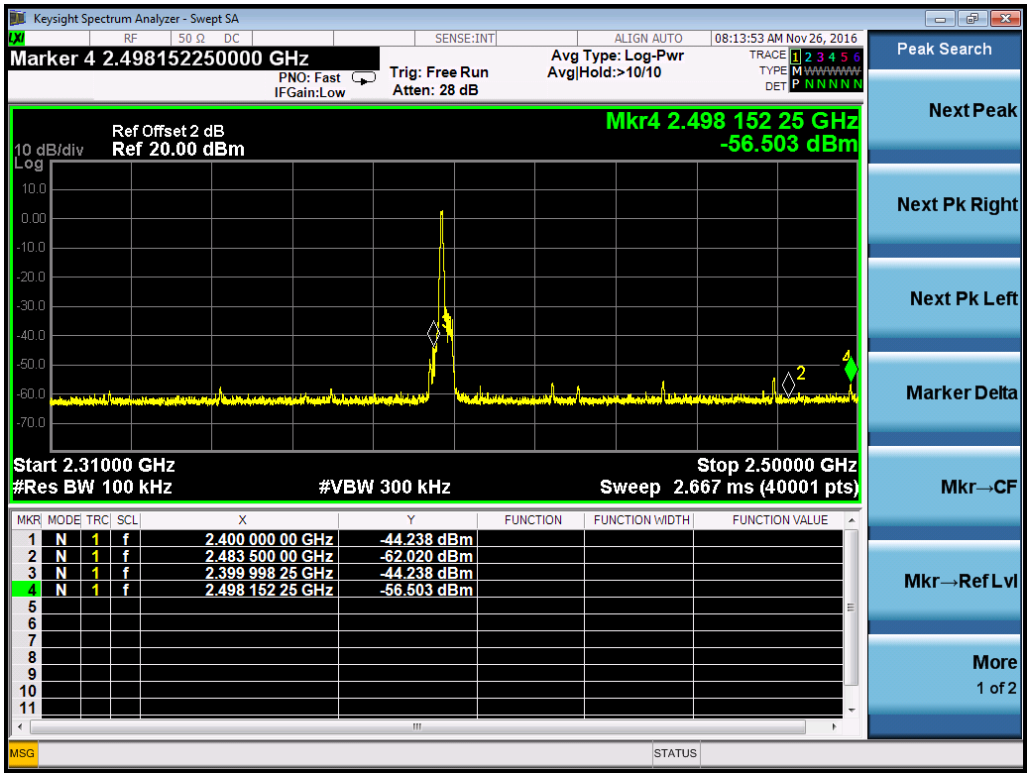
6.4 Test Protocol

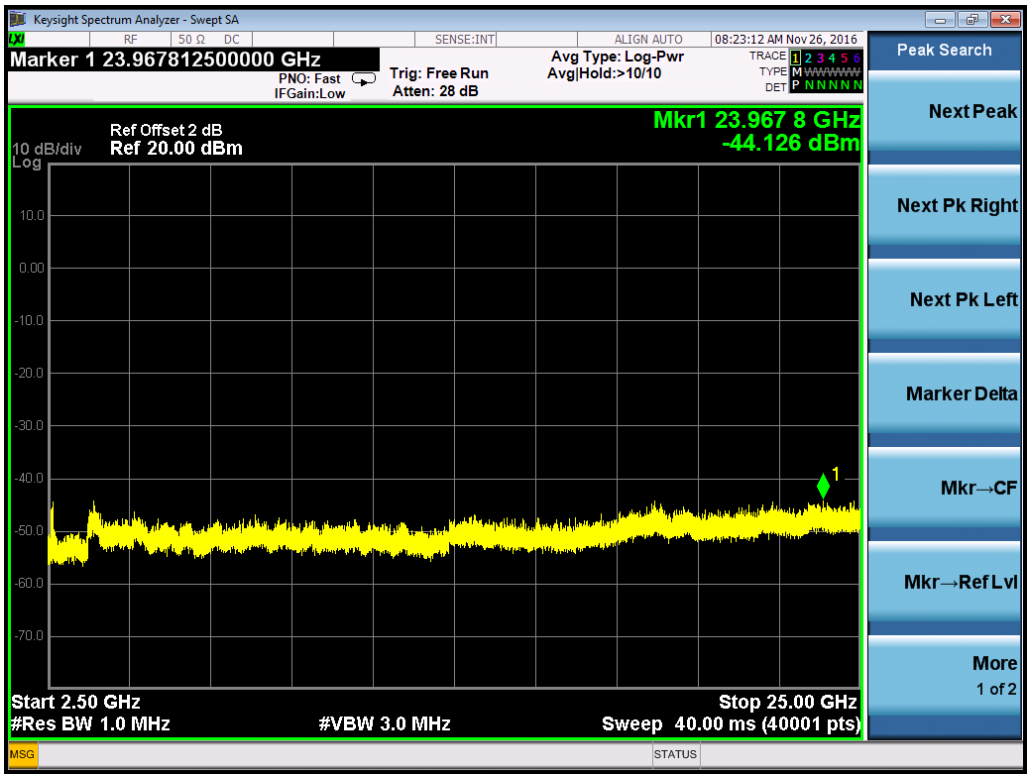
Temperature: 22°C
Relative Humidity: 54%

Modulation	Channel	Results	Limit (dBm)
GFSK	L	Pass	≥20
	M	Pass	≥20
	H	Pass	≥20
	Hopping	Pass	≥20

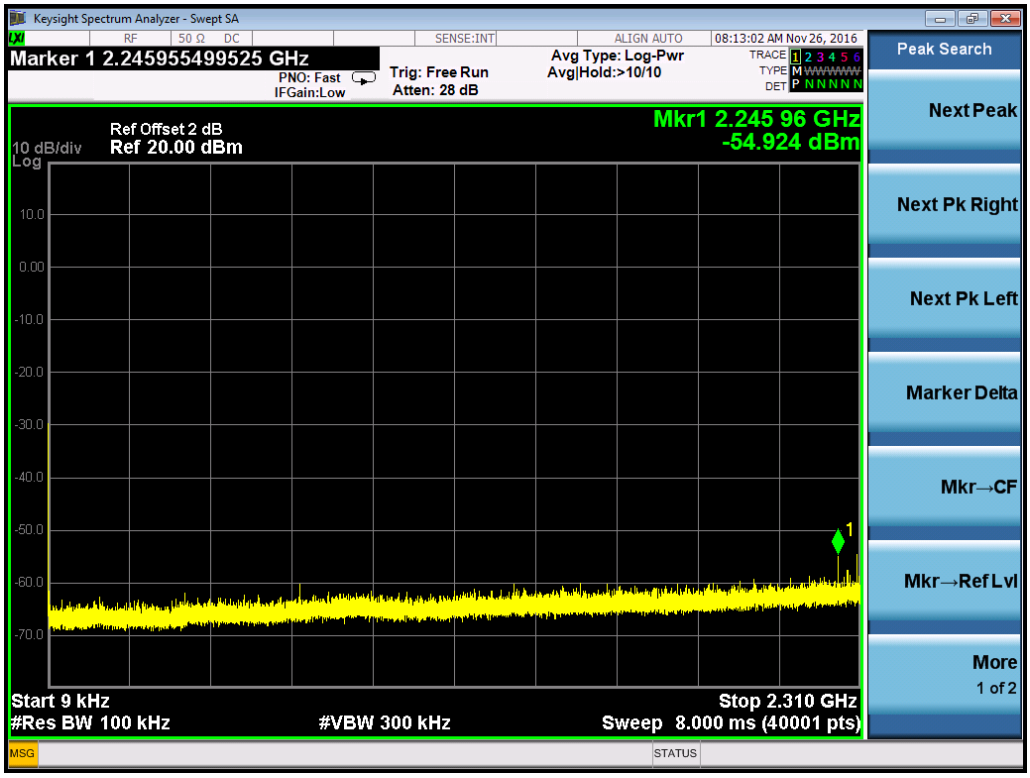
Channel L

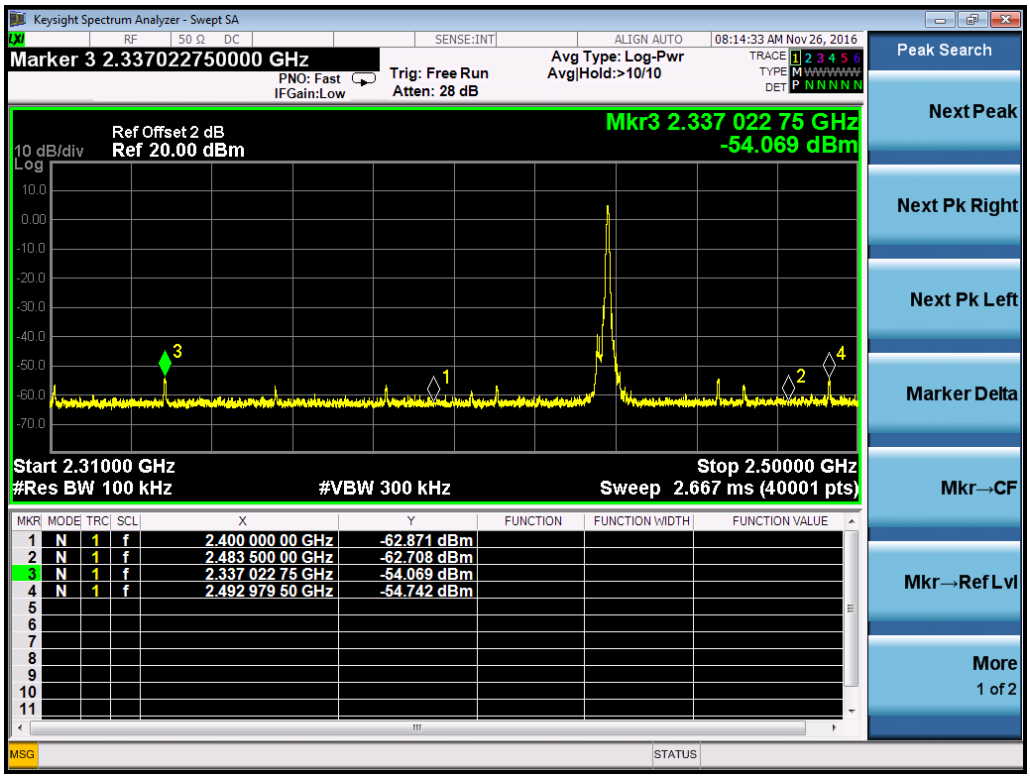


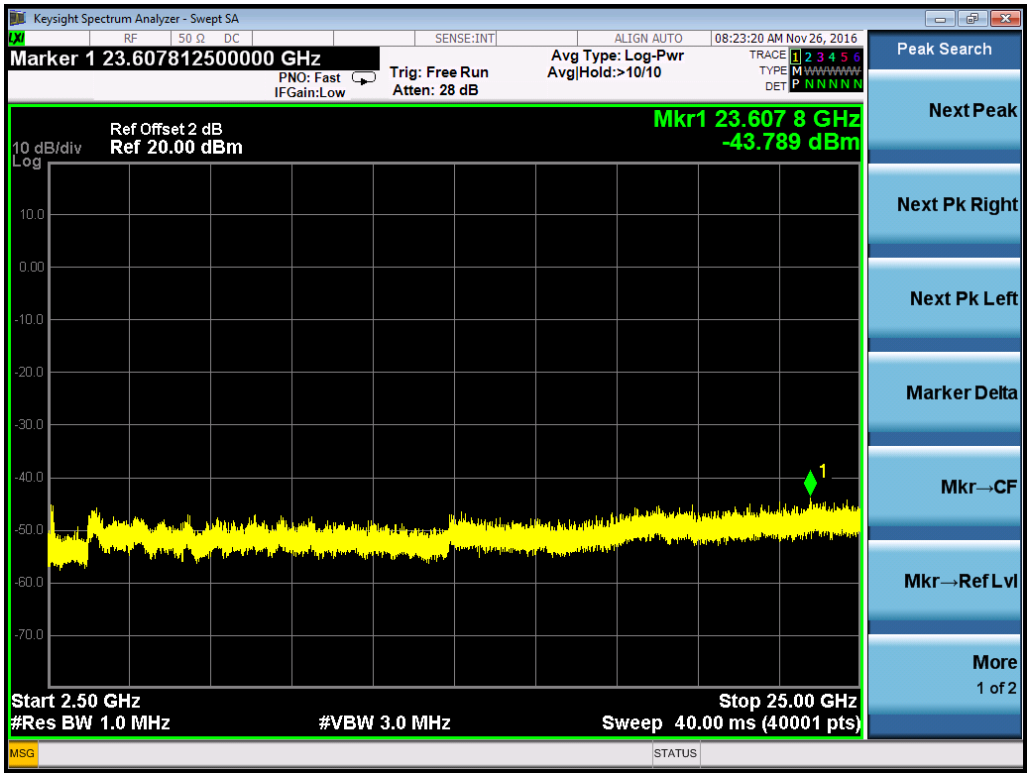




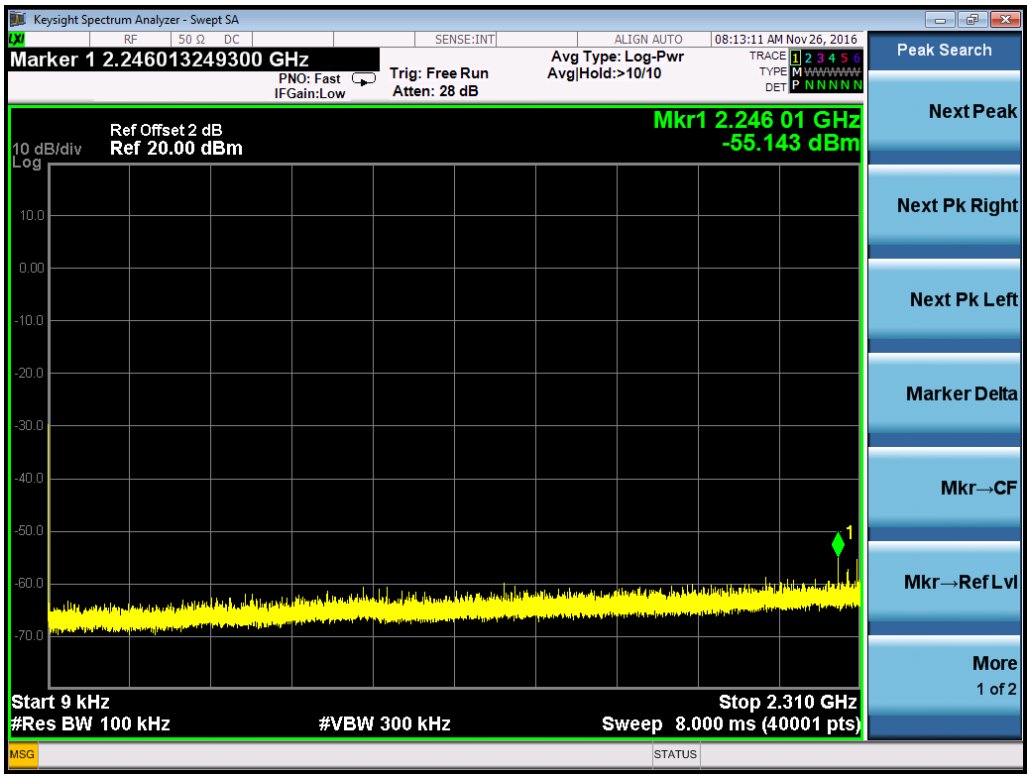
Channel M

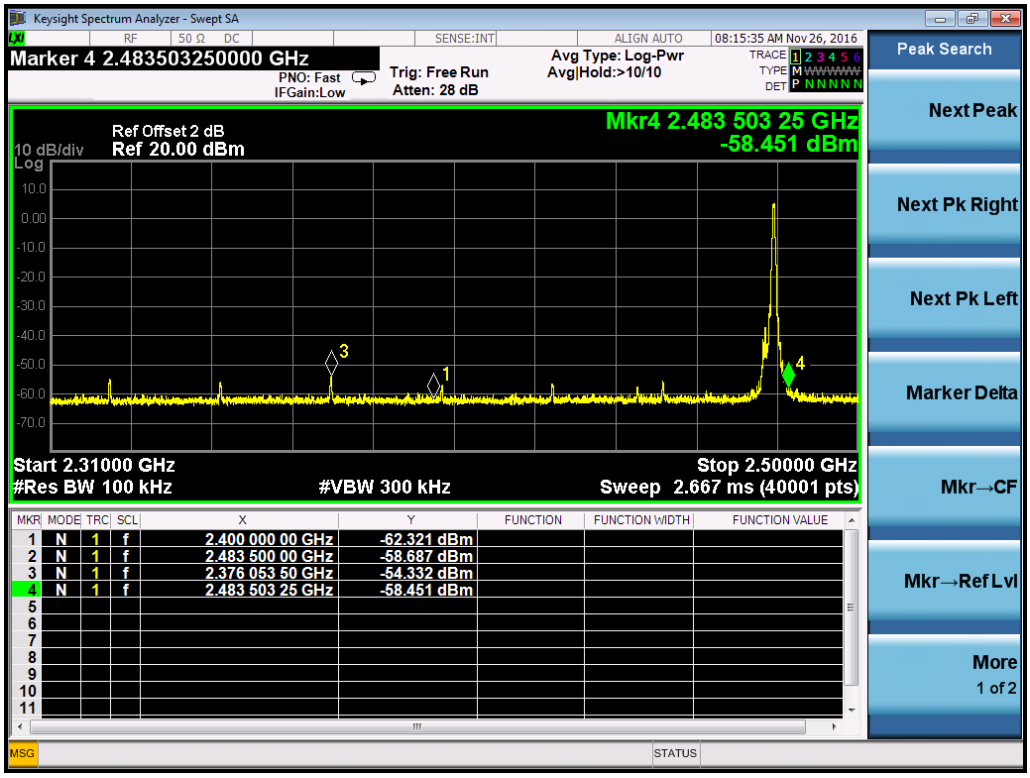

Keysight Spectrum Analyzer - Swept SA
Marker 1 2.245955499525 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
08:13:02 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.245 96 GHz
-54.924 dBm
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Marker 3 2.337022750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
08:14:33 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr3 2.337 022 75 GHz
-54.069 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.667 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.400 000 00 GHz -62.871 dBm
2 N 1 f 2.483 500 00 GHz -62.708 dBm
3 N 1 f 2.337 022 75 GHz -54.069 dBm
4 N 1 f 2.492 979 50 GHz -54.742 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

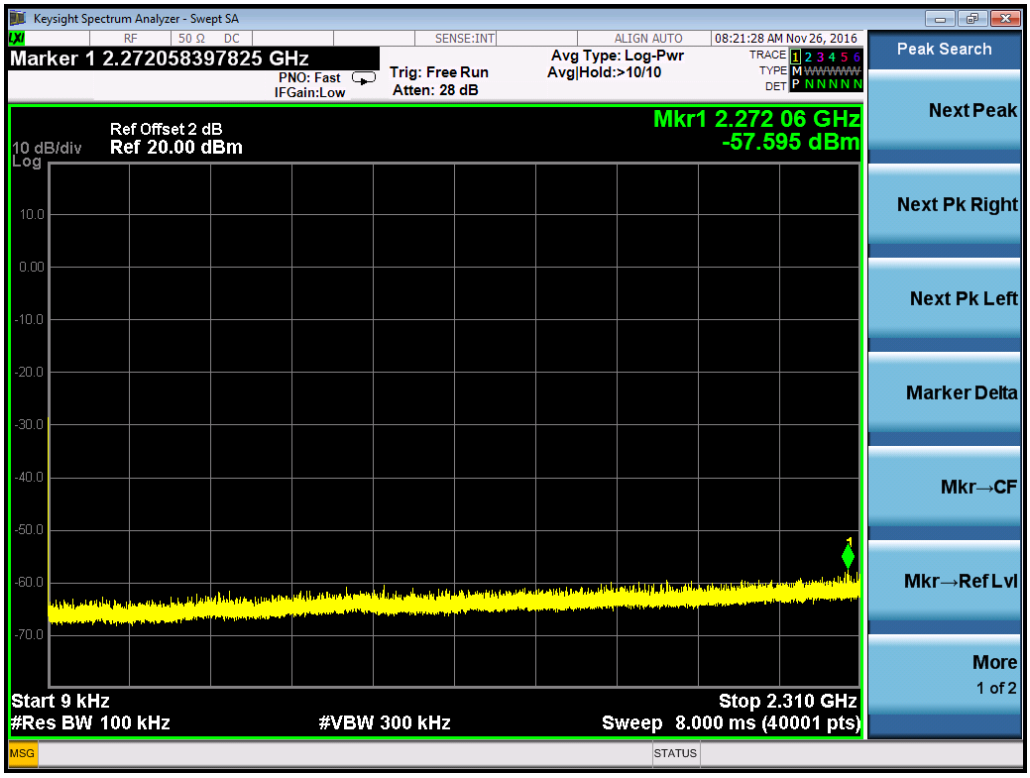

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:23:20 AM Nov 26, 2016
Marker 1 23.607812500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.607 8 GHz
-43.789 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
1
Start 2.50 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 40.00 ms (40001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

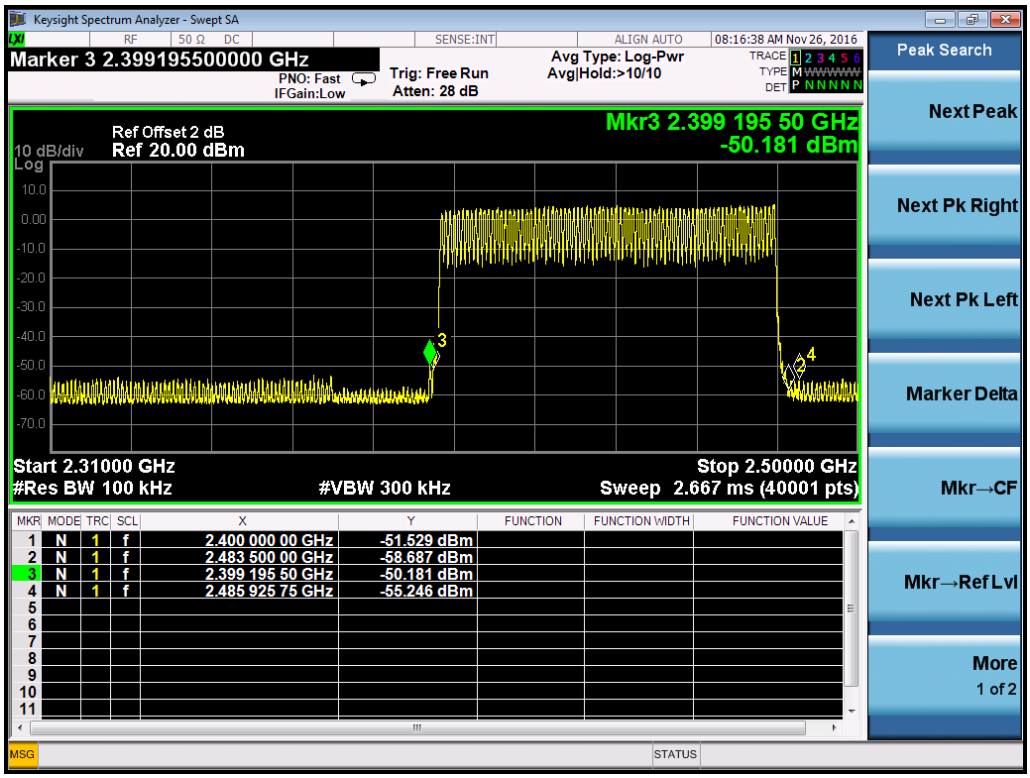
Channel H

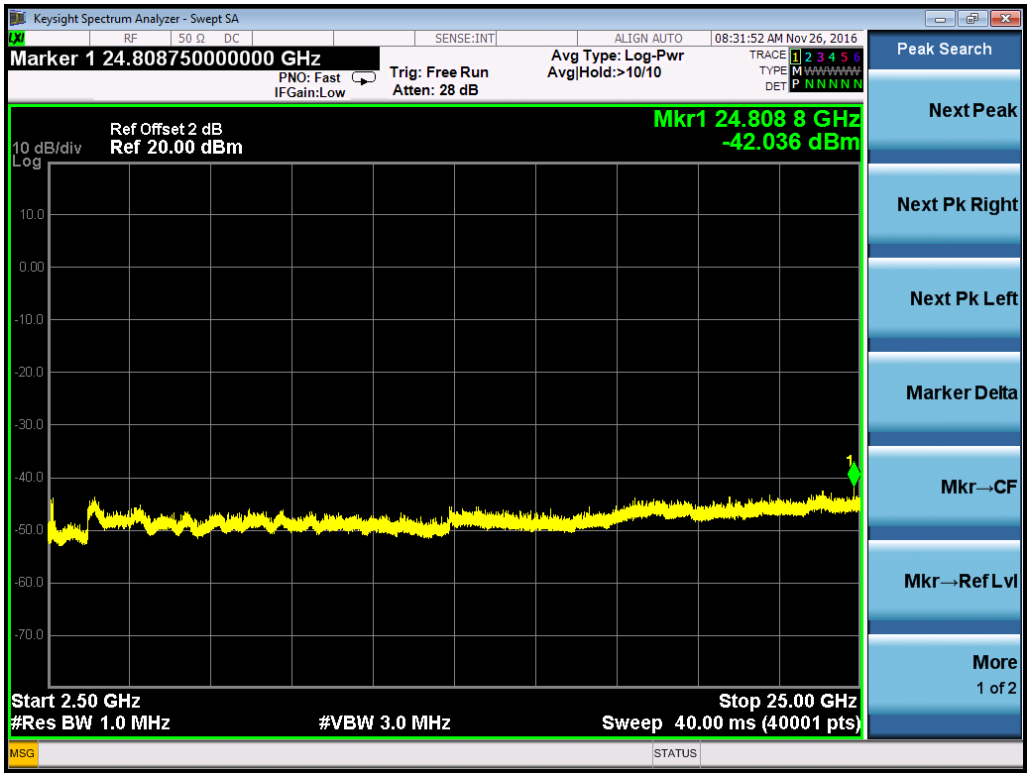

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:13:11 AM Nov 26, 2016
Marker 1 2.246013249300 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.246 01 GHz
-55.143 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
1
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2



Hopping

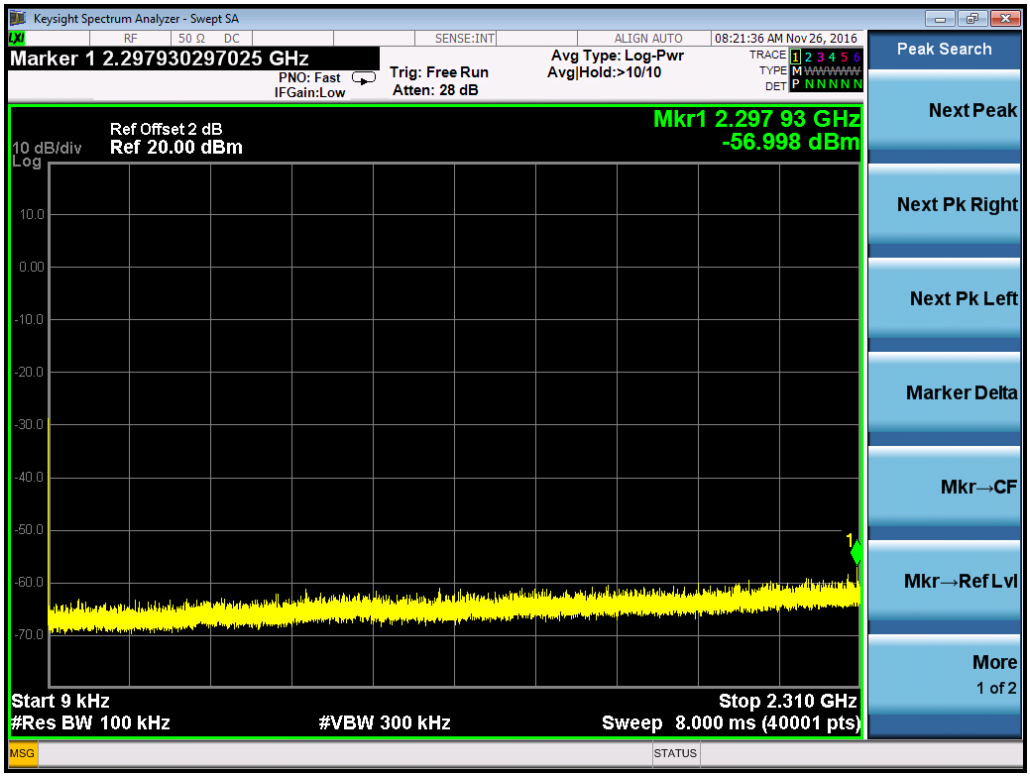

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:21:28 AM Nov 26, 2016
Marker 1 2.272058397825 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.272 06 GHz
-57.595 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

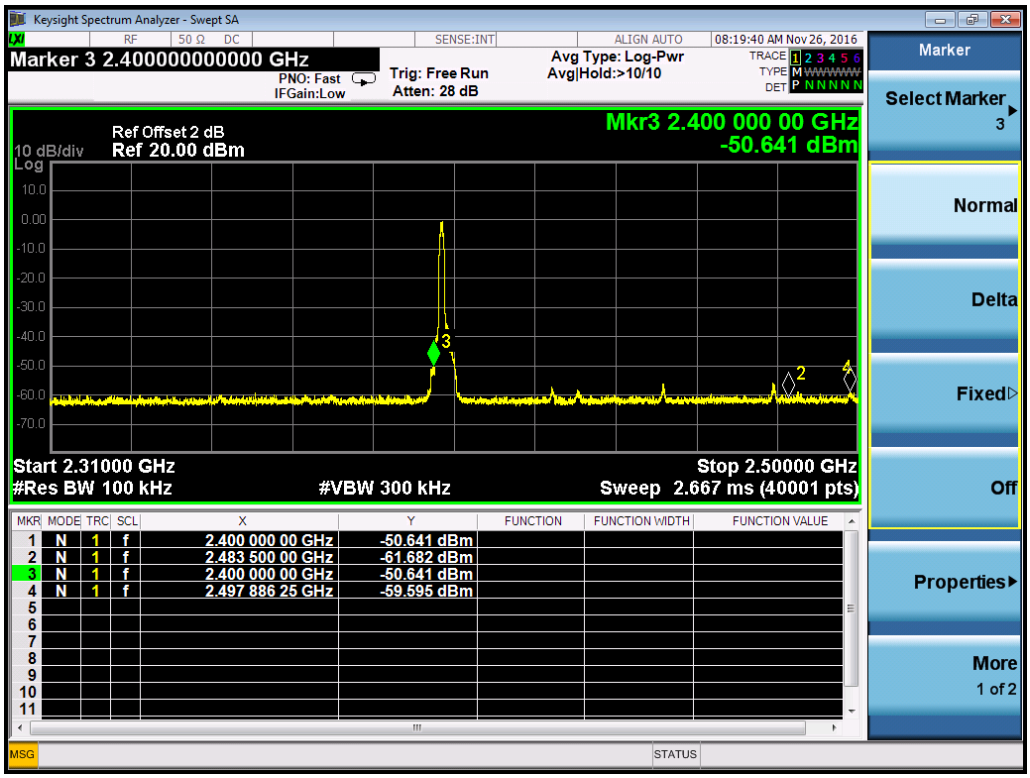

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:16:38 AM Nov 26, 2016
Marker 3 2.399195500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr3 2.399 195 50 GHz
-50.181 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.667 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.400 000 00 GHz -51.529 dBm
2 N 1 f 2.483 500 00 GHz -58.687 dBm
3 N 1 f 2.399 195 50 GHz -50.181 dBm
4 N 1 f 2.485 925 75 GHz -55.246 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

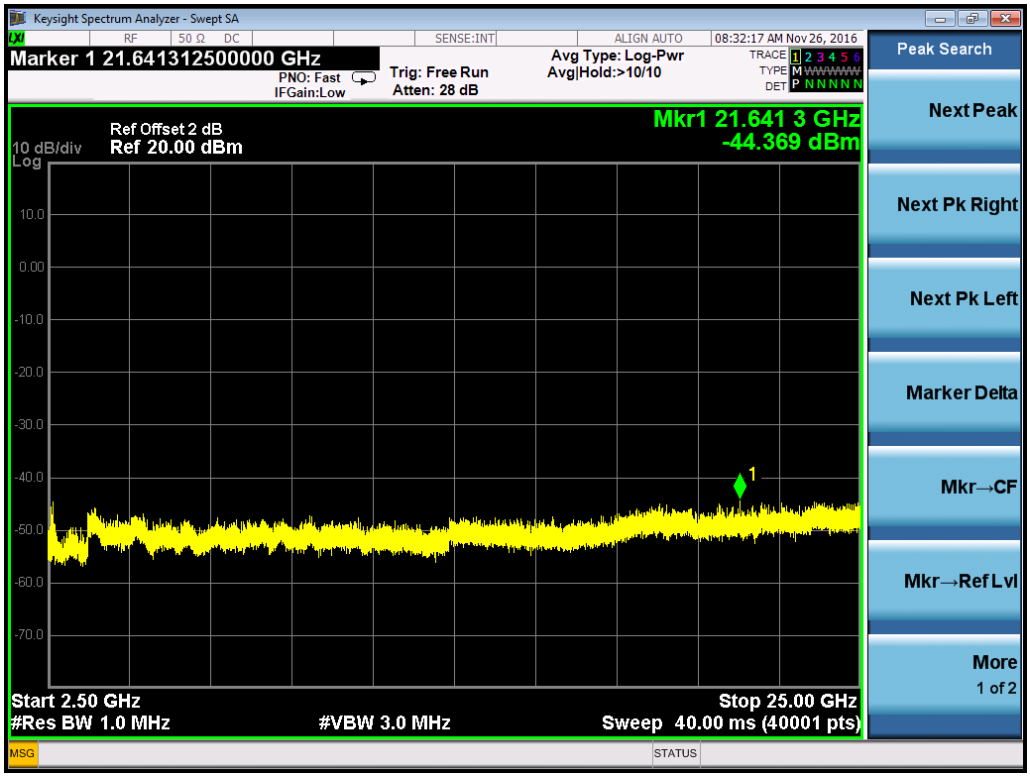


Modulation	Channel	Results	Limit (dBm)
8DPSK	L	Pass	≥20
	M	Pass	≥20
	H	Pass	≥20
	Hopping	Pass	≥20

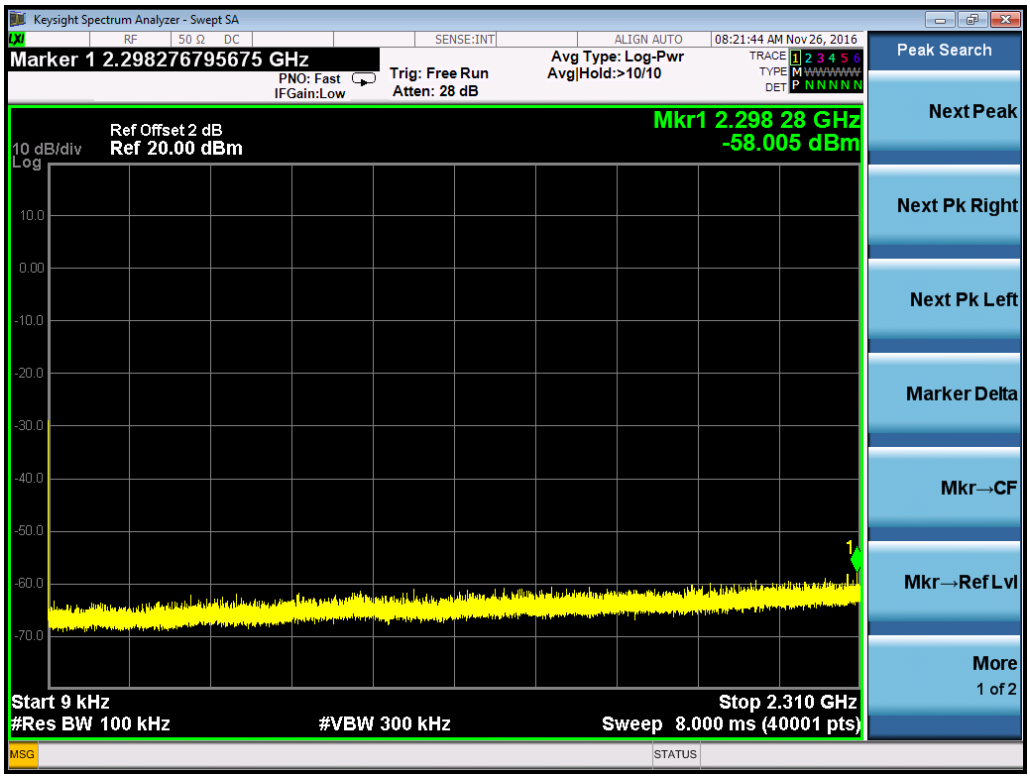
Channel L

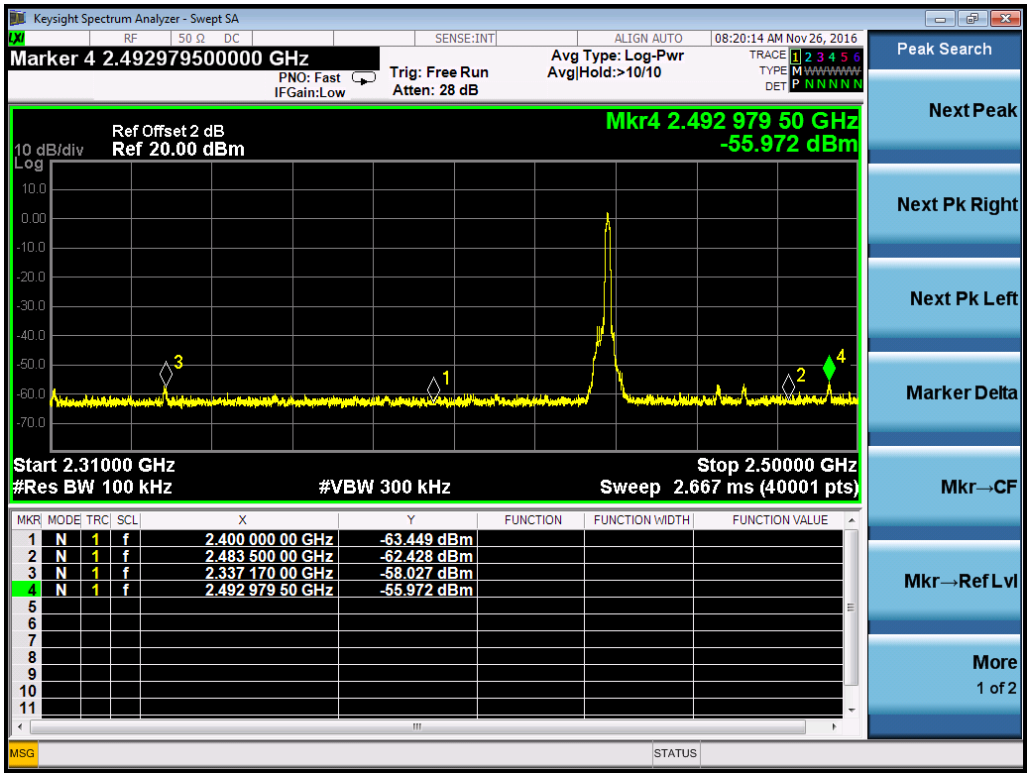

Keysight Spectrum Analyzer - Swept SA
Marker 1 2.297930297025 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
08:21:36 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Mkr1 2.297 93 GHz
-56.998 dBm
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

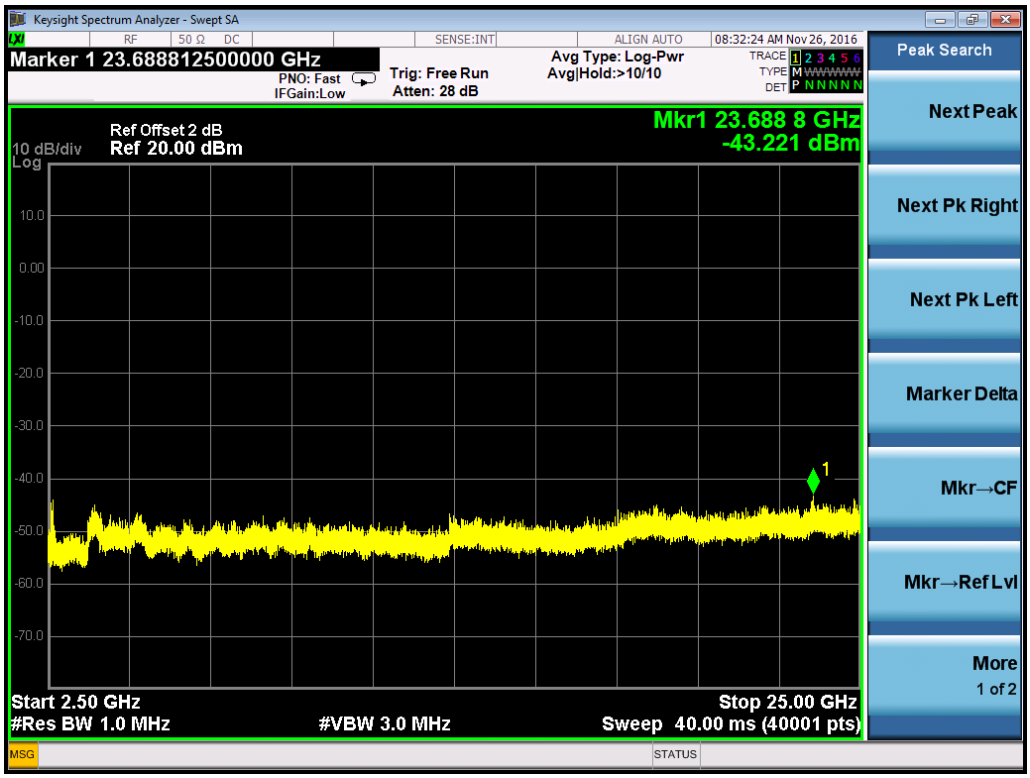

Keysight Spectrum Analyzer - Swept SA
Marker 3 2.400000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
08:19:40 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Mkr3 2.400 000 00 GHz
-50.641 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.667 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.400 000 00 GHz -50.641 dBm
2 N 1 f 2.483 500 00 GHz -61.682 dBm
3 N 1 f 2.400 000 00 GHz -50.641 dBm
4 N 1 f 2.497 886 25 GHz -59.595 dBm
Marker
Select Marker 3
Normal
Delta
Fixed
Off
Properties
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:32:17 AM Nov 26, 2016
Marker 1 21.641312500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 21.641 3 GHz
-44.369 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
1
Start 2.50 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 40.00 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

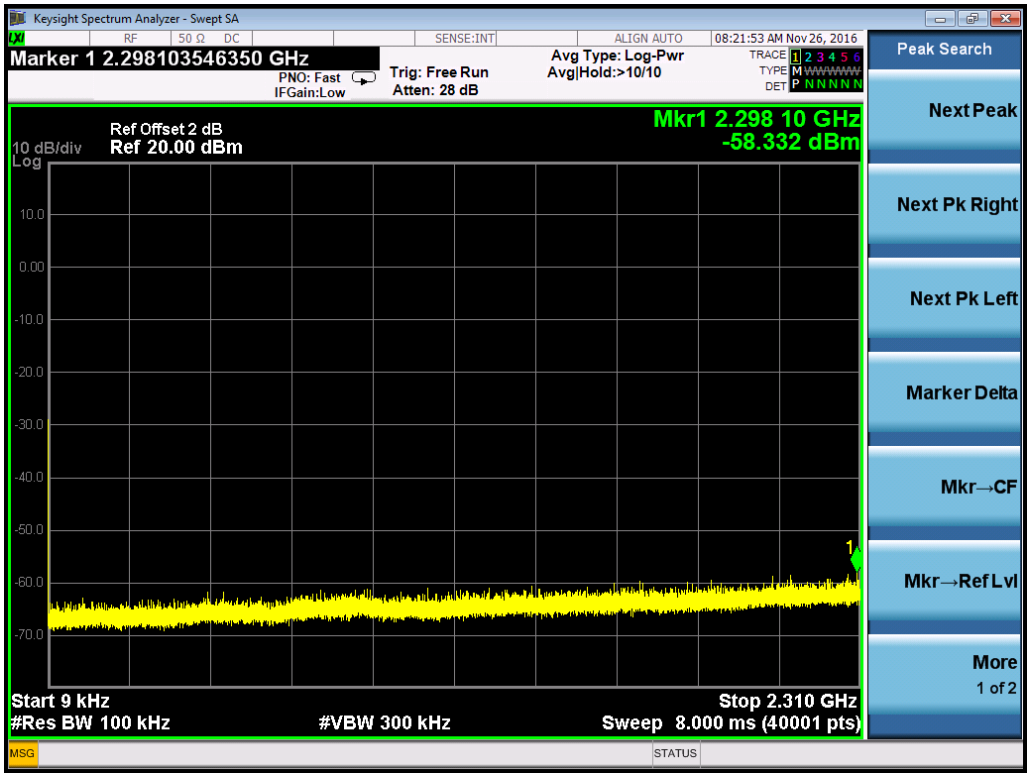
Channel M

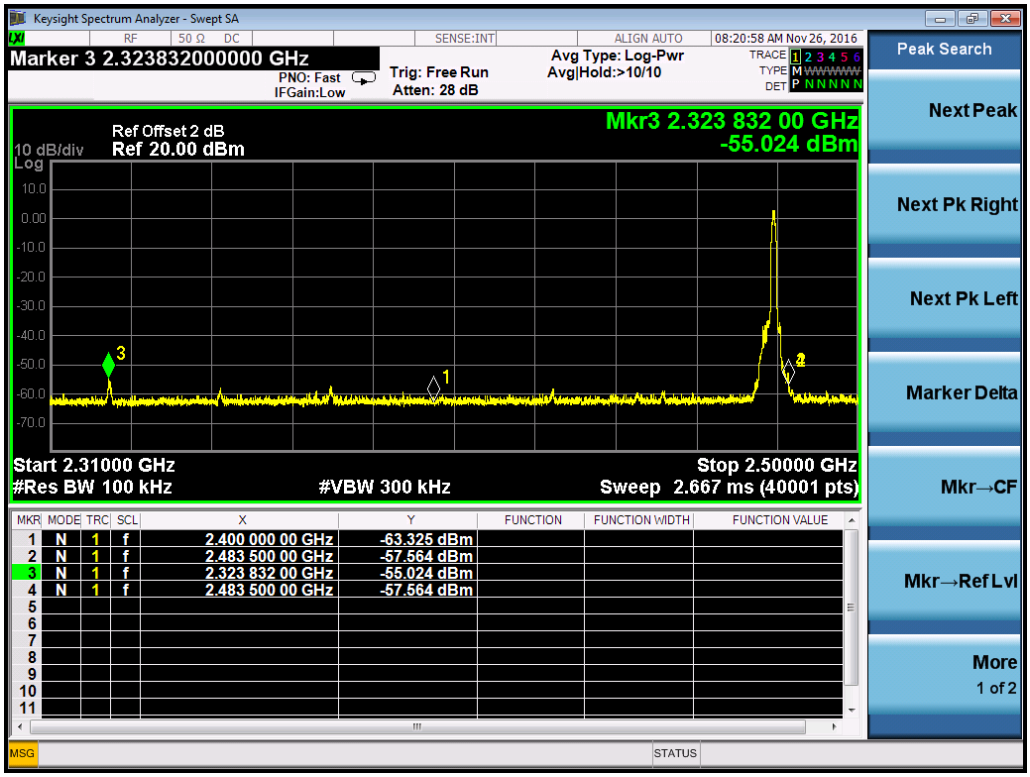

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:21:44 AM Nov 26, 2016
Marker 1 2.298276795675 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.298 28 GHz
-58.005 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
1
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

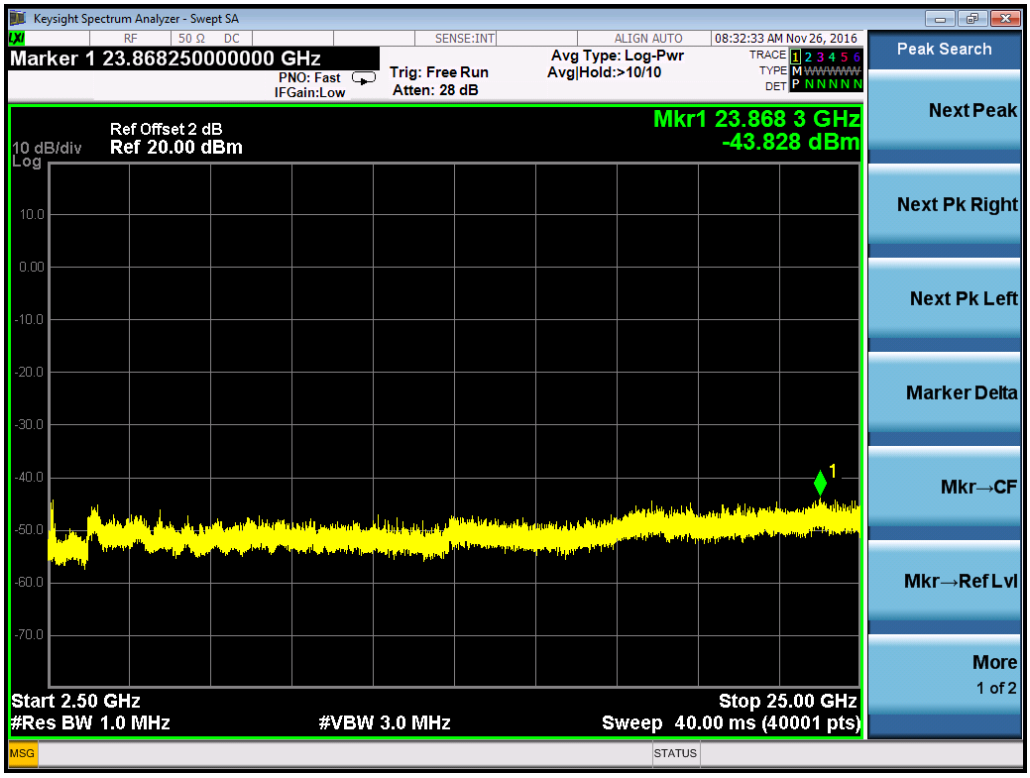




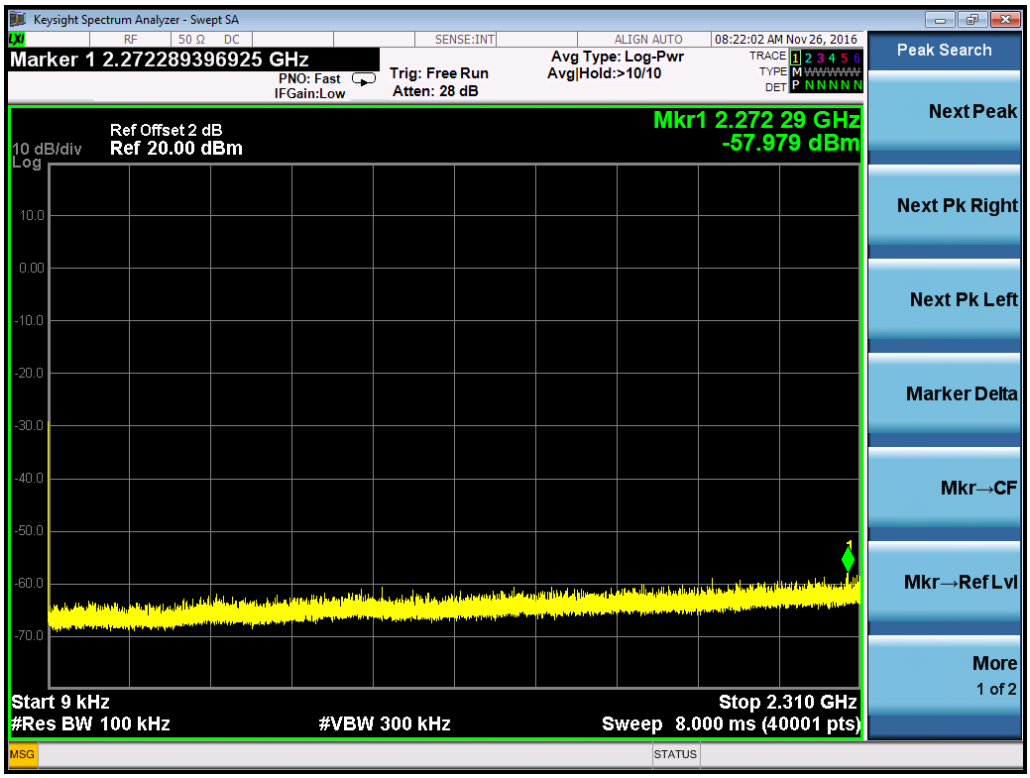
Channel H

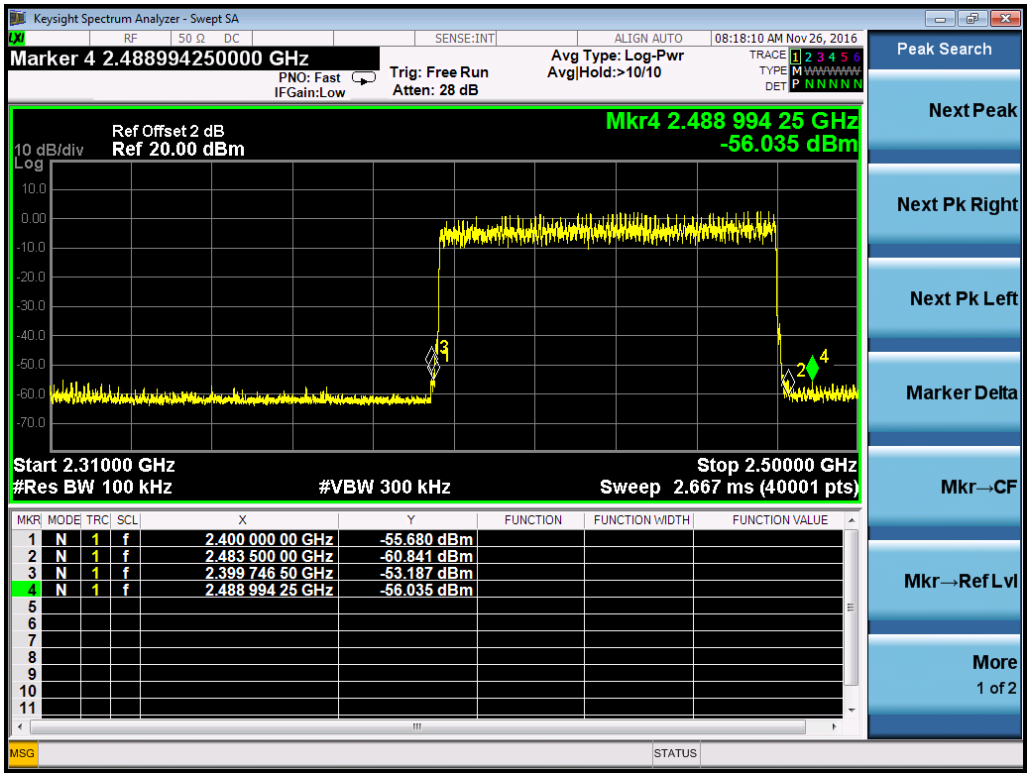


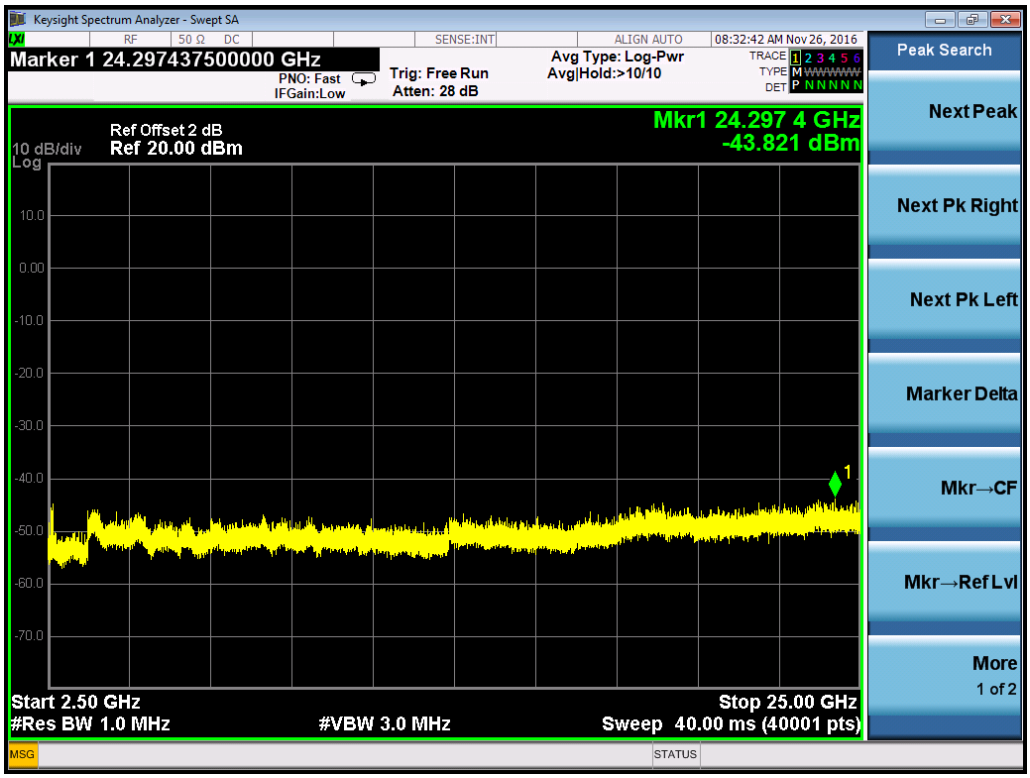



Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:32:33 AM Nov 26, 2016
Marker 1 23.868250000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.868 3 GHz
-43.828 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Start 2.50 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 40.00 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

Hopping


Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:22:02 AM Nov 26, 2016
Marker 1 2.272289396925 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.272 29 GHz
-57.979 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS


Keysight Spectrum Analyzer - Swept SA
Marker 4 2.488994250000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
08:18:10 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr4 2.488 994 25 GHz
-56.035 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.667 ms (40001 pts)
1 N 1 f 2.400 000 00 GHz -55.680 dBm
2 N 1 f 2.483 500 00 GHz -60.841 dBm
3 N 1 f 2.399 746 50 GHz -53.187 dBm
4 N 1 f 2.488 994 25 GHz -56.035 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Marker 1 24.297437500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
08:32:42 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 24.297 4 GHz
-43.821 dBm
Start 2.50 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 40.00 ms (40001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

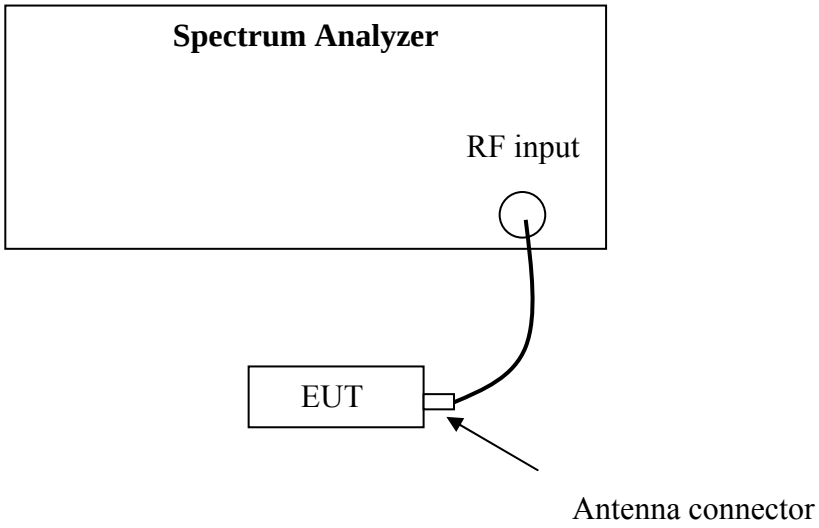
7 Number of Hopping Frequencies

Test result: **Pass**

7.1 Test limit

Number of Hopping Frequencies in the 2400-2483.5 MHz band shall use at least 15 channels.

7.2 Test Configuration



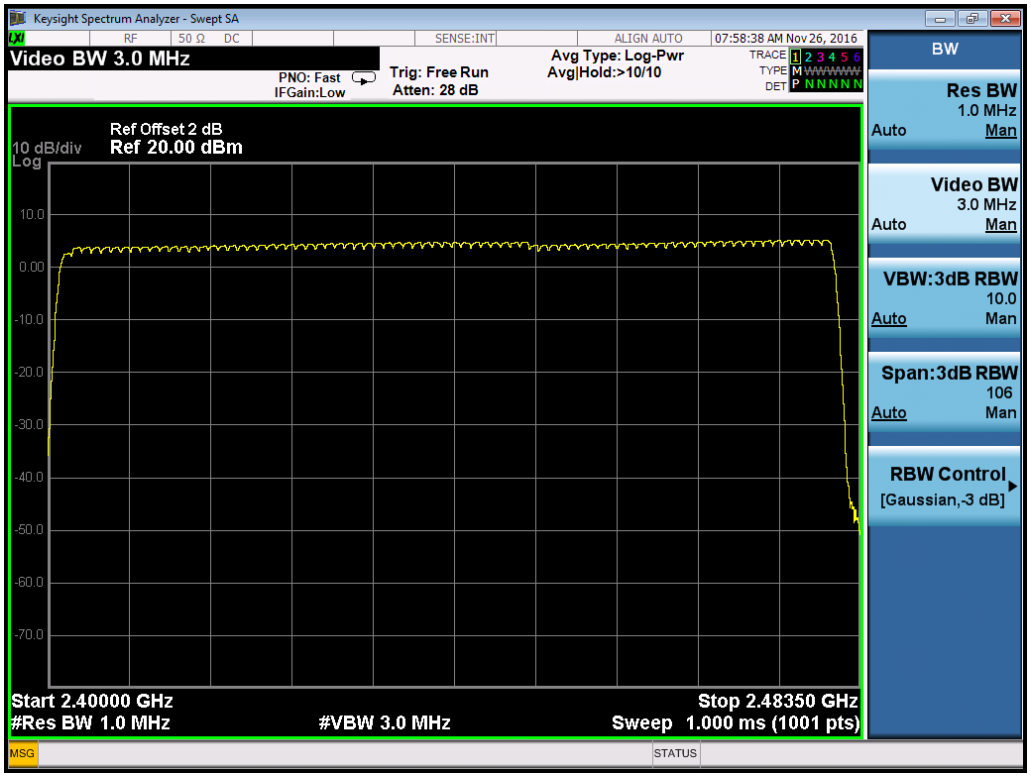
7.3 Test procedure and test setup

The Number of Hopping Frequencies per FCC § 15.247(a)(1)(iii) is measured using the Spectrum Analyzer with RBW=100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

7.4 Test Protocol

Temperature: 22°C
Relative Humidity: 54%

Number of Hopping Frequencies	Limit
79	≥15



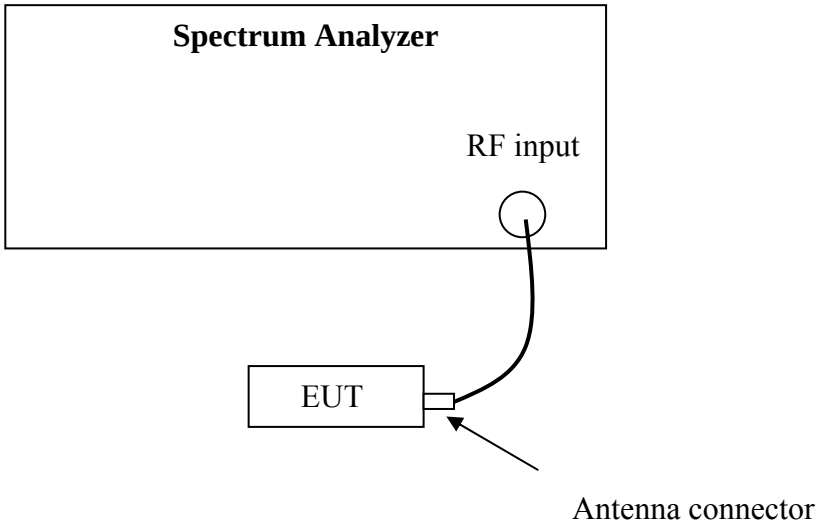
8 Dwell Time

Test result: **Pass**

8.1 Test limit

The dwell time 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

8.2 Test Configuration



8.3 Test procedure and test setup

Dwell time per FCC § 15.247(a)(1)(iii) is measured using the Spectrum Analyzer with Span = 0, RBW=1MHz, VBW≥RBW, Sweep can capture the entire dwell time, Detector = peak, Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

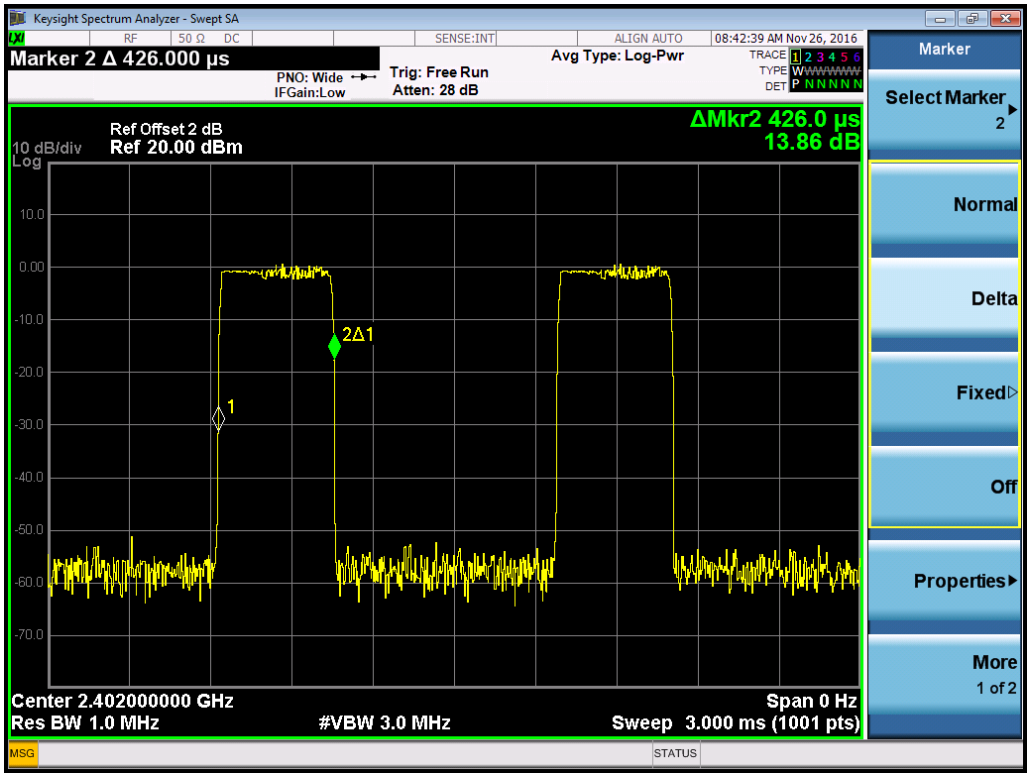
8.4 Test Protocol

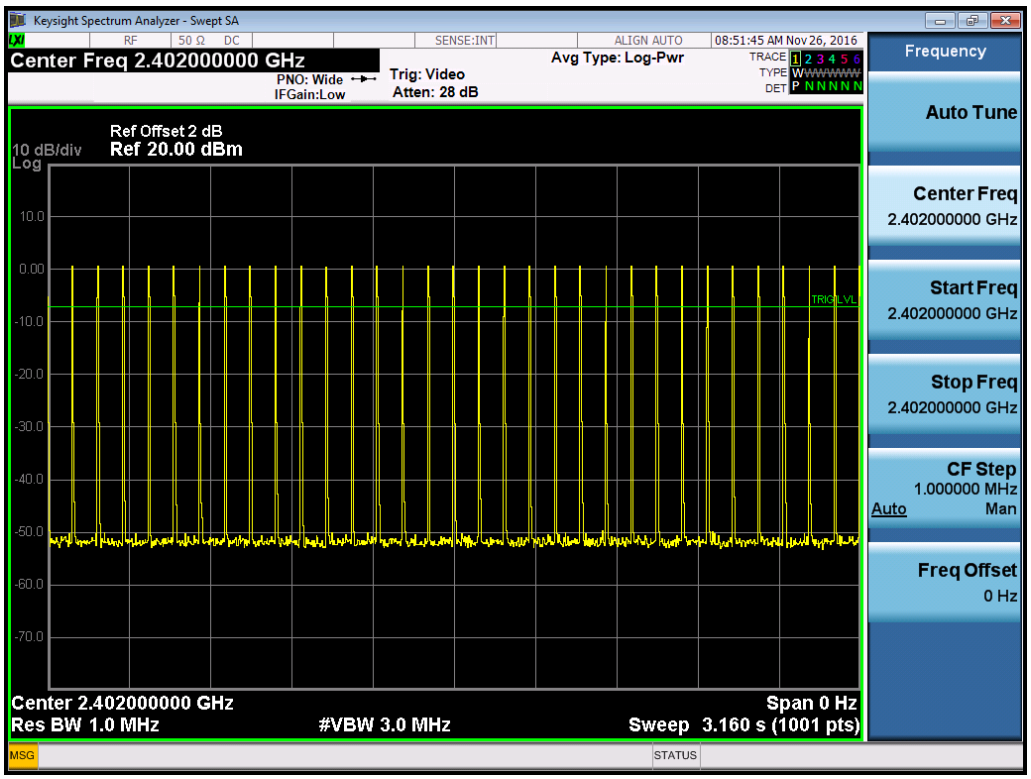
Temperature: 22°C
Relative Humidity: 54%

Packet	Occupancy time for single hop (ms) O	Channel	Real observed period (s) P	Hops among Observed period I	Dwell time (ms) T	Limit (s)
DH1	0.426	L	3.16	32	136.32	≤0.4
		M	3.16	32	136.32	
		H	3.16	32	136.32	
DH3	1.676	L	3.16	16	268.16	
		M	3.16	16	268.16	
		H	3.16	16	268.16	
DH5	2.936	L	3.16	11	322.96	
		M	3.16	11	322.96	
		H	3.16	11	322.96	

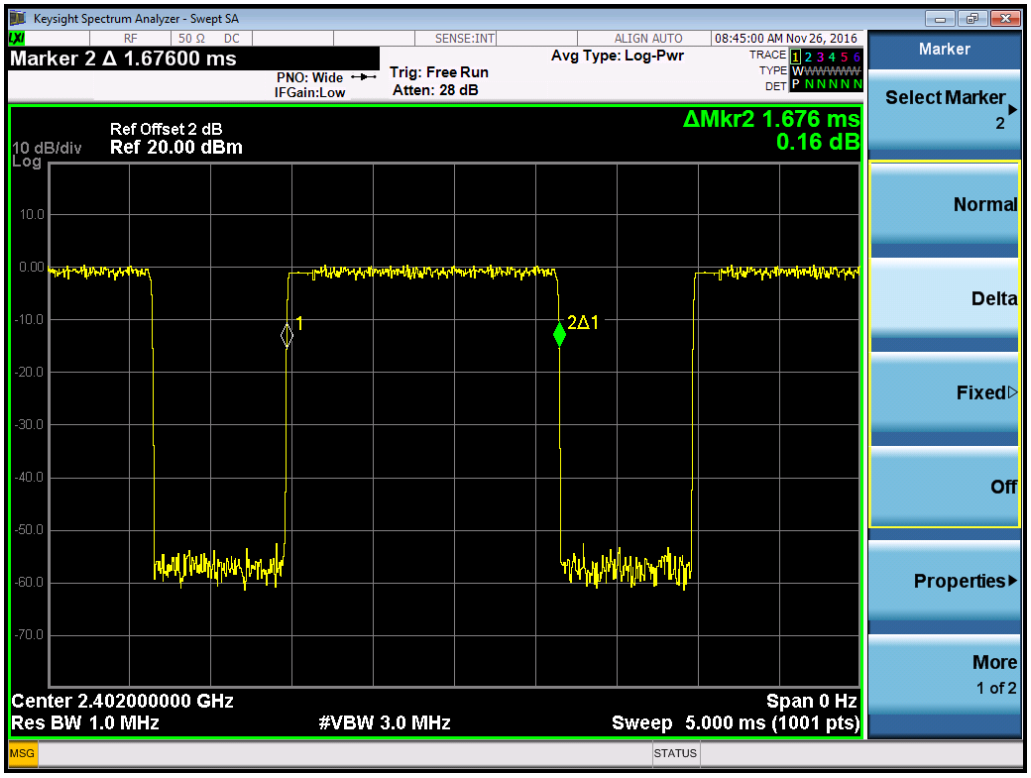
Remark: 1. There are 79 channels in all. So the complete observed period P = 0.4 * 79 = 31.6 s.
2. Average time of occupancy **T = O *I * 31.6 / P**

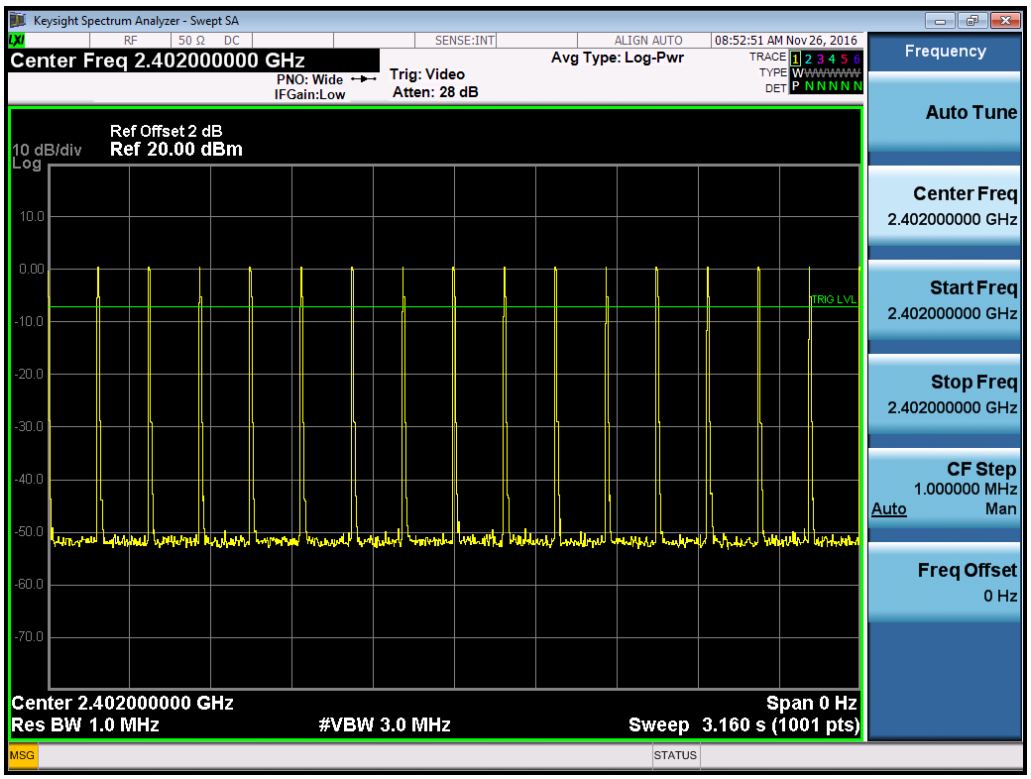
DH1


Keysight Spectrum Analyzer - Swept SA
Marker 2 Δ 426.000 µs
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 28 dB
Avg Type: Log-Pwr
08:42:39 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
ΔMkr2 426.0 µs
13.86 dB
2Δ1
1
Center 2.402000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 3.000 ms (1001 pts)
Marker
Select Marker
2
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS

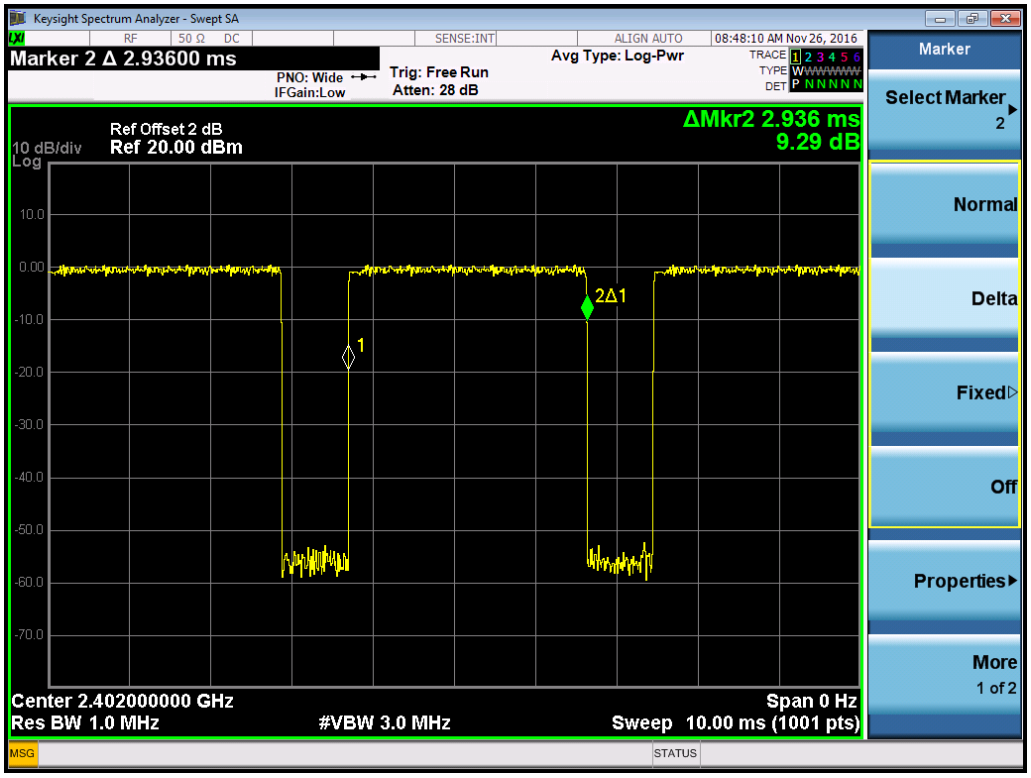

Keysight Spectrum Analyzer - Swept SA
Center Freq 2.402000000 GHz
PNO: Wide
IFGain:Low
Trig: Video
Atten: 28 dB
Avg Type: Log-Pwr
08:51:45 AM Nov 26, 2016
Ref Offset 2 dB
10 dB/div
Log
Ref 20.00 dBm
TRIG LVL
Center 2.402000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 3.160 s (1001 pts)
Frequency
Auto Tune
Center Freq
2.402000000 GHz
Start Freq
2.402000000 GHz
Stop Freq
2.402000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

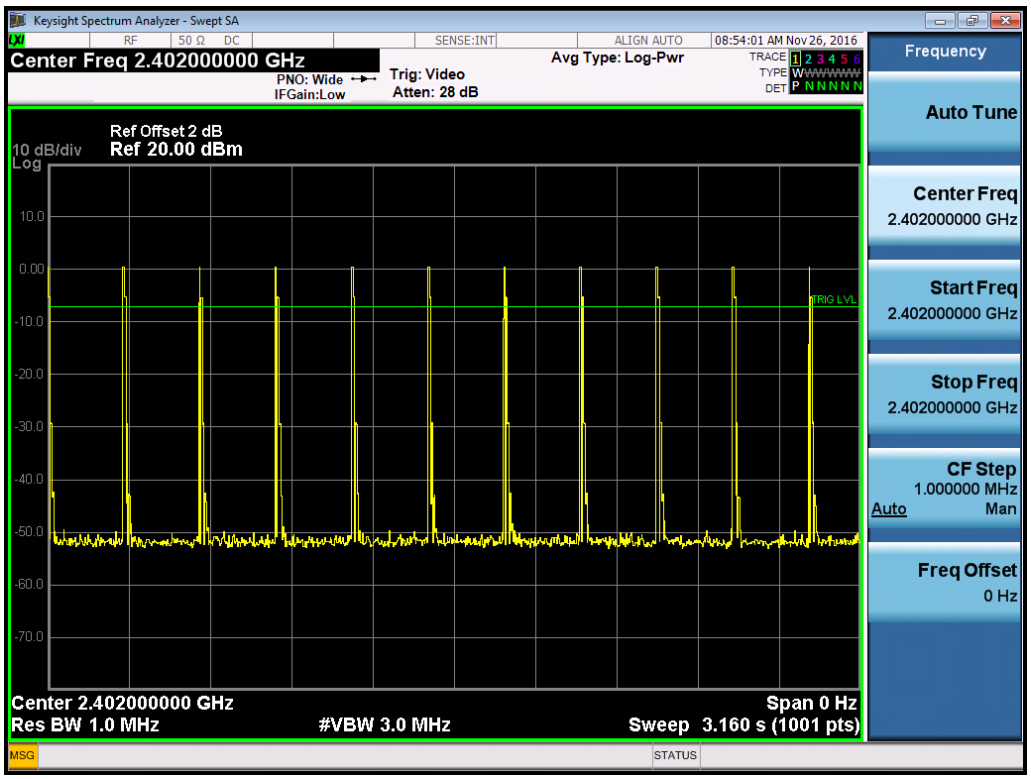
DH3





DH5





9 Radiated Emissions in restricted frequency bands

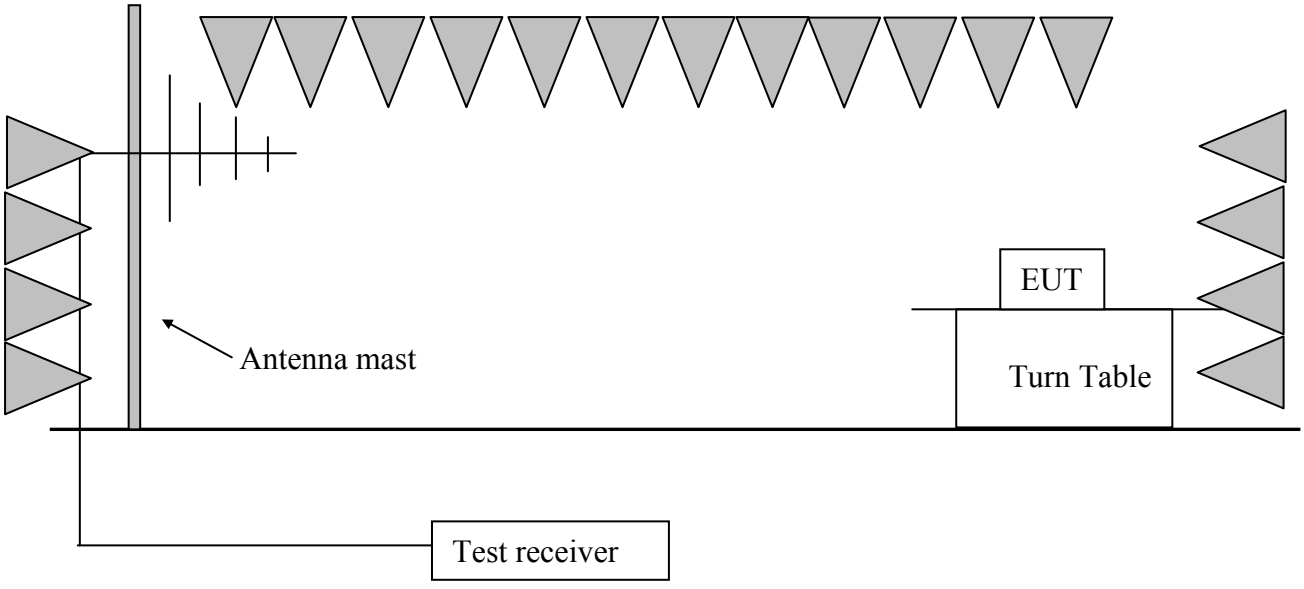
Test result: **Pass**

9.1 Test limit

The 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) showed as below:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

9.2 Test Configuration



9.3 Test procedure and test setup

The radiated emissions were tested according to the procedure of ANSI C63.10 for compliance to FCC 47CFR 15.247 requirements.

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);
RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

Remark:
1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

Example:

Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Measured level = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m,
Measured level = 10.20dBuV/m, then Margin = 54 - 10.20 = 43.80dBuV/m.

9.4 Test Protocol

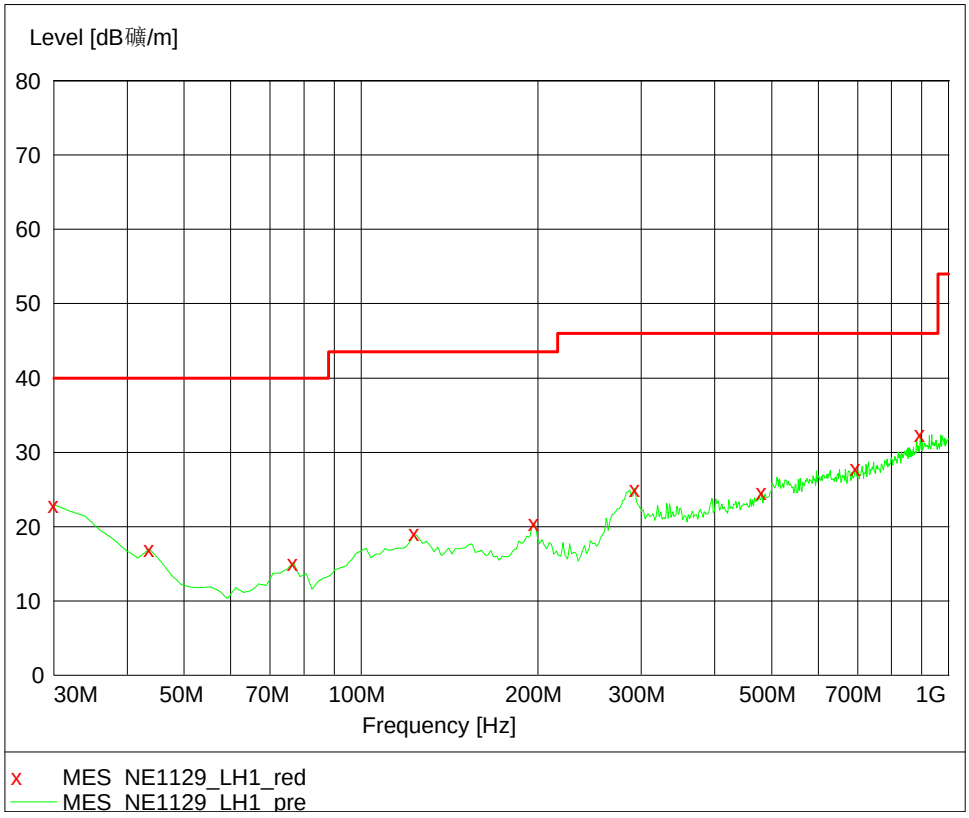
Temperature: 22°C
Relative Humidity: 54%

All the two models of product were tested and the worst data was listed in the report.

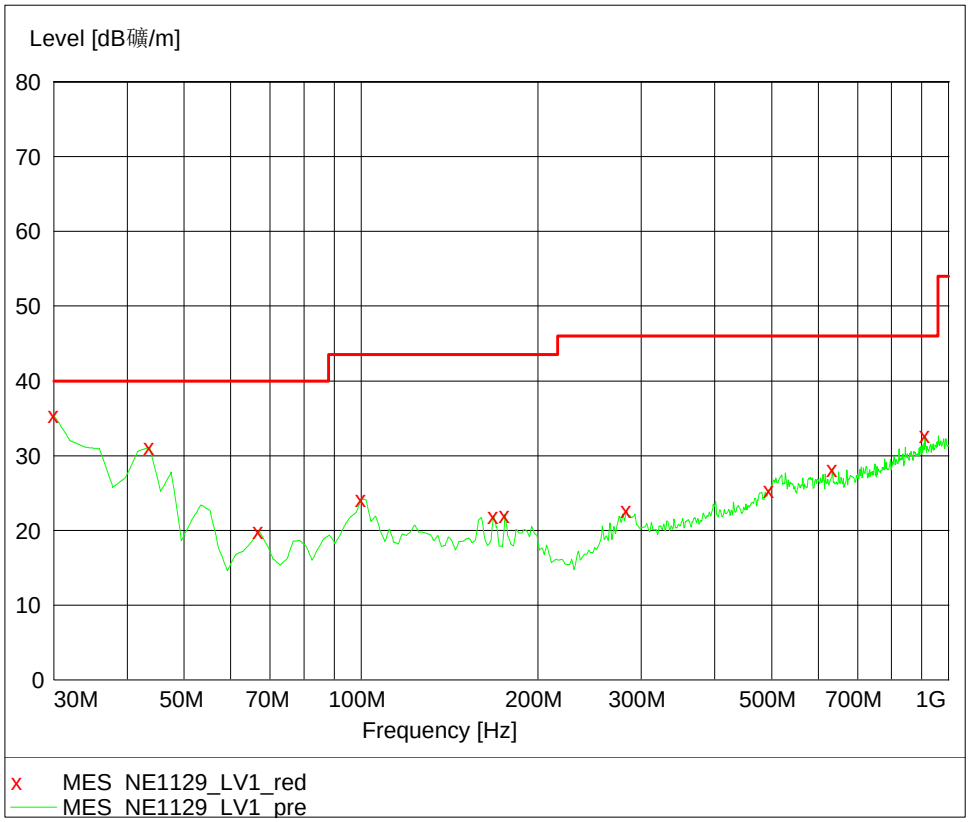
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal



Vertical



Note: The worst test result (30MHz to 1GHz) of channel L (2402MHz) chosen to list in the report as representative.

Test result from 30MHz to 1000MHz:

Polarization	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	30.00	22.90	21.40	40.00	17.10	PK
	694.81	27.80	22.40	46.00	18.20	PK
	895.03	32.40	24.80	46.00	13.60	PK
V	30.00	35.40	21.00	40.00	4.60	PK
	43.61	31.10	12.20	40.00	8.90	PK
	634.55	28.30	22.00	46.00	17.70	PK
	912.53	32.70	25.00	46.00	13.30	PK

Test result above 1GHz:

GFSK:

Channel	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.20	92.60	34.34	Fundamental	/	PK
	H	2390.00	48.35	34.29	74.00	25.65	PK
	H	4803.61	46.16	13.4	74.00	27.84	PK
M	H	2441.20	92.80	34.60	Fundamental	/	PK
H	H	2480.20	92.80	34.62	Fundamental	/	PK
	H	2483.50	45.10	34.63	74.00	28.90	PK
	H	7440.90	52.61	13.4	74.00	21.39	PK

8DPSK:

Channel	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.20	88.90	34.34	Fundamental	/	PK
	H	2389.96	50.00	34.29	74.00	24.00	PK
	H	4804.31	46.05	13.4	74.00	27.95	PK
M	H	2441.20	88.80	34.60	Fundamental	/	PK
H	H	2480.20	89.30	34.62	Fundamental	/	PK
	H	2483.50	44.80	34.63	74.00	29.20	PK
	H	7440.89	46.21	13.4	74.00	27.79	PK

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit – Corrected Reading

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then
Margin = 54 -10.20 = 43.80dBuV/m

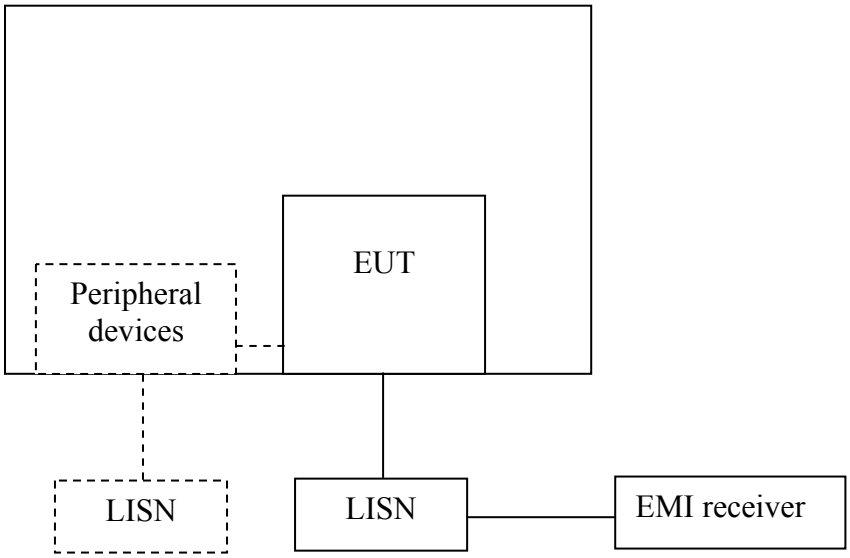
10 Power line conducted emission

Test result: **Pass**

10.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

10.2 Test configuration



☒ For table top equipment, wooden support is 0.8m height table

☐ For floor standing equipment, wooden support is 0.1m height rack.

10.3 Test procedure and test set up

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

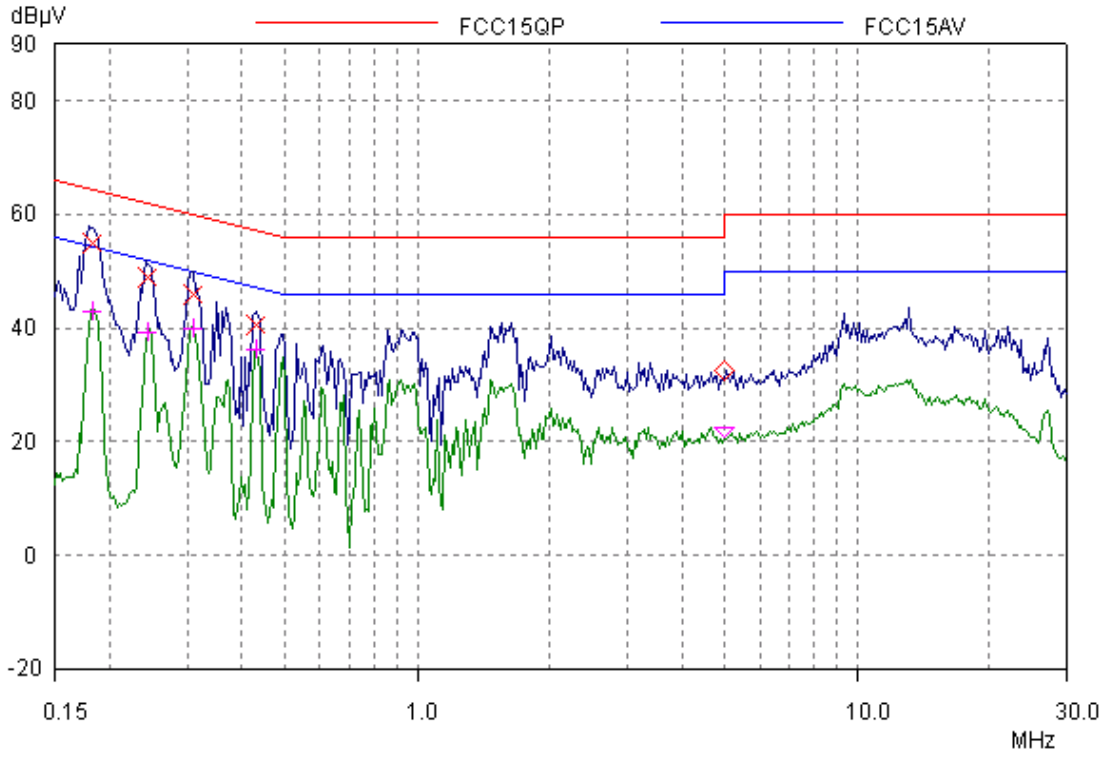
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

10.4 Test protocol

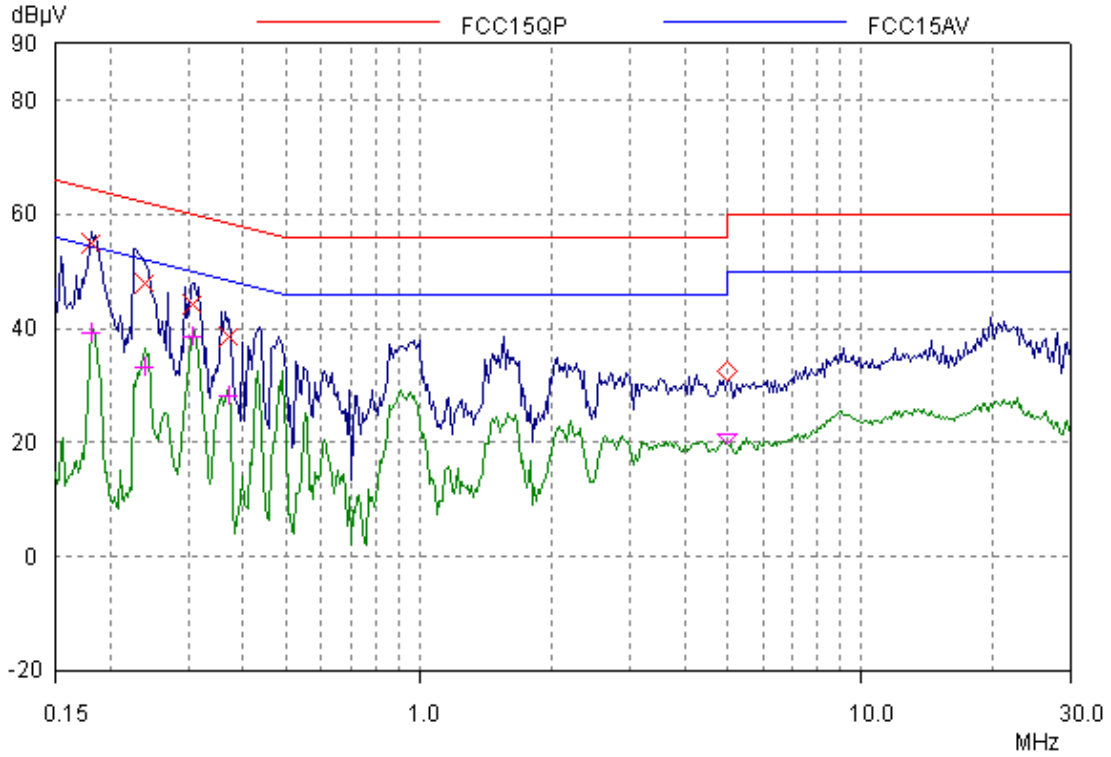
Temperature: 22°C
Relative Humidity: 54%

L line:



Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (dB)
0.182	55.00	64.38	9.38	43.04	54.38	11.34
0.244	48.89	61.95	13.09	39.05	51.95	12.90
0.308	46.02	60.03	14.01	39.88	50.03	10.15
0.429	40.59	57.28	16.69	36.29	47.28	10.99

N line:



Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (dB)
0.180	55.06	64.48	9.42	39.25	54.48	15.23
0.238	48.05	62.15	14.10	33.03	52.15	19.12
0.306	44.12	60.07	15.95	38.64	50.07	11.43
0.368	38.57	58.54	19.97	28.10	48.54	20.44