FCC & IC TEST REPORT for Bluetooth Device
No. 161100632SHA-001

Applicant	:	SHENZHEN DNS INDUSTRIES CO., LTD. 23/F Building A, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian, Shenzhen, China
Manufacturer	:	SHENZHEN DNS INDUSTRIES CO., LTD. 23/F Building A, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian, Shenzhen, China
Product Name	:	Waterproof Bluetooth Speaker
Type/Model	:	WX08, OMSPBTBKHOL, 16WMS129, 16WMS129 – XXX (X=A to Z), 16WMS129-WHT, 16WMS129-BLK, 16WMS129 -BLU
TEST RESULT	**:**	**PASS**

SUMMARY

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

47CFR Part 15 (2015): Radio Frequency Devices

RSS-247 (Issue 1, 2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 4 (November 2014): General Requirements and Information for the Certification of Radiocommunication Equipment

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

Date of issue: Nov 10, 2016

Prepared by: Reviewed by:

Wakeyou Wang (*Project Engineer*) Daniel Zhao (*Reviewer*)

Description of Test Facility

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Content

1. General Information

1.1 Applicant Information

Applicant	:	SHENZHEN DNS INDUSTRIES CO., LTD. 23/F Building A, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian, Shenzhen, China
Name of contact	:	Wu Yutang
Tel	:	+86-755-83401338
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Manufacturer	:	SHENZHEN DNS INDUSTRIES CO., LTD. 23/F Building A, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian, Shenzhen, China

1.2 Identification of the EUT

Product Name	:	Waterproof Bluetooth Speaker
Type/model	:	WX08, OMSPBTBKHOL, 16WMS129, 16WMS129 –XXX (X=A to Z), 16WMS129-WHT, 16WMS129-BLK, 16WMS129 -BLU
FCC ID	:	ZBCW129
IC	:	Not applied

1.3 Technical specification

Operation Frequency Band	:	2402 - 2480 MHz
Type of Modulation	:	FHSS
EUT Modes of Modulation	:	GFSK, Pi/4 DQPSK, 8DQPSK
Channel Number	:	79 channels with spacing of 1MHz.
Description of EUT	:	There are series of models. They are electrically identical except for different outside view.
Port identification	:	USB x 1; Audio in x 1
Antenna	:	PCB antenna, 0dBi
Rating	:	Built-in Battery DC 5V

Declared Temperature	:	/
Category of EUT	:	Class B
EUT type	:	☒ Table top ☐ Floor standing
Sample received date	:	Nov 7, 2016
Sample Identification	:	/
Date of test	:	Nov 7, 2016 –Nov 10, 2016

2. TEST SPECIFICATIONS

2.1 Test Standard

47CFR Part 15 (2015)
RSS-247 (Issue 1, 2015)
RSS-Gen Issue 4 (November 2014)
ANSI C63.10 (2013)
DA 00-705 (March 30, 2000)

2.2 Mode of operation during the test / Test peripherals used

The EUT can be powered by internal battery as well as external AC/DC adapter. Both modes were assessed and the worst test data is listed here.
For the EUT is a portable device, three axes (X, Y, Z) were observed while the test receiver worked as “max hold” continuously and the highest reading among the whole test procedure was recorded.

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

Test software setting: Power level 3 setting among the software *BK3256 RF Test_V1.3.*

Test Channel:

Channel	Frequency (MHz)
LCH	2402
MCH	2441
HCH	2480

Frequency Hopping System Requirement

☒**Compliance for Section 15.247 (a)(1), (g), (h) requirement**

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom 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.

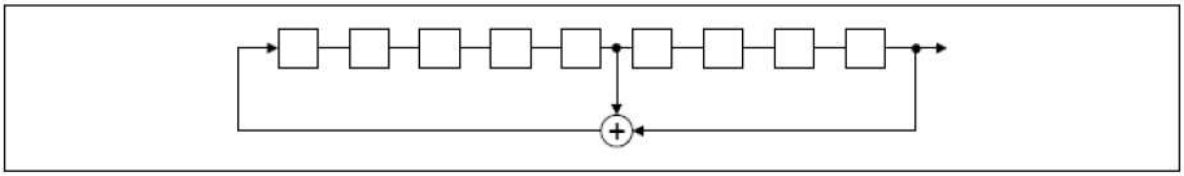
Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented 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.

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 hop sets 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.

☒ **Compliance for Section 15.247 (a)(1)**

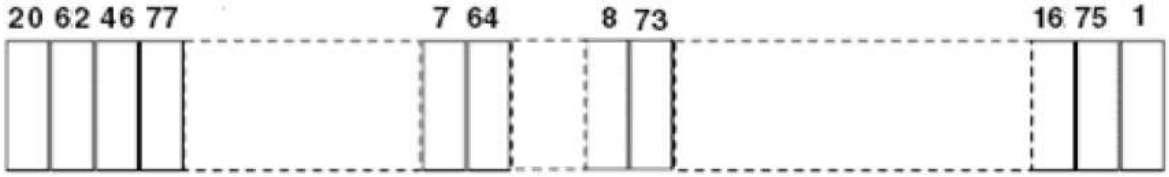
According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a ninestage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

• Number of shift register stages: 9
• Length of pseudo-random sequence: 2^9 -1 = 511 bits
• Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

☒ **Compliance for section 15.247(g)**
According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

☒ **Compliance for section 15.247(h)**
According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.
According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

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 ProBook 6470b	NA
2	AC/DC adapter	Lenovo C-P64	AC 100-240V input; DC 5V, 1.5A output

2.5 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2016-10-21	2017-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2016-10-20	2017-10-19
A.M.N.	ESH2-Z5	R&S	EC 3119	2016-1-9	2017-1-8
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2016-4-28	2017-4-27
Horn antenna	HF 906	R&S	EC 3049	2016-4-28	2017-4-27
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2016-4-12	2017-4-11
Semi-anechoic chamber	-	Albatross project	EC 3048	2016-5-12	2017-5-11
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2016-1-8	2017-1-7
Power sensor / Power meter	N1911A/N1921A	Agilent	EC4318	2016-04-12	2017-04-11
Temperature Camber	SETH-E	tayasaf	EC4315	2016-4-9	2017-4-8
Spectrum analyzer	E7402A	Agilent	EC2254	2016-08-16	2017-08-15

2.6 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
20 dB Bandwidth	15.247(a)(1)	RSS-247 Issue 1 Annex 5.1	Tested
Occupied bandwidth	-	RSS-Gen Issue 4 Clause 6.6	Tested
Carrier Frequency Separation	15.247(a)(1)	RSS-247 Issue 1 Annex 5.1	Pass
Output power	15.247(b)(1)	RSS-247 Issue 1 Annex 5.4	Pass
Radiated Spurious Emissions	15.205 & 15.209	RSS-Gen Issue 4 Clause 8.10	Pass
Band Edge Emission	15.247(d)	RSS-247 Issue 1 Annex 5.5	Pass
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	Pass
Number of Hopping Frequencies	15.247(a)(1)(iii)	RSS-247 Issue 1 Annex 5.1	Pass
Dwell time	15.247(a)(1)(iii)	RSS-247 Issue 1 Annex 5.1	Pass

Note: “NA” means “not applied”.

3. 20 dB Bandwidth & 99% Occupied Bandwidth

Test result: Tested

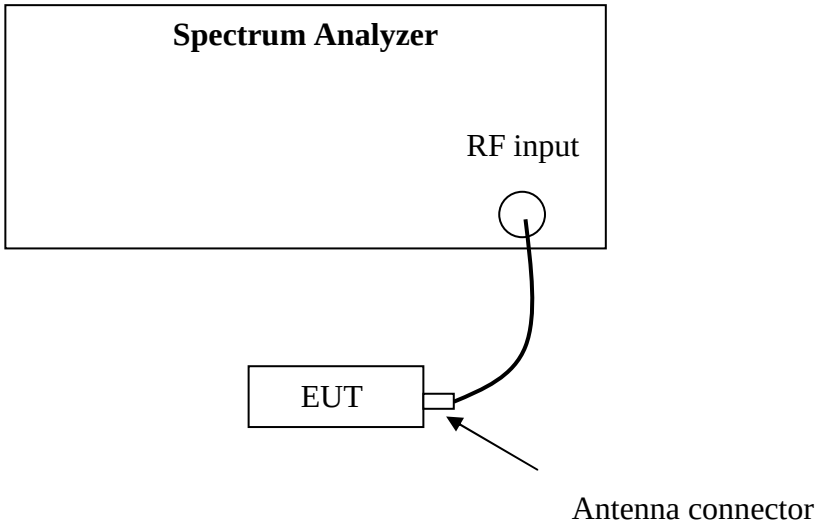
3.1 Limit

☐ 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.

☒No limit for 99% Occupied Bandwidth

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 = approximately 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)

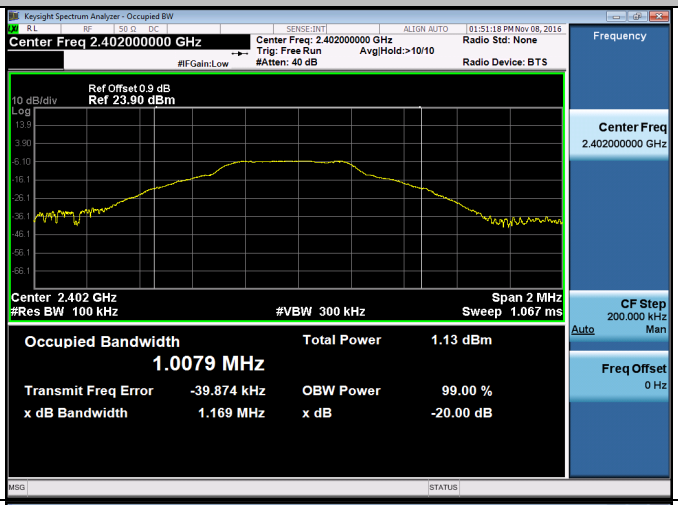
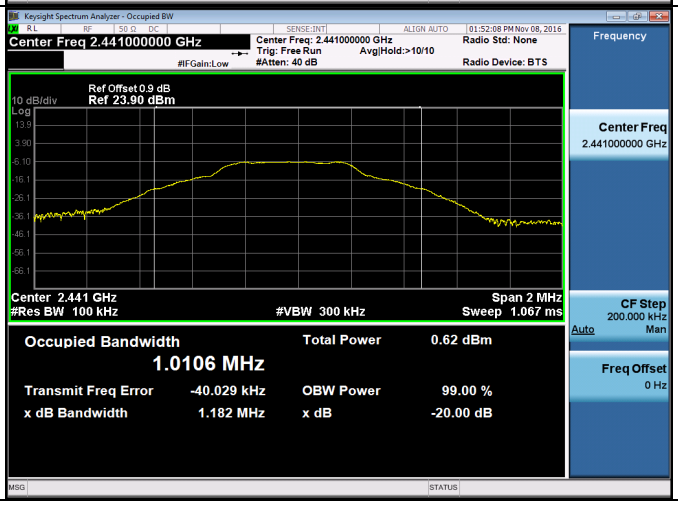
The occupied bandwidth per RSS-Gen Issue 4 Clause 6.6 was measured using the Spectrum Analyzer with the RBW close to 1% of the selected span, VBW = 3 * RBW
Detector = Sample, Sweep = Auto.

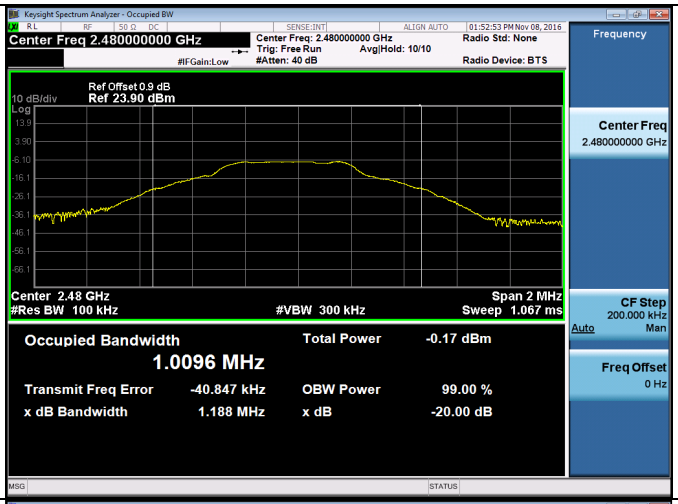
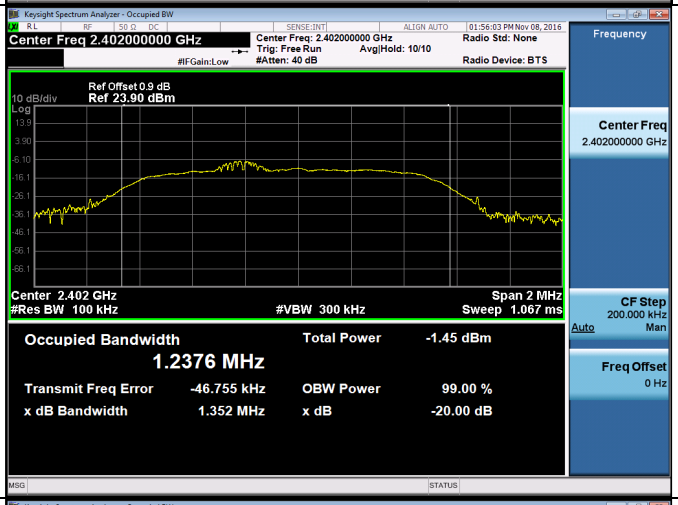
3.4 Test Protocol

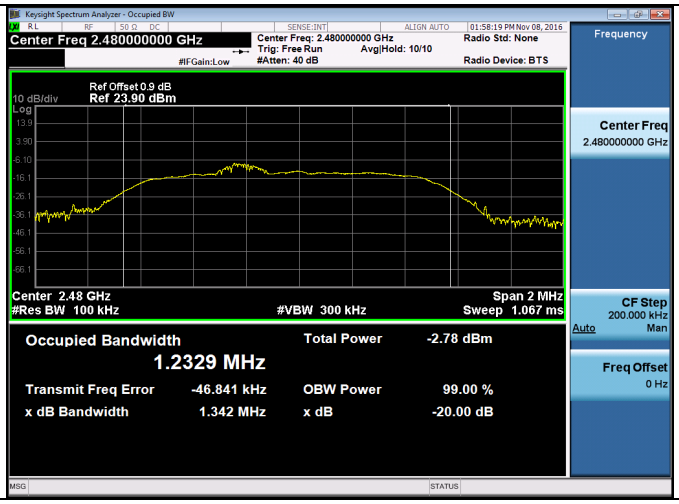
Temperature : 25°C
Relative Humidity : 55 %

Mode	Channel.	20dB Bandwidth (MHz)	99% OBW (MHz)	Two-thirds of 20dB OW (MHz)
GFSK	LCH	1.17	1.01	0.78
GFSK	MCH	1.18	1.01	0.79
GFSK	HCH	1.19	1.01	0.79
8DPSK	LCH	1.35	1.24	0.90
8DPSK	MCH	1.33	1.24	0.89
8DPSK	HCH	1.34	1.24	0.89

Test Graph

Graphs		
GFSK/LCH		
GFSK/MCH		

GFSK/HCH		
8DPSK/LCH		
8DPSK/MCH		

8DPSK/HCH			

3.5 Measurement uncertainty

Measurement uncertainty: ± 3 %
The measurement uncertainty is given with a confidence of 95%, k=2.

4. Carrier Frequency Separation

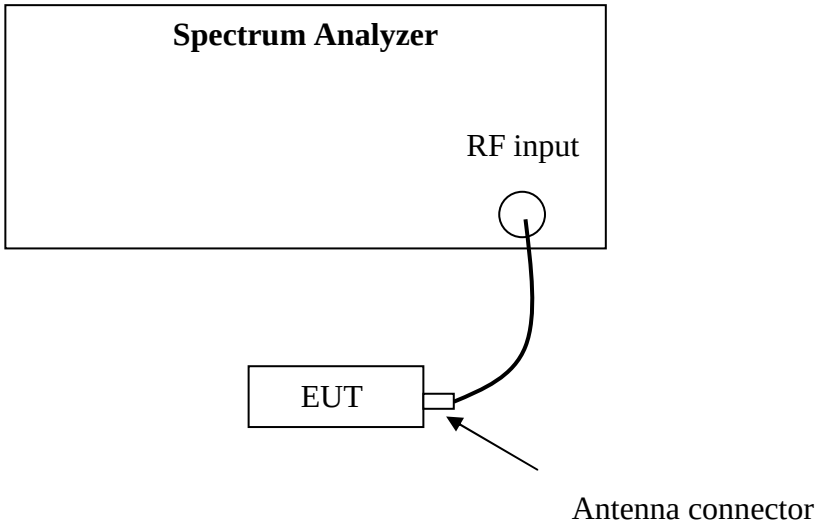
Test result: Pass

4.1 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

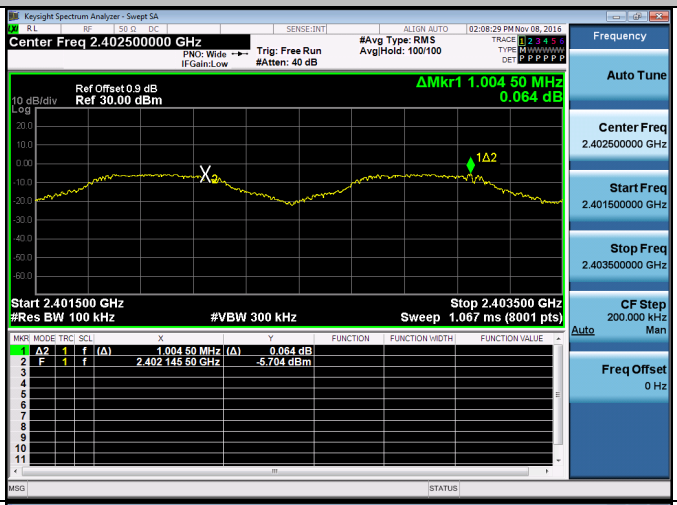
The Carrier Frequency Separation per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels, RBW≥1% of the span, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT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

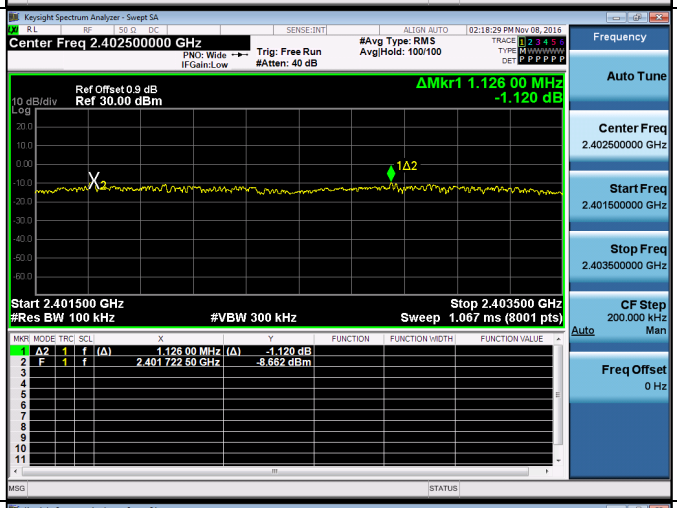
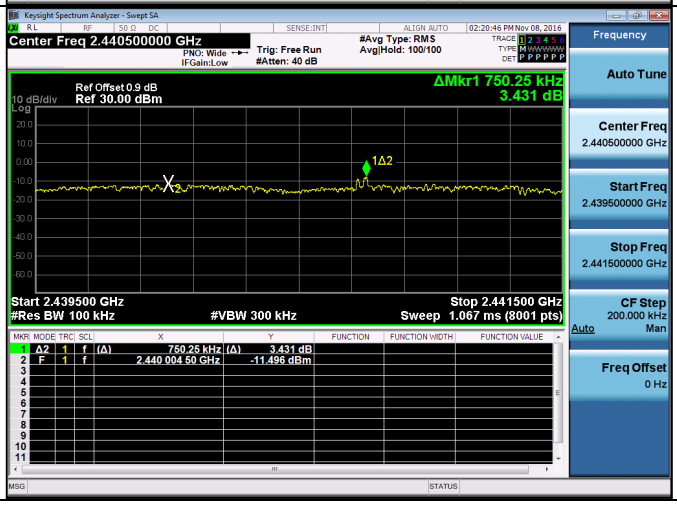
4.4 Test Protocol

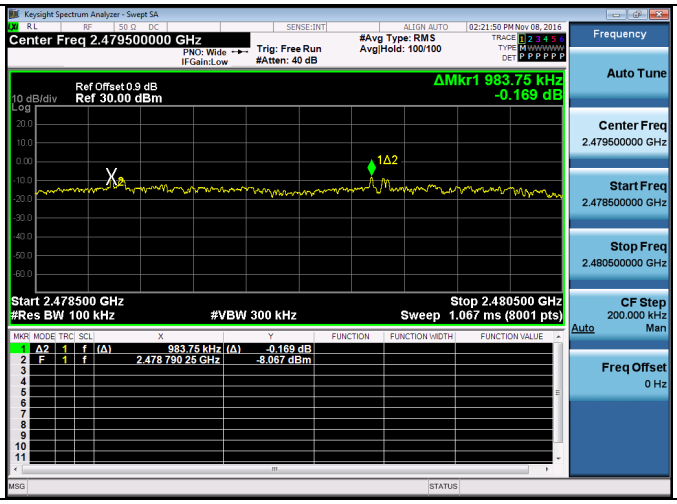
Temperature : 25°C
Relative Humidity : 55 %

Mode	Channel	Carrier Frequency Separation (MHz)	Limit (kHz)
GFSK	LCH	1.01	≥ 2/3 of 20dB BW
GFSK	MCH	0.81	≥ 2/3 of 20dB BW
GFSK	HCH	1.18	≥ 2/3 of 20dB BW
8DPSK	LCH	1.13	≥ 2/3 of 20dB BW
8DPSK	MCH	0.75	≥ 2/3 of 20dB BW
8DPSK	HCH	0.98	≥ 2/3 of 20dB BW

Test Graph

Graphs		
GFSK/LCH		
GFSK/MCH		

GFSK/HCH			
8DPSK/LCH			
8DPSK/MCH			

8DPSK/HCH			

4.5 Measurement uncertainty

Measurement uncertainty: ± 3 %
The measurement uncertainty is given with a confidence of 95%, k=2.

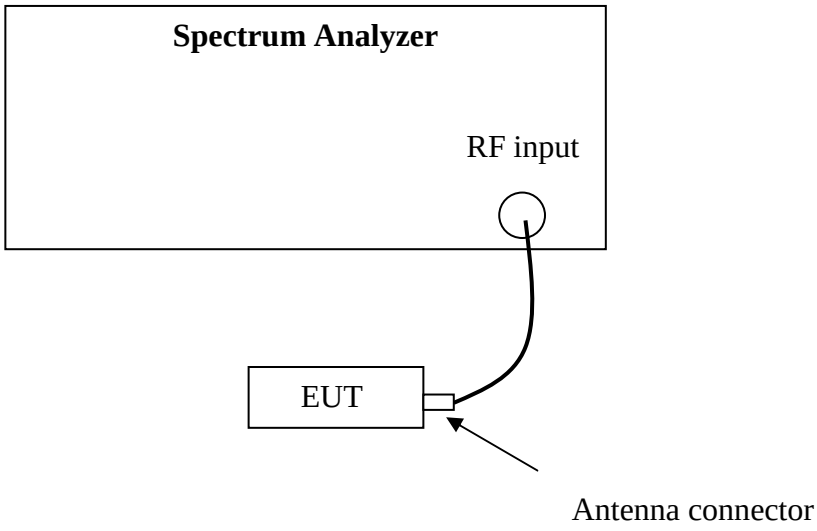
5. Maximum peak output power

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 power output per FCC § 15.247(b) is measured by setting the Spectrum Analyzer as RBW = 1MHz, VBW = 3MHz, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The test method is following DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

5.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

Mode	Channel	Cable loss (dB)	Conducted Power (dBm)	Limit (dBm)
GFSK	LCH	0.80	1.50	21
GFSK	MCH	0.80	0.20	21
GFSK	HCH	0.80	-0.50	21
8DPSK	LCH	0.80	2.20	21
8DPSK	MCH	0.80	0.10	21
8DPSK	HCH	0.80	-0.40	21

Conclusion: The maximum EIRP = 2.20dBm = 1.66mW which is lower than the limit of 4W listed in RSS-247.

5.5 Measurement uncertainty

Measurement uncertainty: ± 0.74dB
The measurement uncertainty is given with a confidence of 95%, k=2.

6. Radiated Spurious Emissions

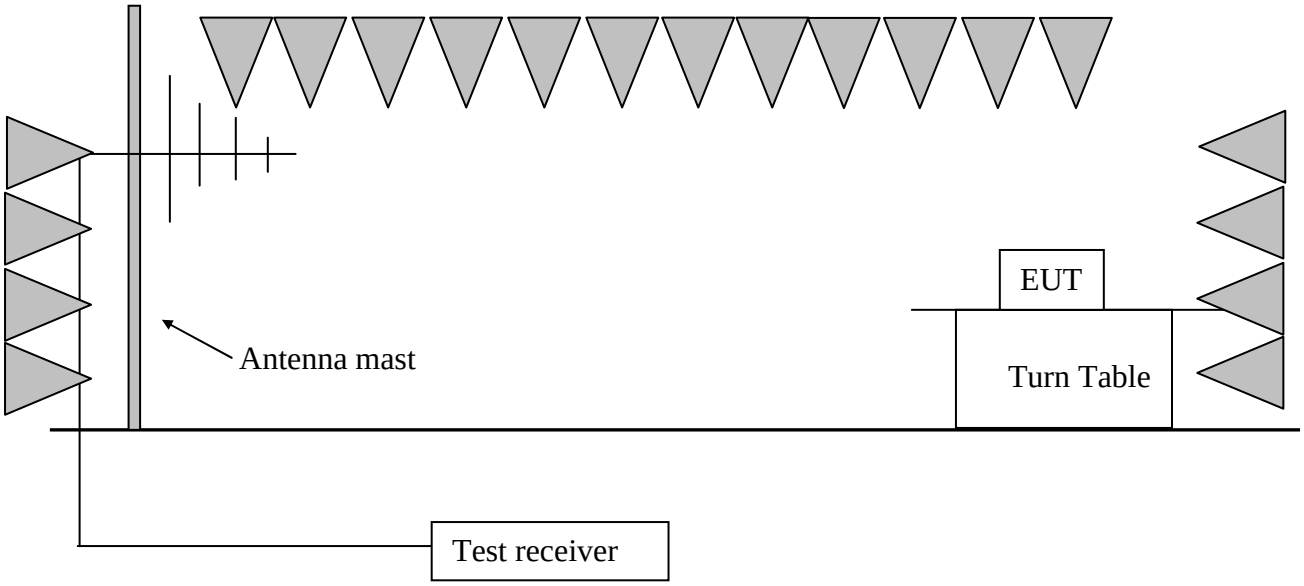
Test result: PASS

6.1 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:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

6.2 Test Configuration



6.3 Test procedure and test setup

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 and the EUT was placed on a 1.5m height.
The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table 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 = 100kHz, VBW = 300kHz (30MHz~1GHz)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);
RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”.

6.4 Test protocol

Hopping off, GFSK_DH5

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
LCH	H	2402.20	30.30	91.50	Fundamental	/	PK
	V	49.43	9.70	31.10	40.00	8.90	PK
	V	290.48	15.30	34.20	46.00	11.80	PK
	H	298.26	15.40	38.10	46.00	7.90	PK
	H	640.38	22.00	36.70	46.00	9.30	PK
	H	2389.56	30.30	59.40	74.00	14.60	PK
	H	2388.56	30.30	47.50	54.00	6.50	AV
	H	3322.64	-4.20	50.90	54.00	3.10	PK
	H	4795.59	0.40	54.40	74.00	19.60	PK
	H	4795.59	0.40	37.10	54.00	16.90	AV
	V	7208.41	6.50	50.10	54.00	3.90	PK
MCH	H	2441.07	30.40	90.20	Fundamental	/	PK
	V	49.43	9.70	31.10	40.00	8.90	PK
	V	290.48	15.30	34.20	46.00	11.80	PK
	H	298.26	15.40	38.10	46.00	7.90	PK
	H	640.38	22.00	36.70	46.00	9.30	PK
	H	3322.64	-4.20	50.70	54.00	3.30	PK
	H	4879.75	0.50	50.20	54.00	3.80	PK
	V	7320.64	7.00	50.90	54.00	3.10	PK
HCH	H	2479.83	30.50	89.50	Fundamental	/	PK
	V	49.43	9.70	31.10	40.00	8.90	PK
	V	290.48	15.30	34.20	46.00	11.80	PK
	H	298.26	15.40	38.10	46.00	7.90	PK
	H	640.38	22.00	36.70	46.00	9.30	PK
	H	2483.54	30.50	63.00	74.00	11.00	PK
	H	2483.50	30.50	49.20	54.00	4.80	AV

	H	3322.64	-4.20	50.10	54.00	3.90	PK
	H	4963.92	0.60	51.40	54.00	2.60	PK
	V	7446.89	7.60	49.10	54.00	4.90	PK

Hopping off, 8DPSK_DH5

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
LCH	H	2402.20	30.30	92.20	Fundamental	/	PK
	V	49.43	9.70	31.10	40.00	8.90	PK
	V	290.48	15.30	34.20	46.00	11.80	PK
	H	298.26	15.40	38.10	46.00	7.90	PK
	H	640.38	22.00	36.70	46.00	9.30	PK
	H	2387.76	30.30	61.10	74.00	12.90	PK
	H	2389.16	30.30	45.50	54.00	8.50	AV
	H	3322.64	-4.20	51.00	54.00	3.00	PK
	H	4795.59	0.40	53.40	74.00	20.60	PK
	H	4795.59	0.40	37.00	54.00	17.00	AV
	V	7208.41	6.50	47.30	54.00	6.70	PK
MCH	H	2441.07	30.40	90.10	Fundamental	/	PK
	V	49.43	9.70	31.10	40.00	8.90	PK
	V	290.48	15.30	34.20	46.00	11.80	PK
	H	298.26	15.40	38.10	46.00	7.90	PK
	H	640.38	22.00	36.70	46.00	9.30	PK
	H	3322.64	-4.20	51.20	54.00	2.80	PK
	H	4879.75	0.50	49.30	54.00	4.70	PK
	V	7320.64	7.00	46.40	54.00	7.60	PK
HCH	H	2479.83	30.50	89.60	Fundamental	/	PK
	V	49.43	9.70	31.10	40.00	8.90	PK
	V	290.48	15.30	34.20	46.00	11.80	PK
	H	298.26	15.40	38.10	46.00	7.90	PK
	H	640.38	22.00	36.70	46.00	9.30	PK

	H	2483.50	30.50	70.00	74.00	4.00	PK
	H	2483.50	30.50	53.10	54.00	0.90	AV
	H	3322.64	-4.20	51.80	54.00	2.20	PK
	H	4949.89	0.60	52.10	54.00	1.90	PK
	V	7446.89	7.60	48.60	54.00	5.40	PK

Remark: 1. For fundamental emission, no amplifier is employed.
2. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
3. Corrected Reading = Original Receiver Reading + Correct Factor
4. Margin = limit – Corrected Reading
5. If the PK reading is lower than AV limit, the AV test can be elided.
6. The emission was conducted from 30MHz to 25GHz.

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

6.5 Measurement uncertainty

Measurement uncertainty of radiated emission (30MHz-1000MHz) is: ± 4.90dB
Measurement uncertainty of radiated emission (1000MHz-6000MHz) is: ± 5.02dB
The measurement uncertainty is given with a confidence of 95%, k=2.

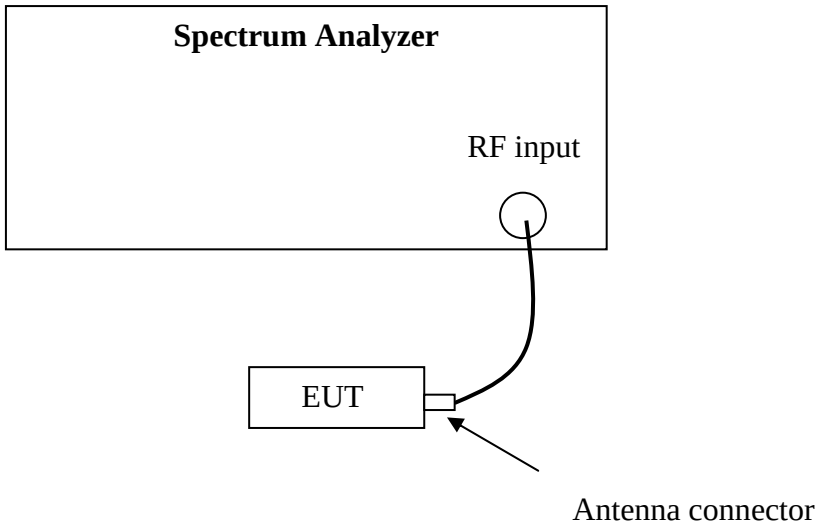
7. Band Edge Emission

Test result: **PASS**

7.1 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.

7.2 Test Configuration



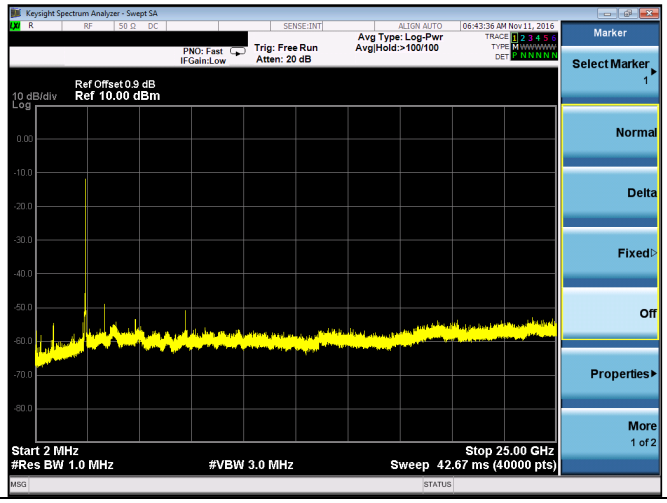
7.3 Test procedure and test setup

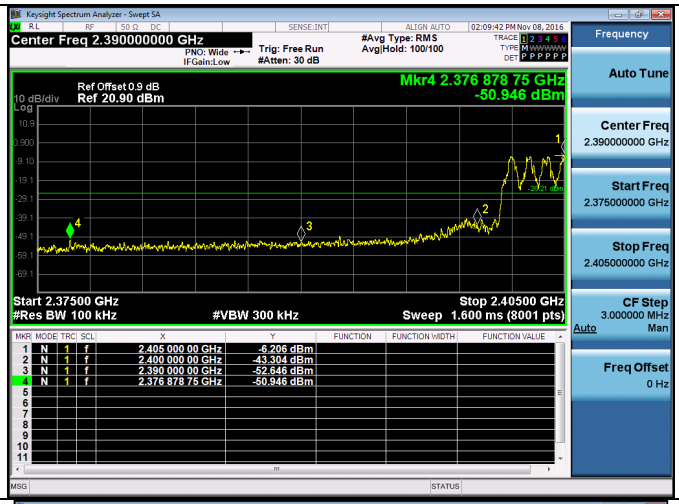
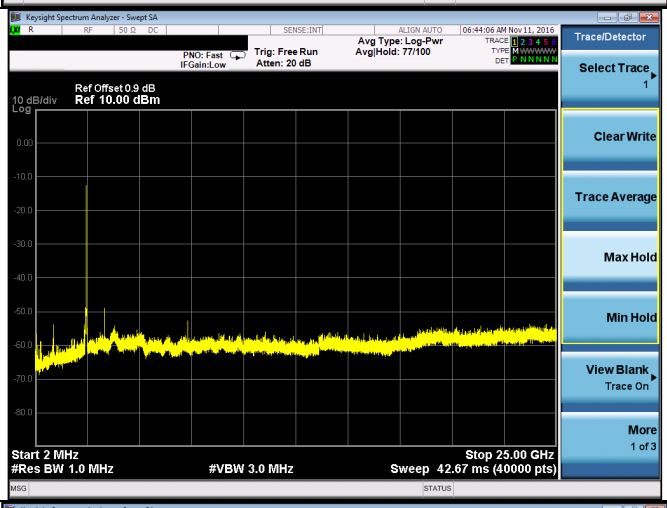
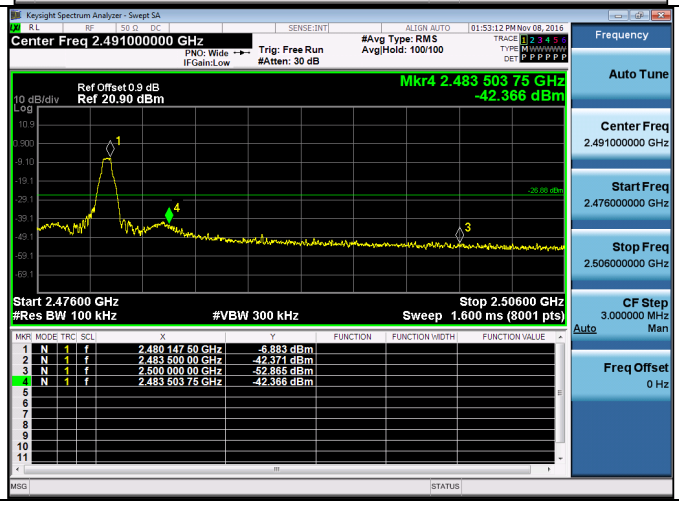
The Band Edge Emissions per FCC § 15.247(d) is measured using the Spectrum Analyzer with Span wide enough capturing all spurious from the lowest emission frequency of the EUT up to 10th harmonics, RBW = 100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels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

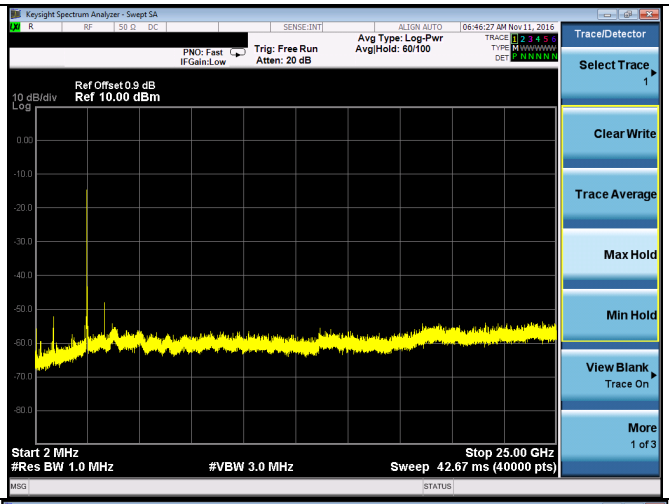
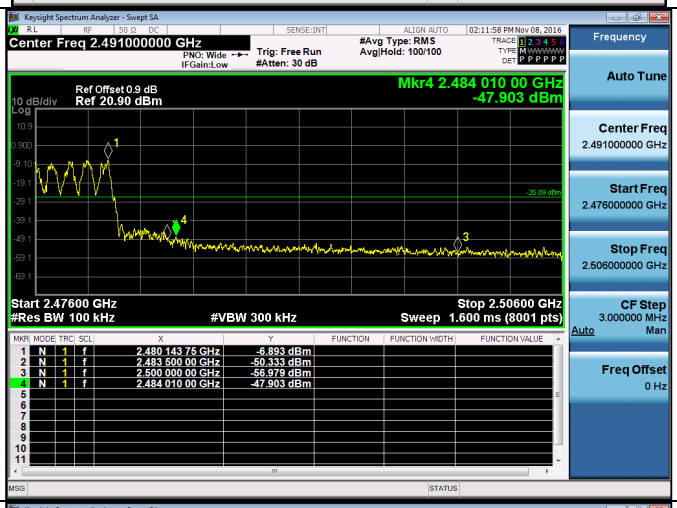
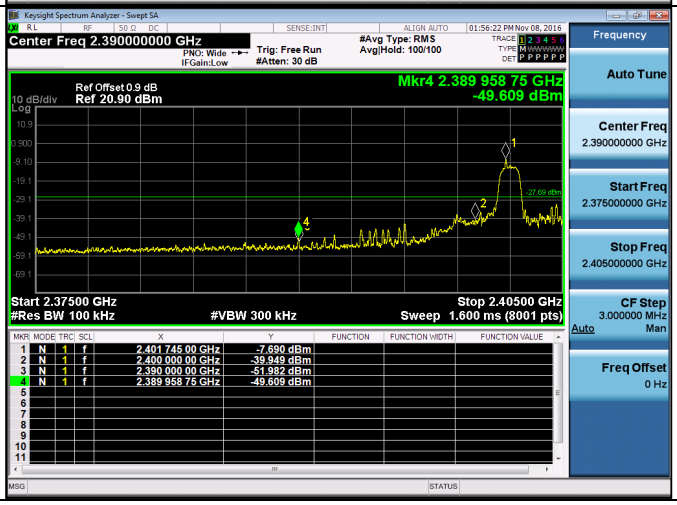
7.4 Test protocol

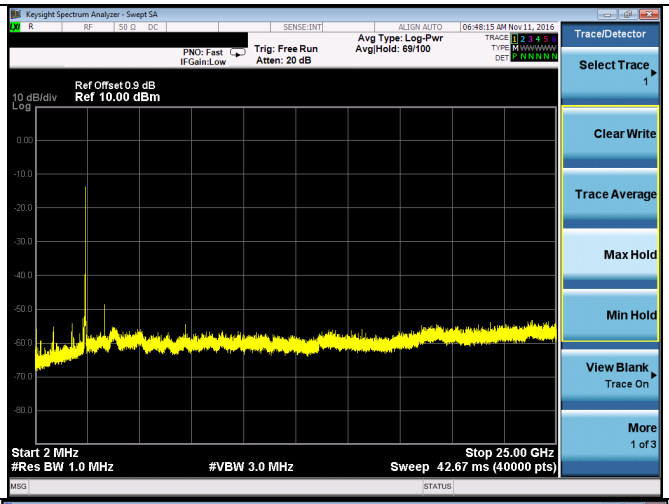
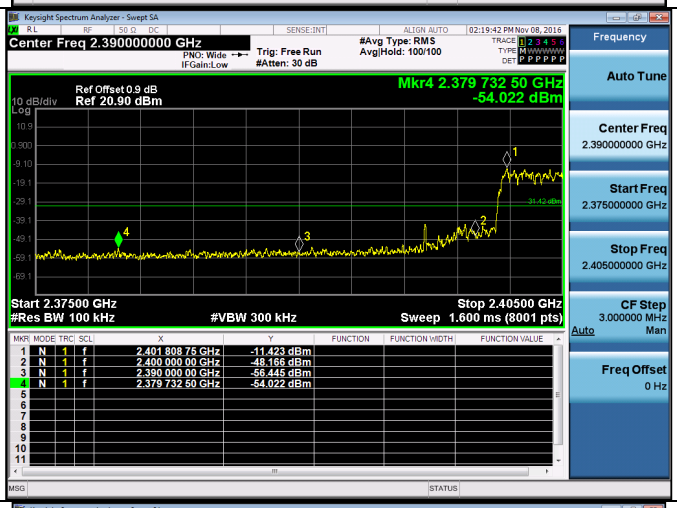
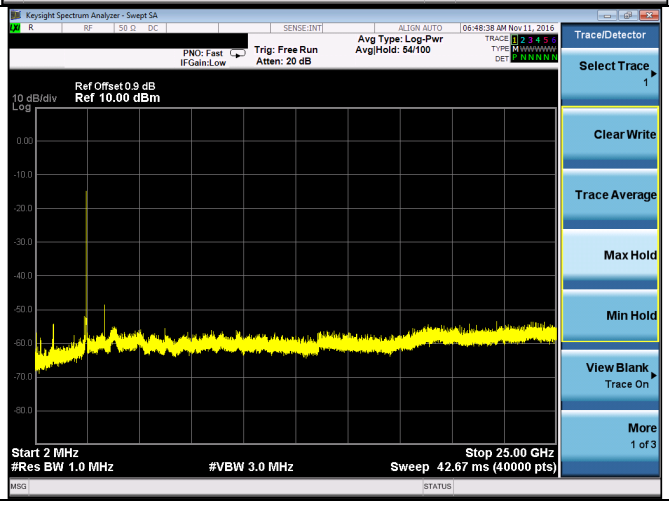
Mode	Channel	Carrier Frequency (MHz)	Reading (dB)	Limit (dBm)
GFSK	LCH	2402	>20	≥20
GFSK	MCH	2441	>20	≥20
GFSK	HCH	2480	>20	≥20
8DPSK	LCH	2402	>20	≥20
8DPSK	MCH	2441	>20	≥20
8DPSK	HCH	2480	>20	≥20

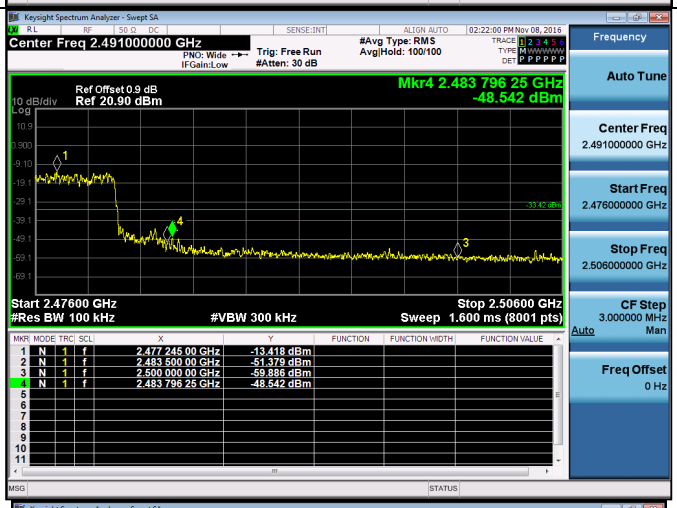
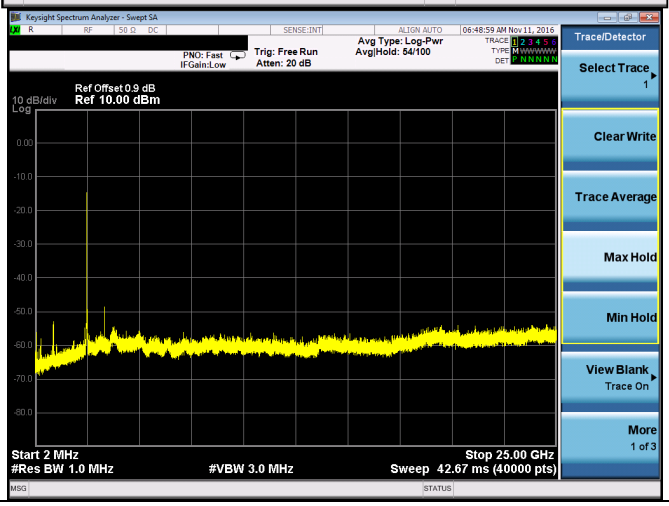
Test Graph

Graphs	
GFSK/LCH/No Hop	 

GFSK/LCH/Hop	
GFSK/MCH/No Hop	
GFSK/HCH/No Hop	

		
GFSK/HCH/Hop		
8DPSK/LCH/No Hop		

	
8DPSK/LCH/Hop	
8DPSK/MCH/No Hop	

8DPSK/HCH/No Hop		
8DPSK/HCH/Hop		 

7.5 Measurement uncertainty

Measurement uncertainty: ± 0.74dB
The measurement uncertainty is given with a confidence of 95%, k=2.

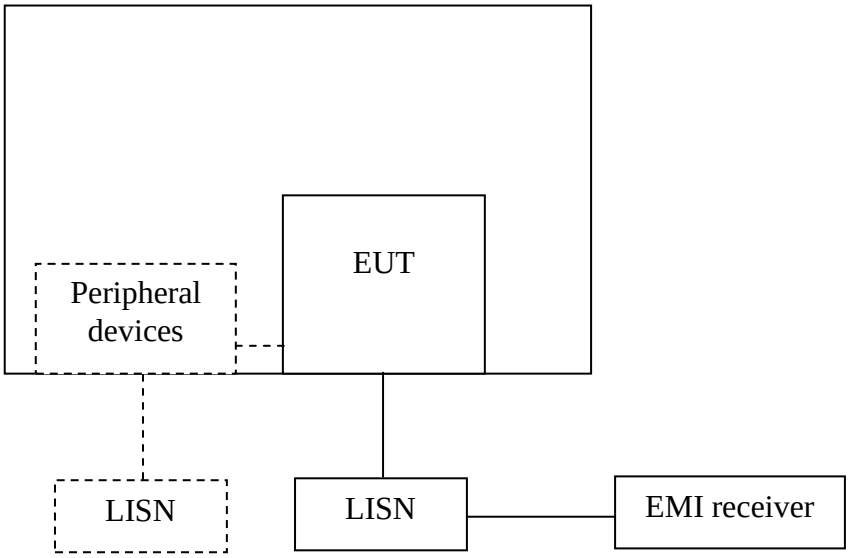
8. Power line conducted emission

Test result: **Pass**

8.1 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.		

8.2 Test configuration



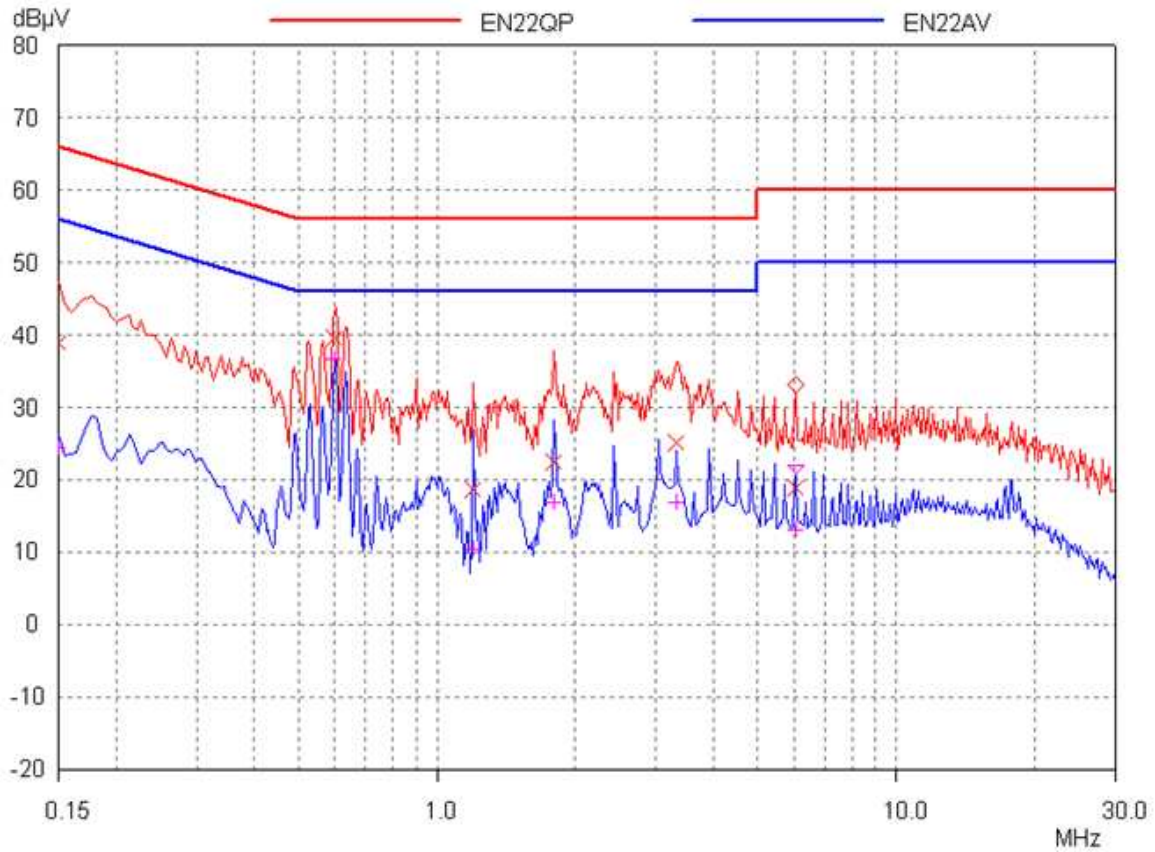
☒ For table top equipment, wooden support is 0.8m height table

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

8.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement.
The bandwidth of the test receiver is set at 9 kHz.

8.4 Test protocol



Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.15 (L)	3.00	38.83	24.47	66.00	56.00	27.17	31.53
0.60 (N)	3.00	39.58	36.75	56.00	46.00	16.42	9.25
1.20 (L)	3.00	18.72	10.34	56.00	46.00	37.28	35.66
1.80 (L)	3.00	22.40	16.88	56.00	46.00	33.60	29.12
3.30 (N)	3.00	25.18	16.79	56.00	46.00	30.82	29.21
5.99 (L)	3.00	18.90	13.08	60.00	50.00	41.10	36.92
Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB). 2. Margin (dB) = Limit - Corrected Reading.							

8.5 Measurement uncertainty

Measurement uncertainty: ± 3.19dB
The measurement uncertainty is given with a confidence of 95%, k=2.

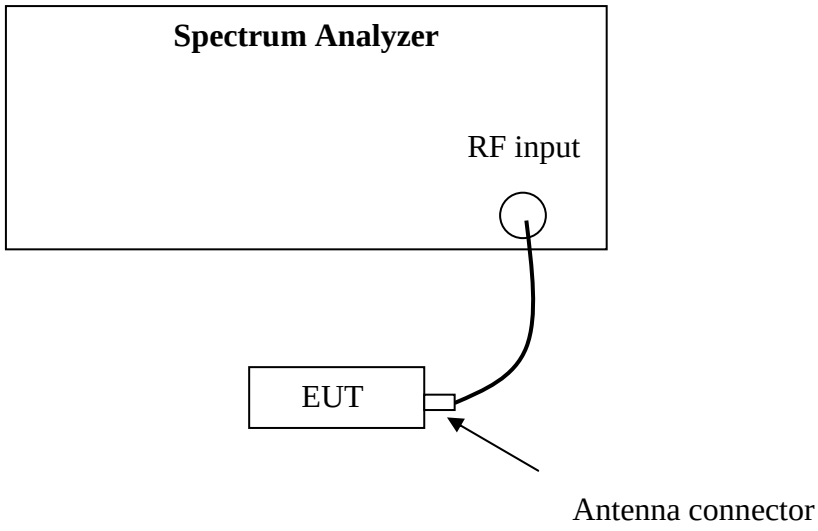
9. Number of Hopping Frequencies

Test result: **Pass**

9.1 Limit

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

9.2 Test Configuration



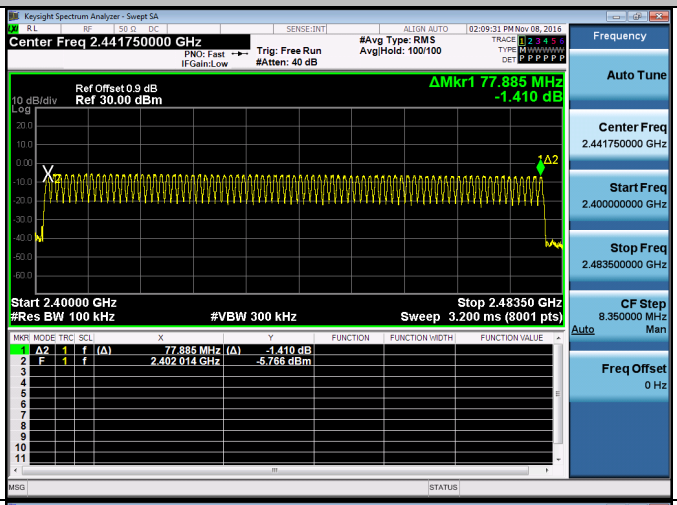
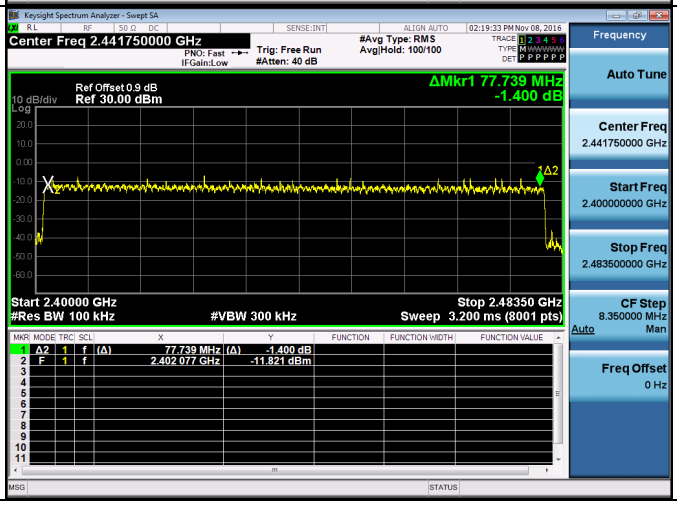
9.3 Test procedure and test setup

The channel number per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with RBW=1MHz, 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).

9.4 Test protocol

Mode	Channel	Number of Hopping Channel
GFSK	Hop	79
8DPSK	Hop	79

Test Graph

Graphs			
GFSK/Hop			
8DPSK/Hop			

9.5 Measurement uncertainty

Measurement uncertainty: ± 3%
The measurement uncertainty is given with a confidence of 95%, k=2.

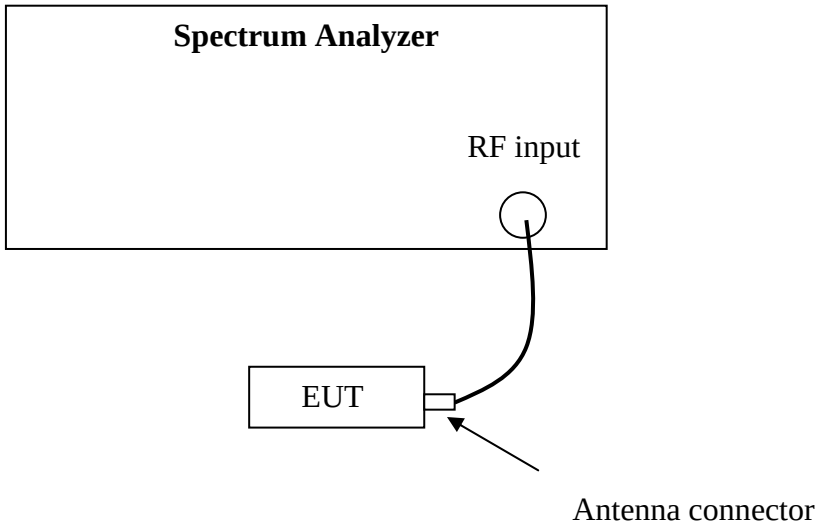
10. Dwell Time

Test result: **Pass**

10.1 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.

10.2 Test Configuration



10.3 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).

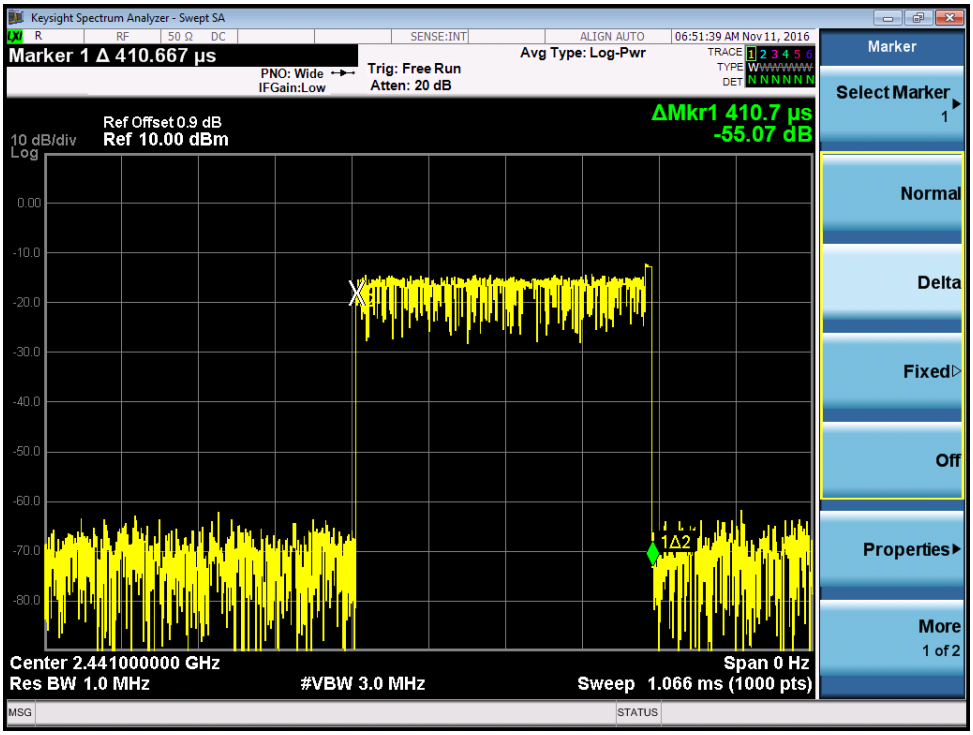
10.4 Test protocol

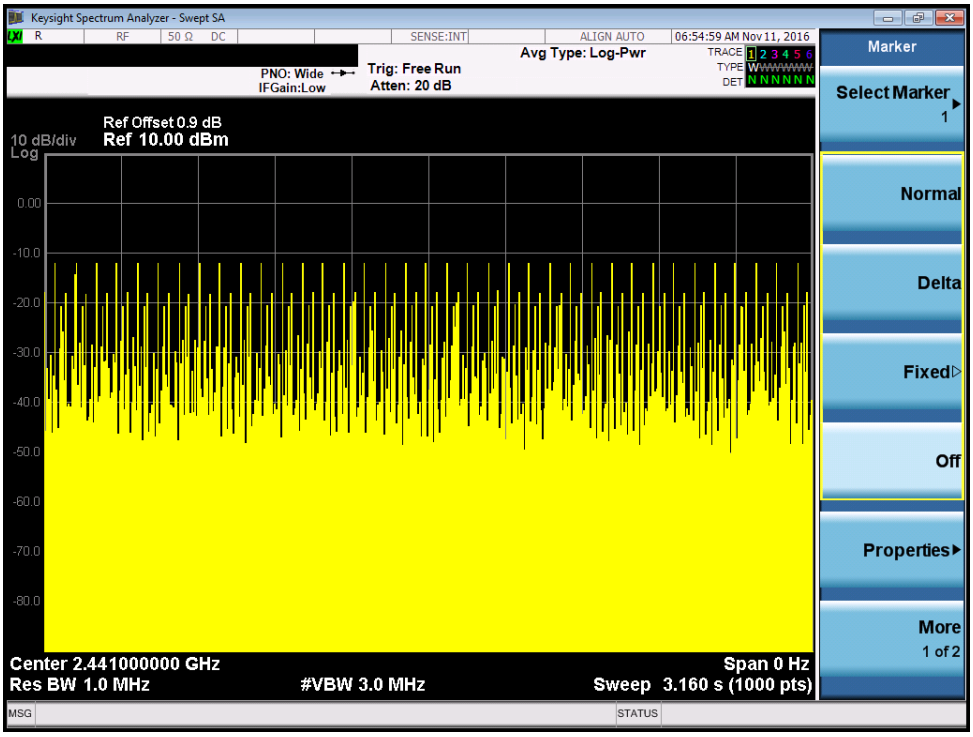
Packet	Occupancy time for single hop (ms) **O**	CH	Real observed period (s) **P**	Hops among Observed period **I**	Dwell time (s) **T**	Limit (s)
3DH1	0.41	L	3.16	37	0.15	≤0.4
		M	3.16	37	0.15	
		H	3.16	37	0.15	
3DH3	1.67	L	3.16	17	0.28	
		M	3.16	17	0.28	
		H	3.16	17	0.28	
3DH5	2.97	L	3.16	11	0.33	
		M	3.16	11	0.33	
		H	3.16	11	0.33	

Remark: 1. There are 79 channels in all. So the complete observed period P = 0.4 * 79 = 31.6 s.

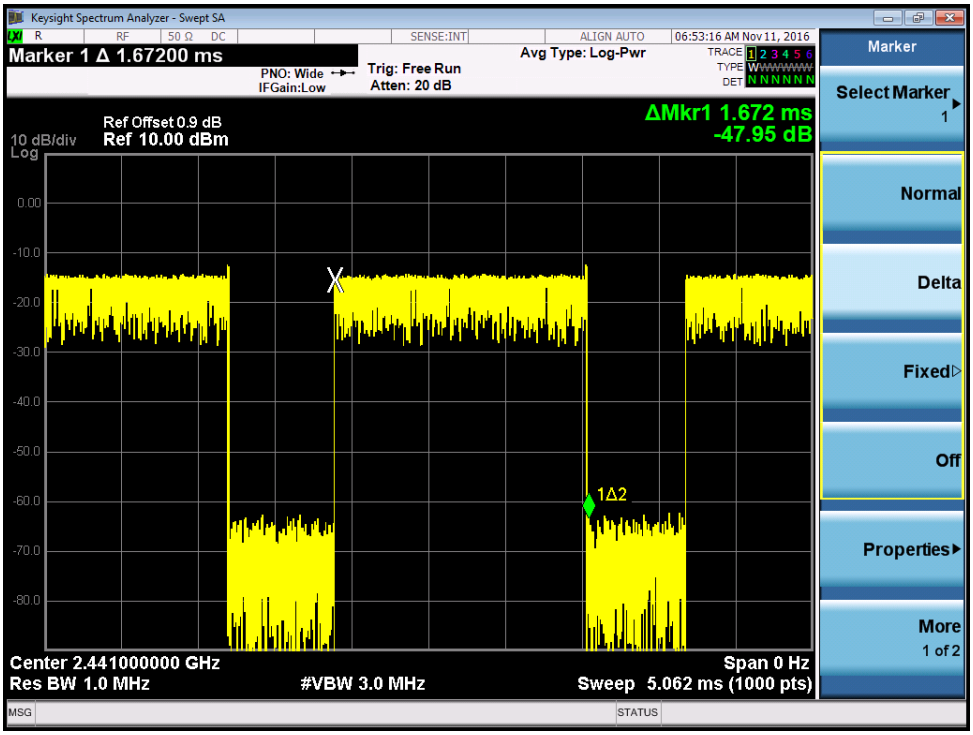
2. Average time of occupancy **T = O *I * 31.6 / P**

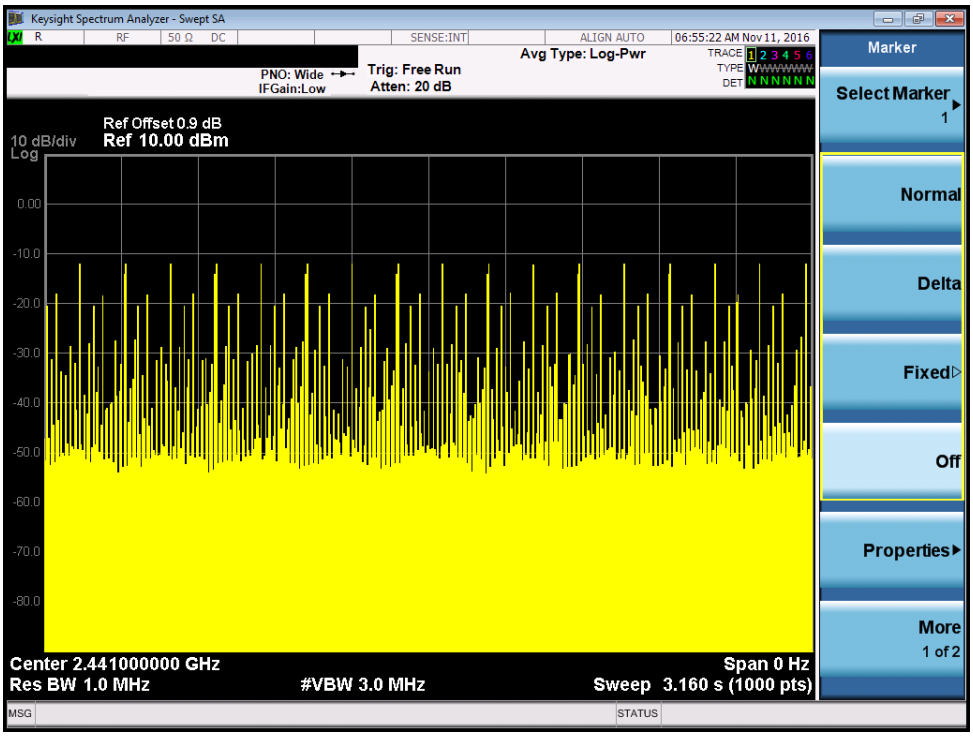
3DH1


Keysight Spectrum Analyzer - Swept SA
Marker 1 Δ 410.667 µs
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
06:51:39 AM Nov 11, 2016
Ref Offset 0.9 dB
10 dB/div
Ref 10.00 dBm
ΔMkr1 410.7 µs
-55.07 dB
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 1.066 ms (1000 pts)
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2

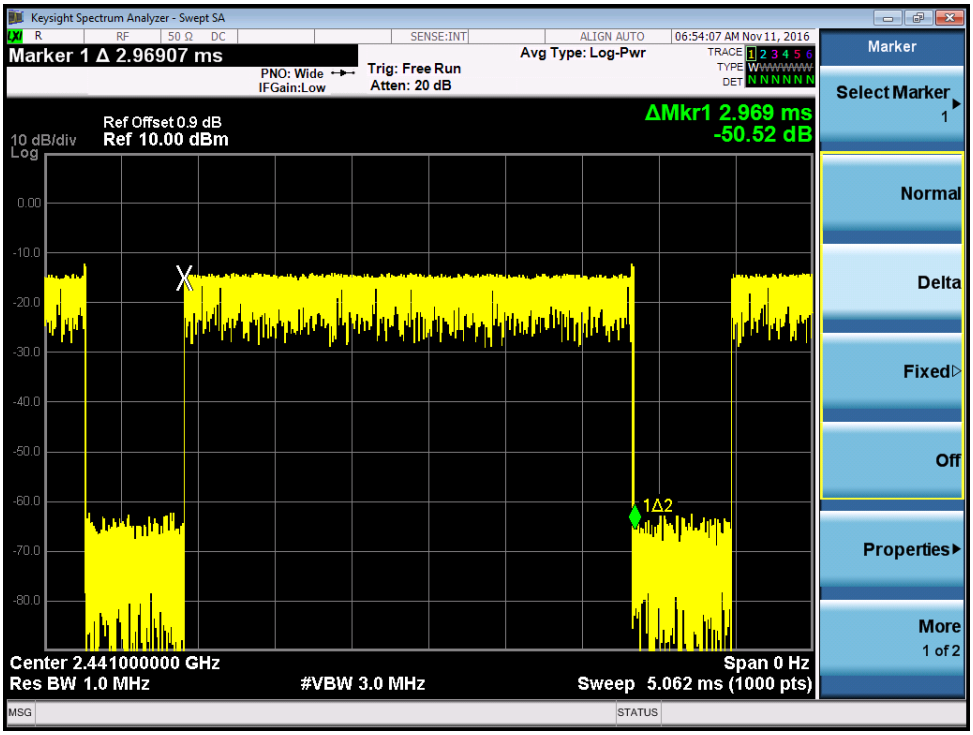

Keysight Spectrum Analyzer - Swept SA
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
06:54:59 AM Nov 11, 2016
Ref Offset 0.9 dB
10 dB/div
Ref 10.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 3.160 s (1000 pts)
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2

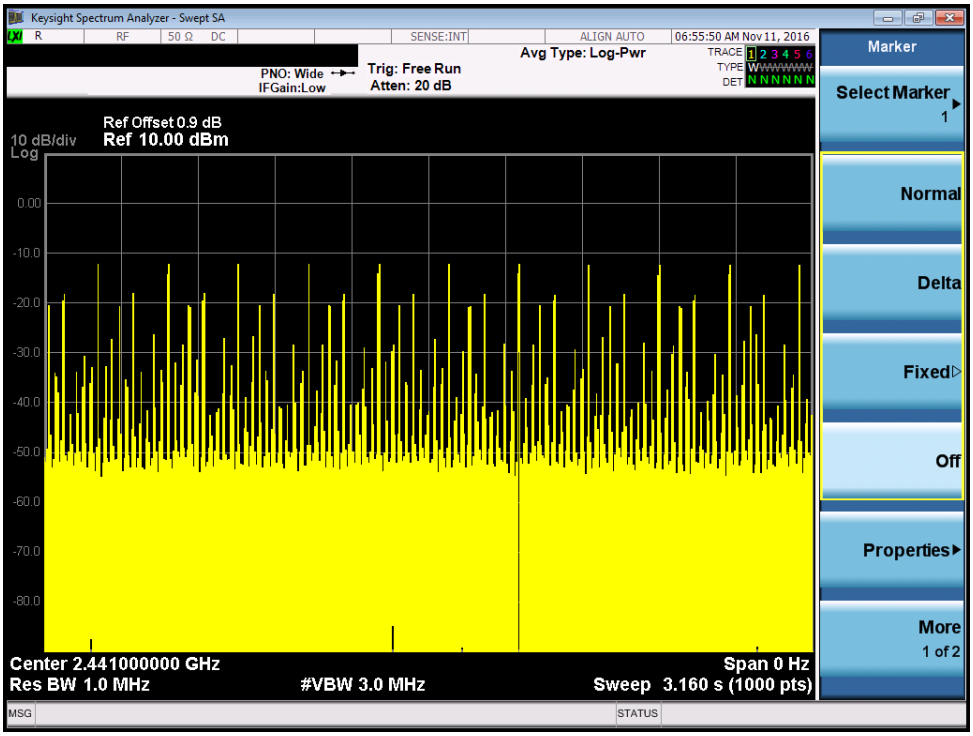
3DH3


Keysight Spectrum Analyzer - Swept SA
Marker 1 Δ 1.67200 ms
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
06:53:16 AM Nov 11, 2016
Ref Offset 0.9 dB
10 dB/div
Ref 10.00 dBm
ΔMkr1 1.672 ms
-47.95 dB
1Δ2
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.062 ms (1000 pts)
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
06:55:22 AM Nov 11, 2016
Ref Offset 0.9 dB
10 dB/div
Ref 10.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 3.160 s (1000 pts)
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2

3DH5





10.5 Measurement uncertainty

Measurement uncertainty: ± 3%
The measurement uncertainty is given with a confidence of 95%, k=2.