

TEST REPORT

Report No.: SHE19090021-01FE

Date: 2019-12-10

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Applicant : Shanghai ZoomSmart Technology Co.,Ltd.
Address of Applicant : Room 802 Hengxi Road No.809 Pujiang Town Minhang district, Shanghai, China

Product Name : Rugged Phone
Model No. : LT600
Sample No. : E19090021-01#03
E19090021-01#05
FCC ID : 2AUFL-LT600

Standards : FCC CFR47 Part 15, Subpart C

Date of Receipt : 2019-09-16
Date of Test : 2019-09-23 ~ 2019-11-27
Date of Issue : 2019-12-10

Remark:

This report details the results of the testing carried out on one sample, the results contained in this report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

Prepared by: Jennifer Zhou Reviewed by: Adrian Shi Approved by: Guoyou Chi
(Jennifer Zhou) (Adrian Shi) (Authorized signatory: Guoyou Chi)

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Revision Record			
Version	Date	Revisions	Revised By
1.0	2019-12-10	Original	--

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1 General Information

1.1 Testing Laboratory

Company Name	ICAS Testing Technology Services (Shanghai) Co., Ltd.
Address	155 Pingbei Rd, Minhang District, Shanghai, China
Telephone	0086 21-51682999
Fax	0086 21-54711112
Homepage	www.icasiso.com

1.2 Details of Application

Company Name	Shanghai ZoomSmart Technology Co.,Ltd.
Address	
Contact Person	yc.qiao
Telephone	15800844215
Email	yc.qiao@zoomsmart.com.cn

1.3 Details of EUT

Product Name	Rugged Phone
Brand Name	ZOOMSMART
Model No.	LT600
FCC ID	2AUFL-LT600
Mode of Operation	Bluetooth BR/EDR
Frequency Range	2400MHz ~ 2483.5MHz
Number of Channels	79 (at intervals of 1 MHz)
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Antenna Type	Internal Antenna
Antenna Gain	2.03 dBi
Extreme Temperature Range	0°C ~ +40°C
Test Voltage	DC 3.85V

1.4 Test Methodology

47 CFR Part 15, Subpart C	Miscellaneous Wireless Communications Services
KDB Publication 558074 D01 v05r02	DTS Meas Guidance.
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Note(s):

All test items were verified and recorded according to the standards and without any addition/deviation/exclusion during the test.

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1.5 Test Verdict

No.	FCC Part No.	ISED Part No.	Description	Test Result	Verdict
1	15.203	RSS-247, 5.4(6)	Antenna Requirement	Clause 4.1.1	PASS
2	15.247(b)	RSS-247, 5.1(4)	Maximum Conducted Output Power	Clause 4.1.2	PASS
3	15.247(a)	RSS-247, 5.1(1)	20dB Bandwidth and 99% Bandwidth	Clause 4.1.3	PASS
4	15.247(d)	RSS-247, 5.5	Conducted Spurious Emission & Authorized-band band-edge	Clause 4.1.4	PASS
5	15.247(d), 15.205, 15.209	RSS-247, 5.5	Spurious Emission	Clause 4.1.5	PASS
6	15.247(d), 15.205, 15.209	RSS-247, 5.5	Band Edge (Restricted-band band-edge)	Clause 4.1.6	PASS
7	15.247(a)	RSS-247 5.1(2)	Hopping Frequency Separation	Clause 4.1.7	PASS
8	15.247(a)	RSS-247 5.1(4)	Number of Hopping Frequency	Clause 4.1.8	PASS
9	15.247(a)	RSS-247 5.1(4)	Time of Occupancy	Clause 4.1.9	PASS
10	15.207(a)	RSS-Gen 8.8	Conducted Emission	Clause 4.2.1	PASS

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2 Test Condition

2.1 Environmental conditions

Temperature (°C)	18-25
Humidity (%RH)	40-65
Barometric Pressure (mbar)	960-1060

2.2 Equipment List

Name of Equipment	Manufacturer	Model	Serial No.	Cal. Due Date
Spectrum Analyzer	Keysight	N9020B	MY59260184	2020-07-28
Spectrum Analyzer	Rohde & Schwarz	FSV40N	101450	2020-06-24
EMI Test Receiver	Rohde & Schwarz	ESPI3	100173	2020-06-19
EMI Test Receiver	Rohde & Schwarz	ESR 7	101911	2020-06-19
V-network	SCHWARZBECK	NSLK 8127	8127-902	2020-02-20
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	100687	2020-08-22
Broadband Antenna	SCHWARZBECK	VULB9163	9163-1037	2020-06-06
Horn Antenna-18G	SCHWARZBECK	BBHA9120D	9120D-1775	2020-06-06
Loop Antenna	SCHWARZBECK	FMZB 1513	N/A	2021-03-19
Horn Antenna-40G	YINGLIAN	LB-180400-KF	N/A	2020-07-26
EMC chamber 9*6*6 (L*W*H)	CHANGNING	966	N/A	2020-06-26
Shielded Enclosure 8*5*4 (L*W*H)	CHANGNING	854	N/A	2020-08-28
Test Software	BL	BL410_E	N/A	N/A

2.3 Measurement Uncertainty

Parameter	Frequency	Uncertainty
Antenna Port Conducted Emission	< 1GHz	± 1.5 dB
	> 1GHz	± 1.5 dB
Radiated Emission	30 MHz – 1 GHz	± 3 dB
	> 1GHz	± 3 dB

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3 Test Set-up and Operation Modes

3.1 Details of Test Mode

Using test software was control EUT work in continuous transmitter and receiver mode. Select test channel as below:

Channel	Frequency
The lowest channel(CH0)	2402MHz
The middle channel(CH39)	2441MHz
The Highest channel(CH78)	2480MHz

The basic operation modes are:

- A. On
 - 1. BR/EDR mode
 - a. Transmitting
 - i. Low Channel
 - ii. Middle Channel
 - iii. High Channel
 - iv. Hopping mode
 - b. Receiving
 - 2. Normal working with Bluetooth on
- B. Standby
- C. Off

3.2 Special Accessories and Auxiliary Equipment

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	TP00083A	N/A

3.3 Support Software

Description	Manufacturer	Software Name
Software	Qualcomm	QRCT3

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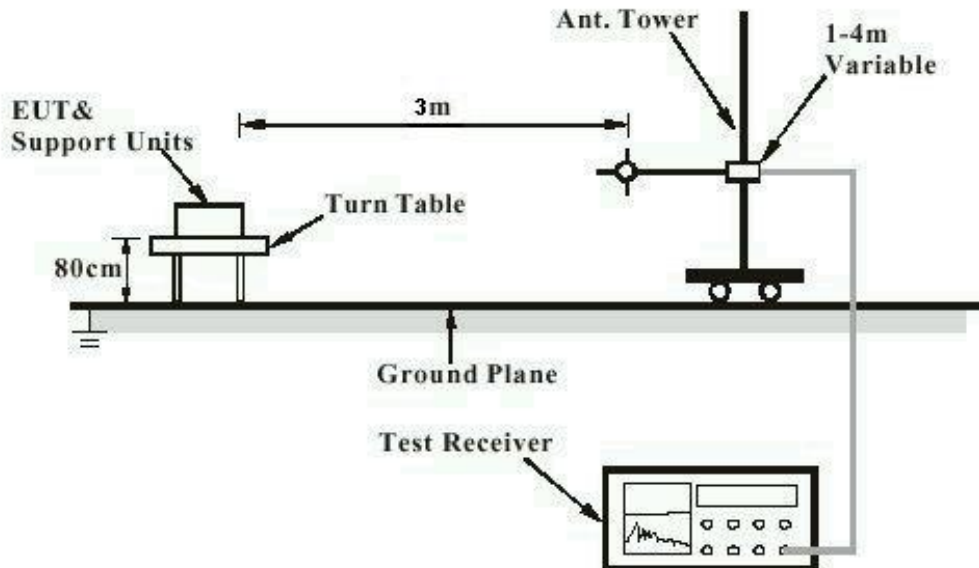
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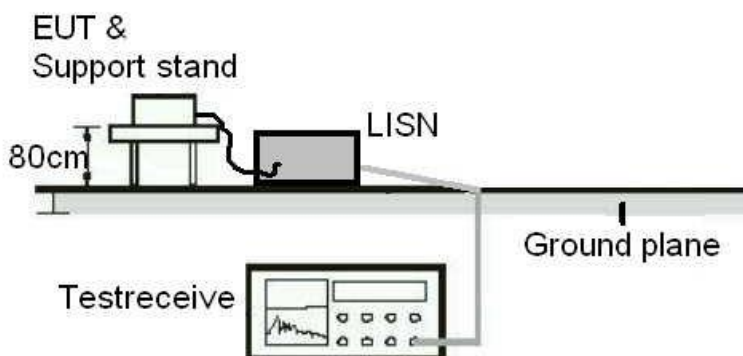
3.4 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1GHz are done with a table height of 1.5m. In addition, there is RF absorbing material on the floor of the test site for above 1GHz measurement.

Diagram of Measurement Equipment Configuration for Conduction Measurement



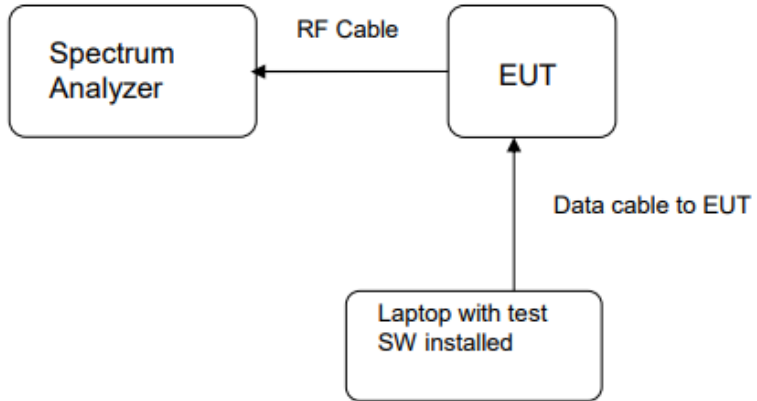
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Diagram of Measurement Equipment Configuration for Transmitter Measurement



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4 Test Results

4.1 Transmitter Requirement & Test Suites

4.1.1 Antenna Requirement

RESULT:

PASS

Test standard : FCC Part 15.247(b)(4), Part 15.203

Requirement : The use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 2.03 dBi. The antenna is an internal antenna with no possibility of replacement with a non-approved antenna by the end-user.

Therefore, the EUT is considered to comply with this provision.

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4.1.2 Maximum Conducted Output Power

RESULT:

PASS

Test standard : FCC Part 15.247(b)(1)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High

Operation Mode : A.1.a

Ambient temperature : 25°C

Relative humidity : 52%

Table 1: Maximum Conducted Output Power

Test Mode	Test Channel (MHz)	Measured Peak Power		Limit (W)
		(dBm)	(mW)	
GFSK	2402	3.78	2.39	< 0.125
	2441	4.59	2.88	
	2480	2.79	1.90	
$\pi/4$ -DQPSK	2402	3.69	2.34	
	2441	4.61	2.89	
	2480	2.85	1.93	
8-DPSK	2402	4.06	2.55	
	2441	4.88	3.08	
	2480	3.06	2.02	

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Figure 1: Maximum Conducted Output Power, 2402MHz, GFSK

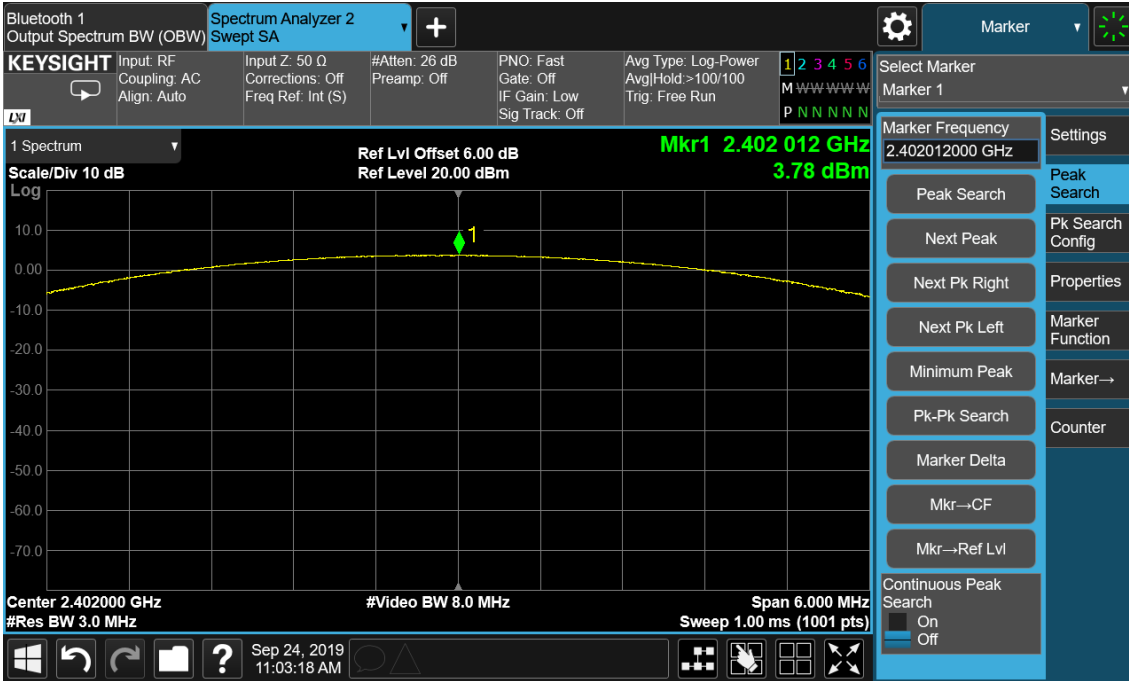
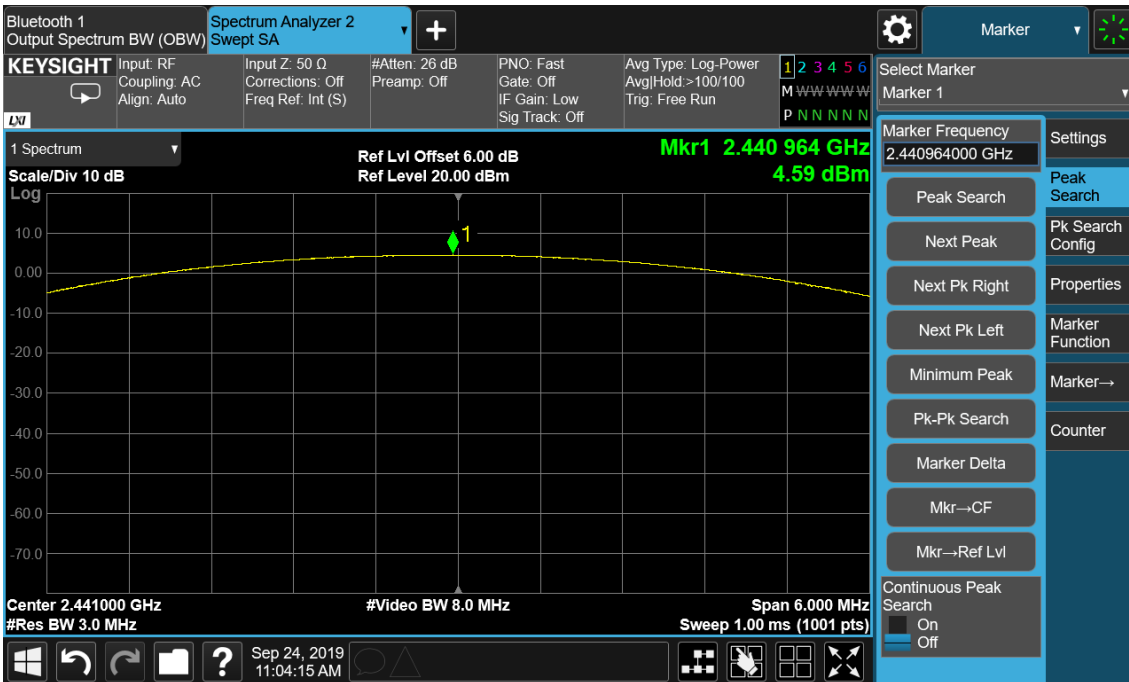


Figure 2: Maximum Conducted Output Power, 2441MHz, GFSK



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Figure 3: Maximum Conducted Output Power, 2480MHz, GFSK

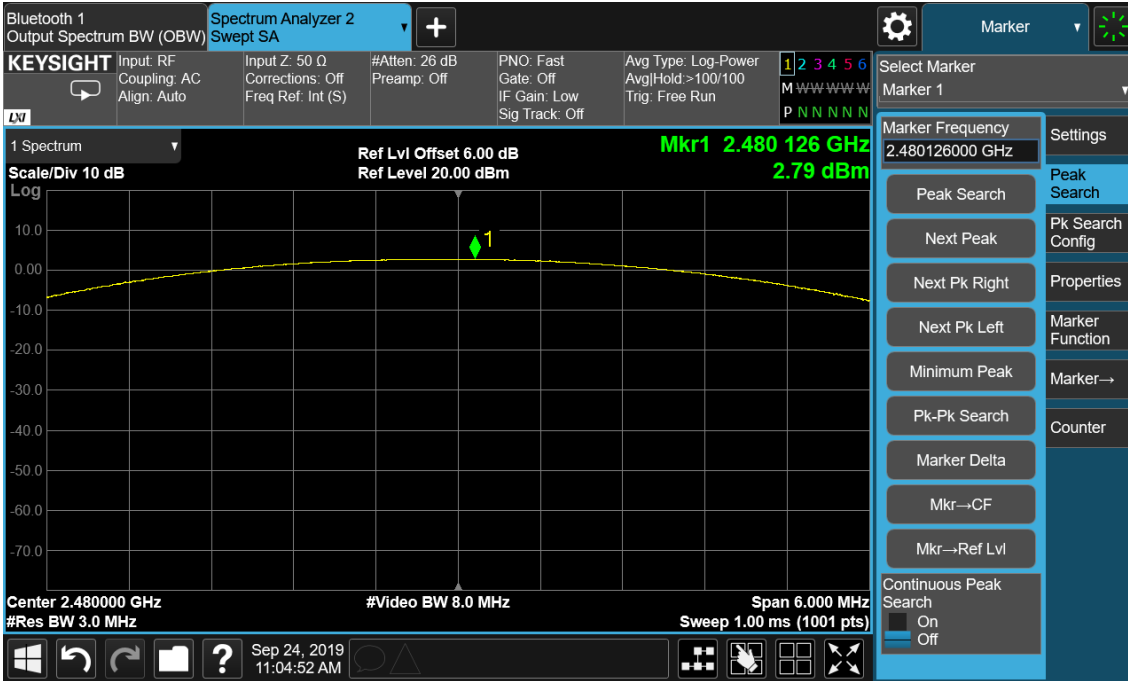
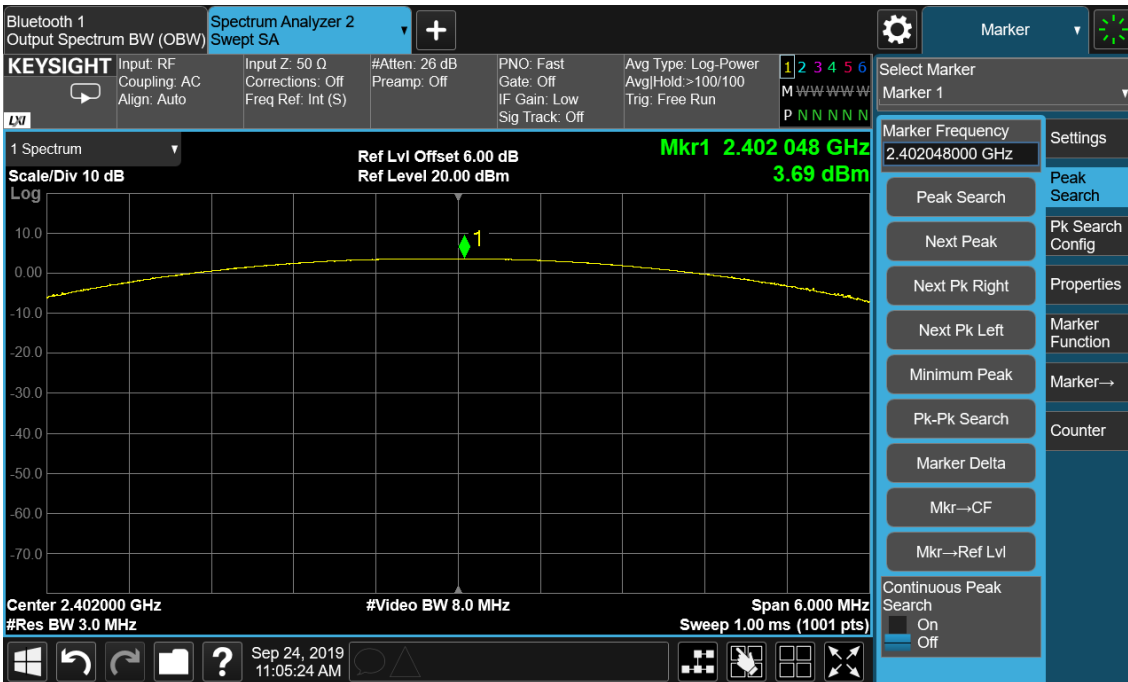


Figure 4: Maximum Conducted Output Power, 2402MHz, $\pi/4$ -DQPSK



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Figure 5: Maximum Conducted Output Power, 2441MHz, $\pi/4$ -DQPSK

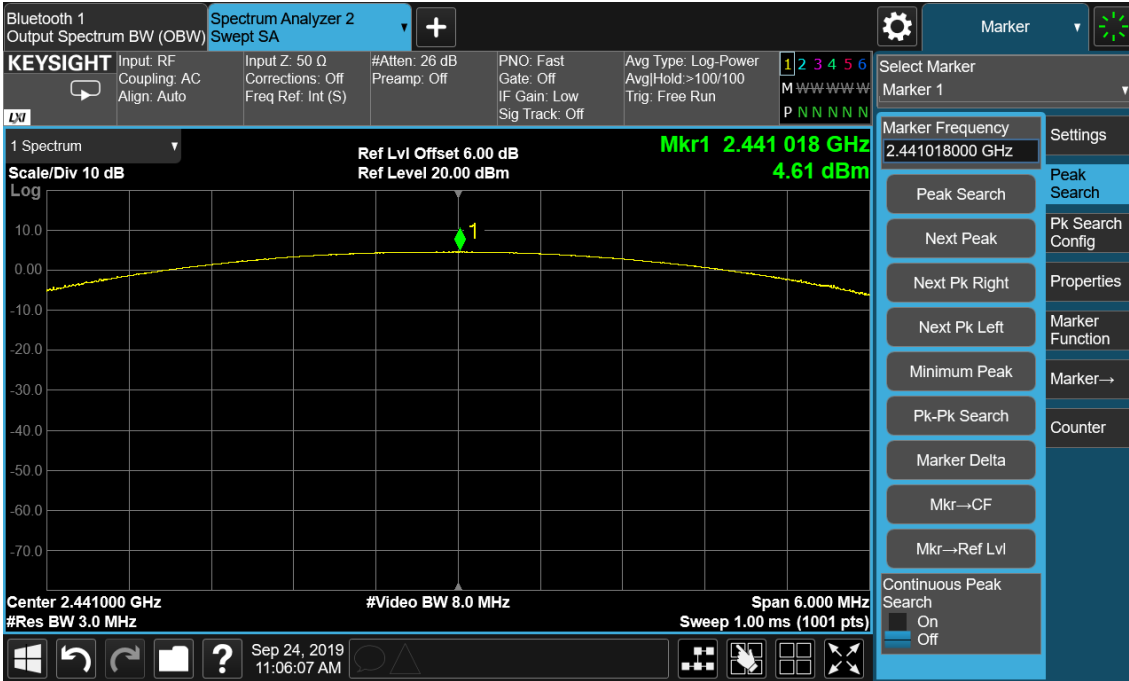
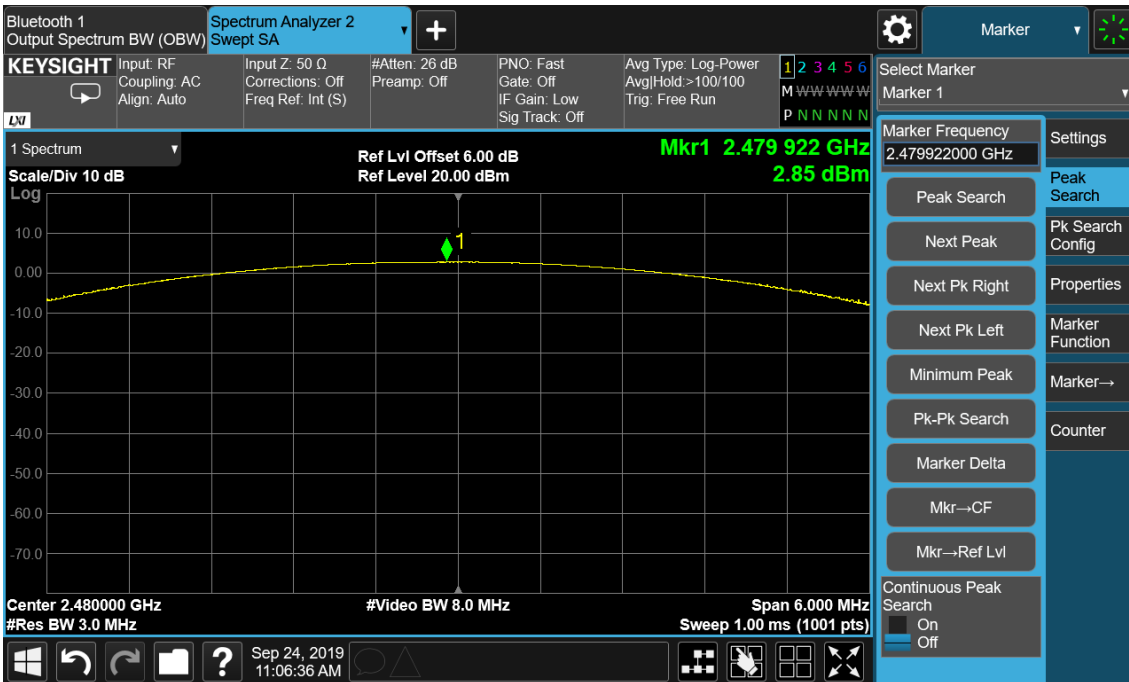


Figure 6: Maximum Conducted Output Power, 2480MHz, $\pi/4$ -DQPSK



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Figure 7: Maximum Conducted Output Power, 2402MHz, 8-DPSK

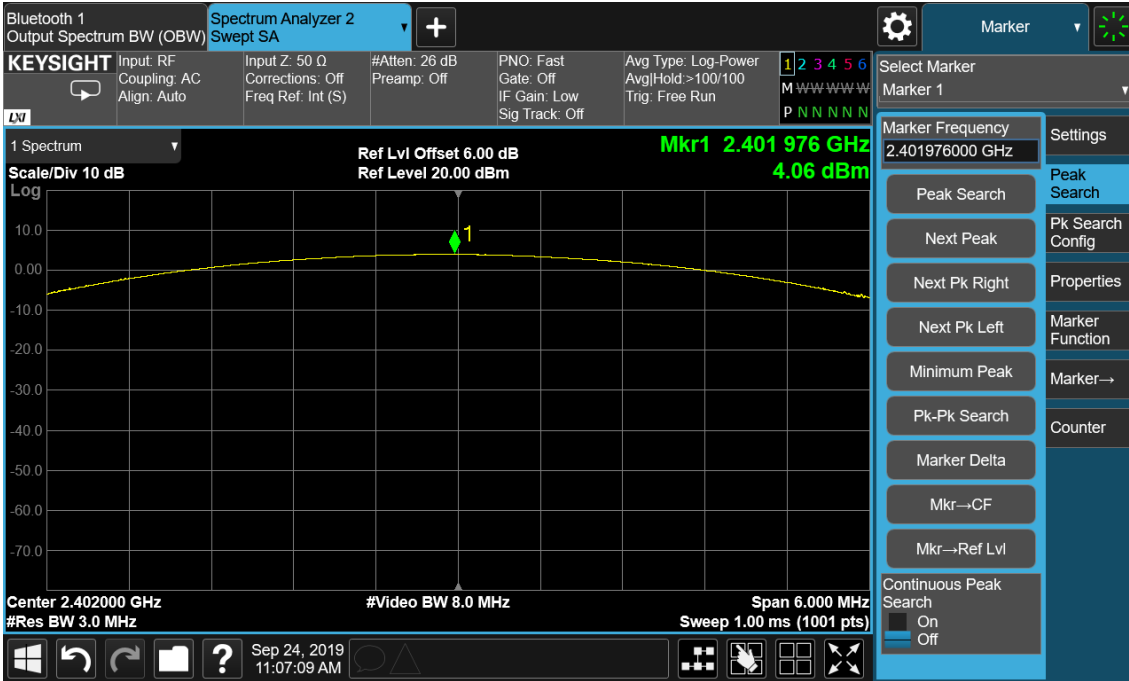
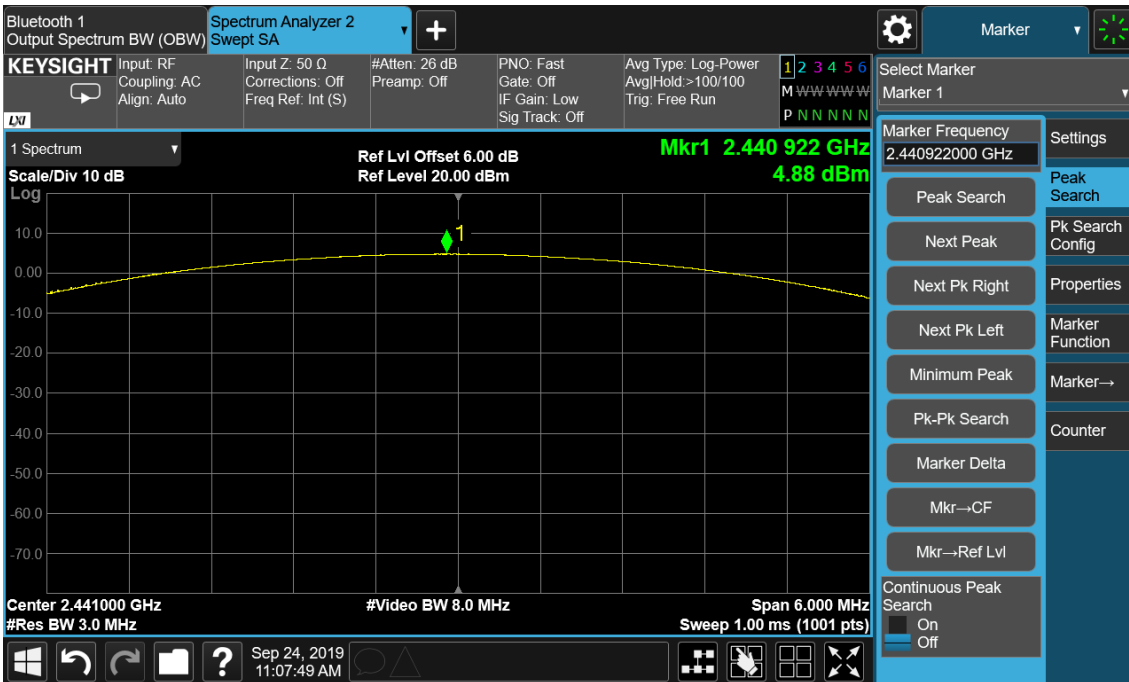


Figure 8: Maximum Conducted Output Power, 2441MHz, 8-DPSK



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Figure 9: Maximum Conducted Output Power, 2480MHz, 8-DPSK



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4.1.3 20dB Bandwidth and 99% Bandwidth

RESULT:

PASS

Test standard : FCC Part 15.247(a)(1)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High

Operation Mode : A.1.a

Ambient temperature : 25°C

Relative humidity : 52%

Table 2: 20dB Bandwidth and 99% Bandwidth

Test Mode	Test Channel (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
GFSK	2402	1.013	0.892
	2441	1.012	0.887
	2480	0.942	0.881
8-DPSK	2402	1.298	1.174
	2441	1.298	1.172
	2480	1.297	1.172

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Figure 10: 20dB Bandwidth and 99% Bandwidth, 2402MHz, GFSK



Figure 11: 20dB Bandwidth and 99% Bandwidth, 2441MHz, GFSK



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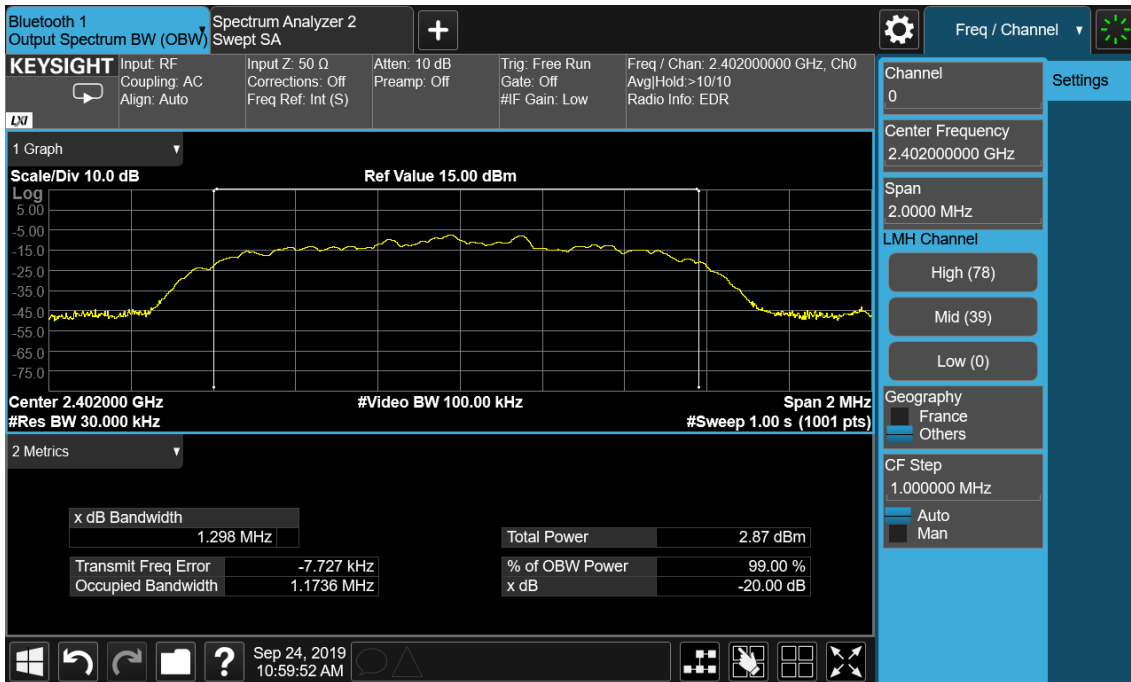
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Figure 12: 20dB Bandwidth and 99% Bandwidth, 2480MHz, GFSK



Figure 13: 20dB Bandwidth and 99% Bandwidth, 2402MHz, 8-DPSK



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Figure 14: 20dB Bandwidth and 99% Bandwidth, 2441MHz, 8-DPSK

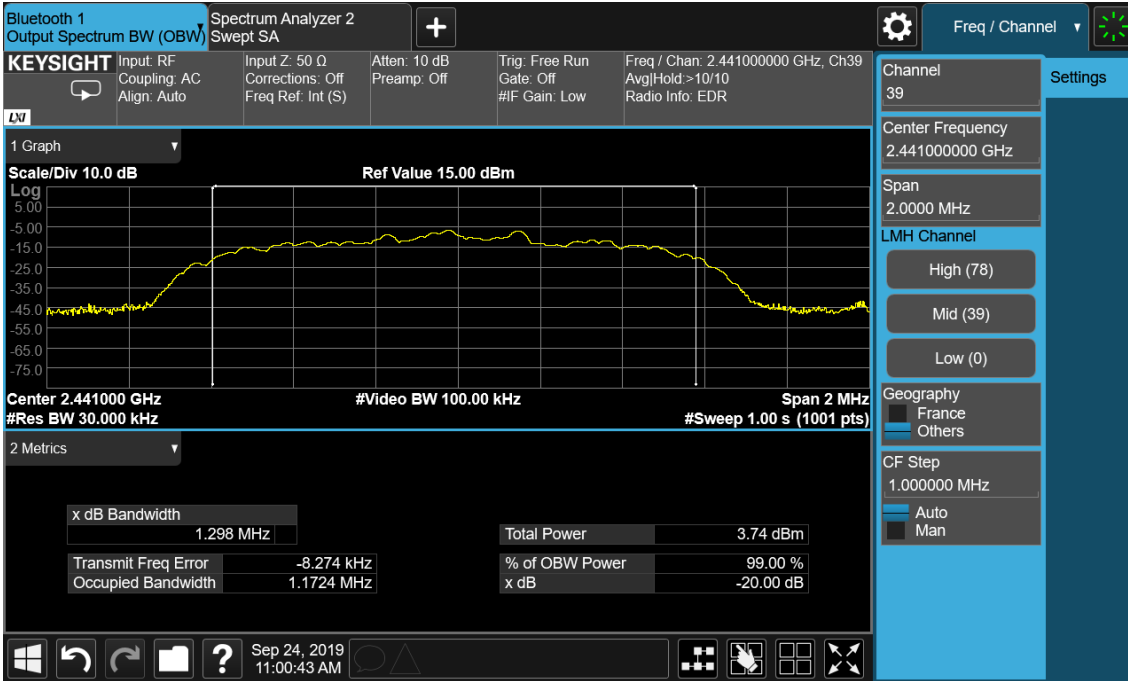


Figure 15: 20dB Bandwidth and 99% Bandwidth, 2480MHz, 8-DPSK



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4.1.4 Conducted Spurious Emission & Authorized-band band-edge

RESULT:

PASS

Test standard : FCC Part 15.247(d)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High for spurious, Low/High for Band
Edge

Operation Mode : A.1.a

Ambient temperature : 25°C

Relative humidity : 52%

For details refer to following test plot.

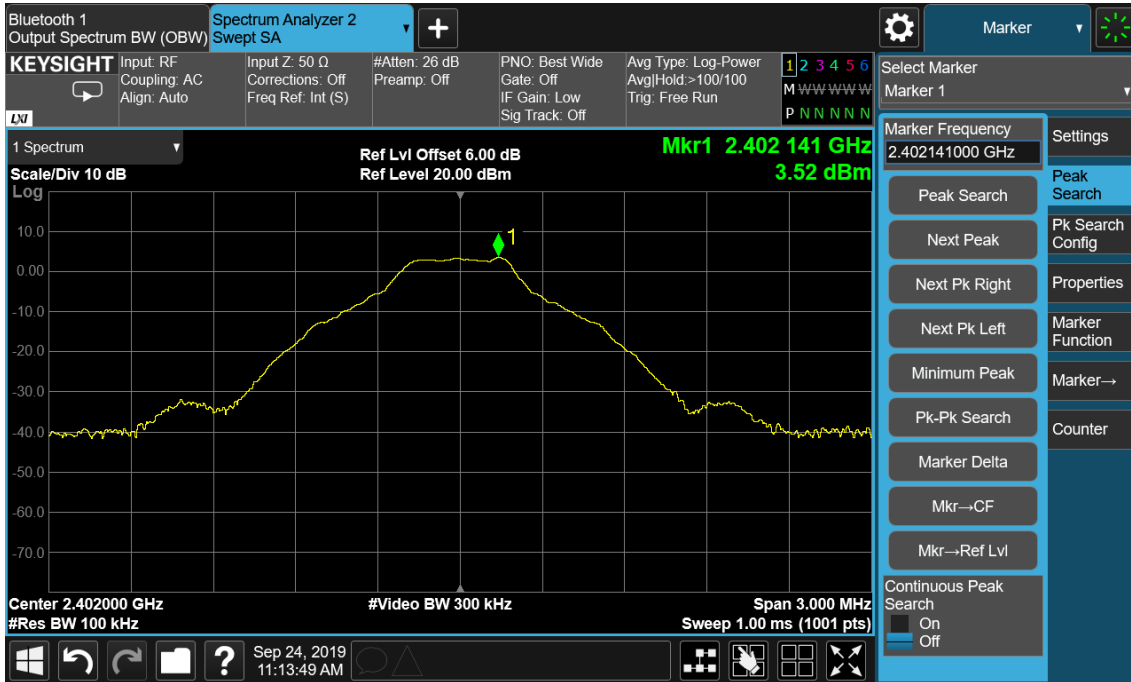
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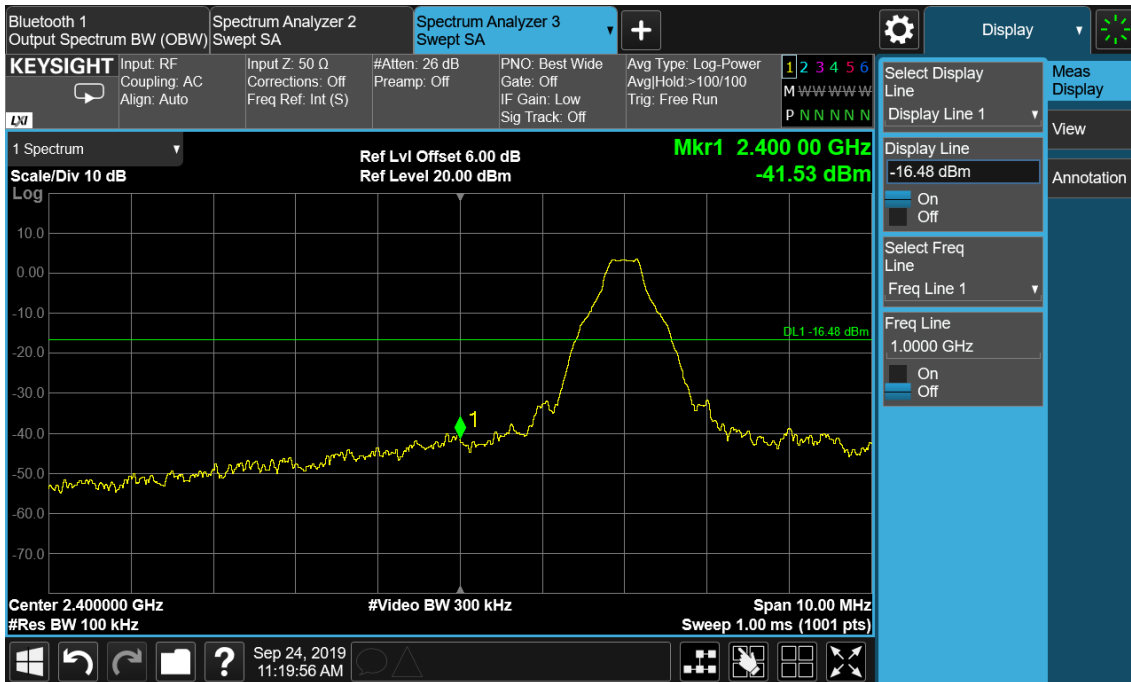
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Figure 16: Conducted Spurious Emission & Authorized-band band-edge, 2402MHz, GFSK Carrier Level



Band Edge



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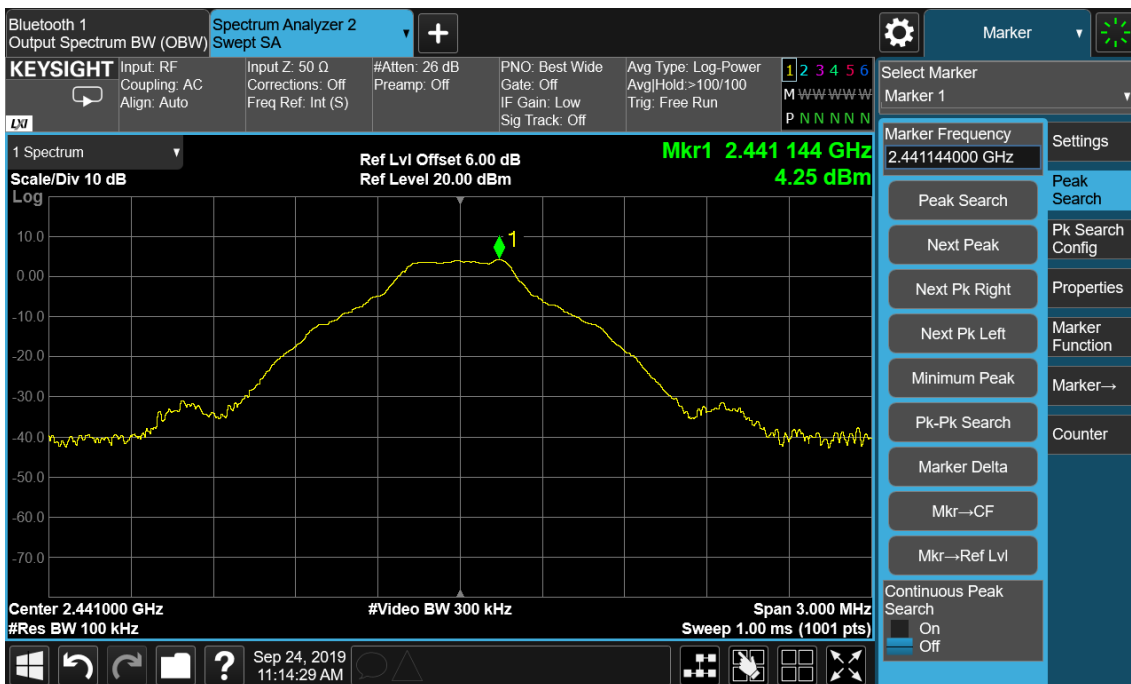
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Conducted spurious emissions 30MHz-25GHz



Figure 17: Conducted Spurious Emission & Authorized-band band-edge, 2441MHz, GFSK Carrier Level



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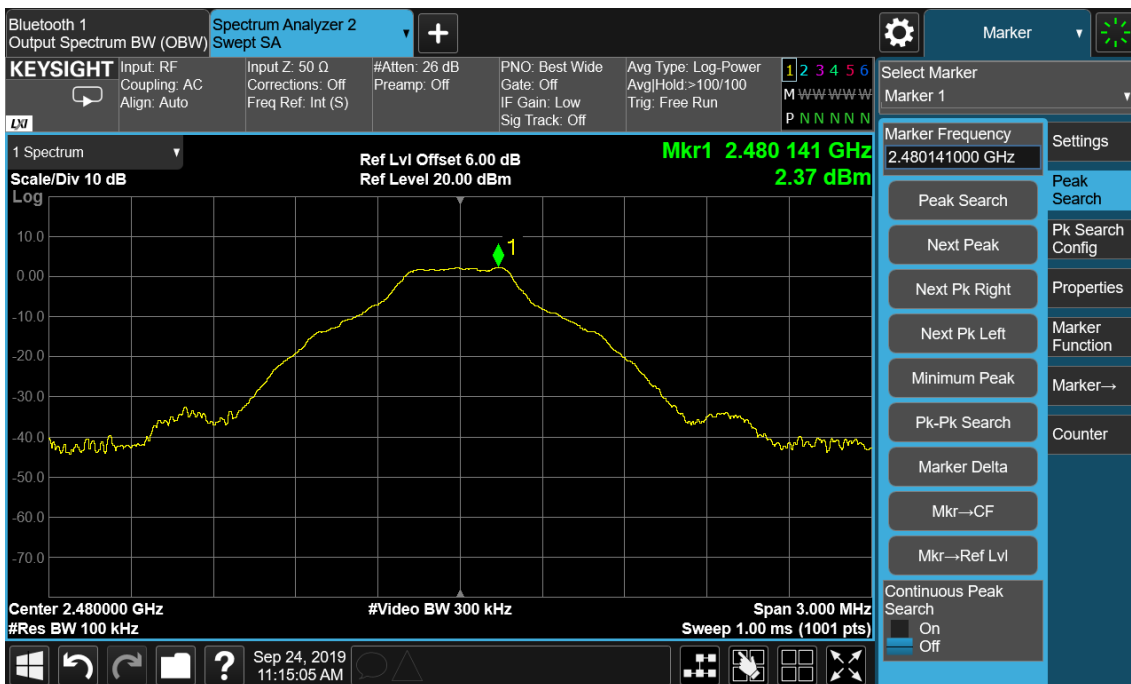
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Conducted spurious emissions 30MHz-25GHz



Figure 18: Conducted Spurious Emission & Authorized-band band-edge, 2480MHz, GFSK Carrier Level



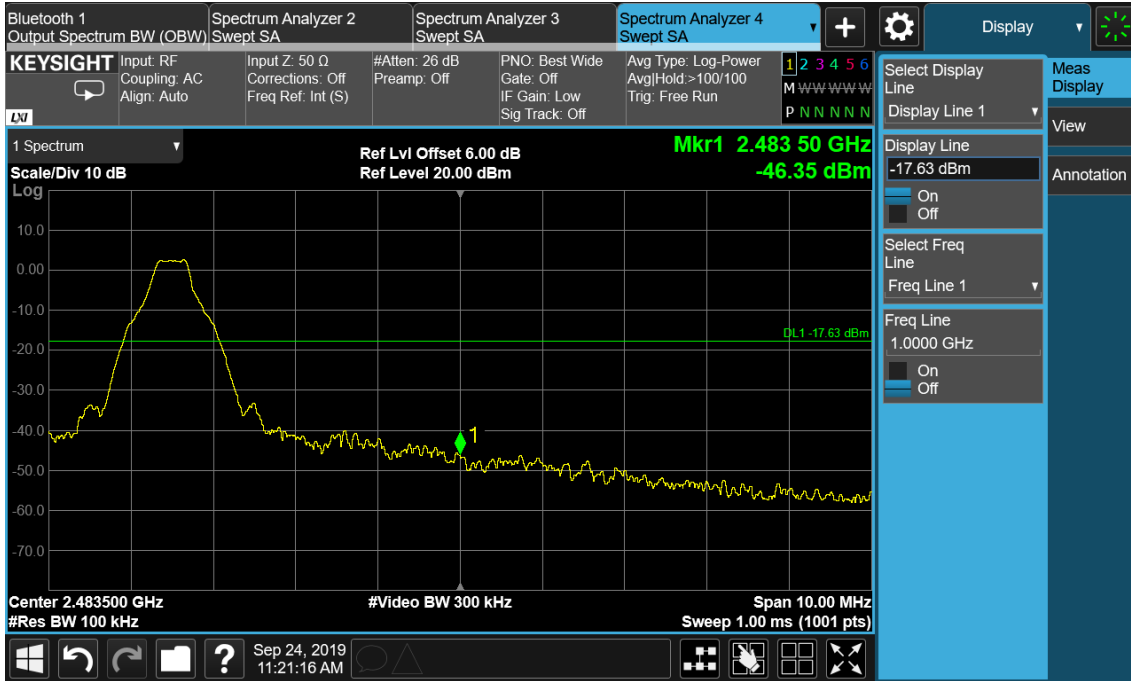
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Band Edge



Conducted spurious emissions 30MHz-25GHz



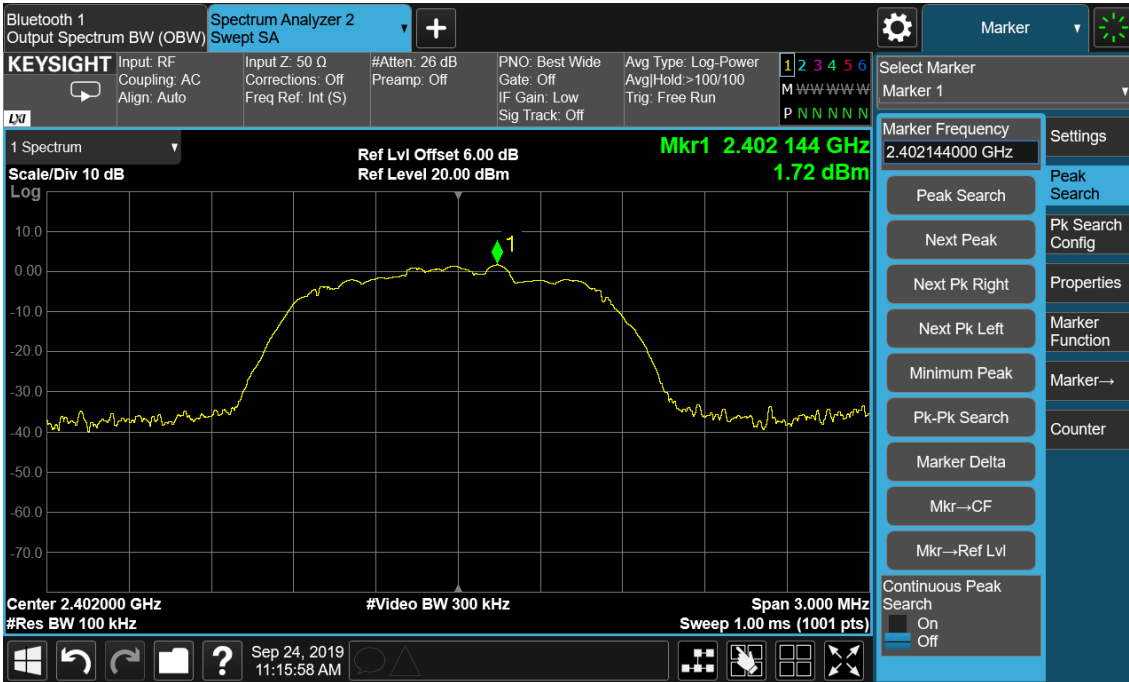
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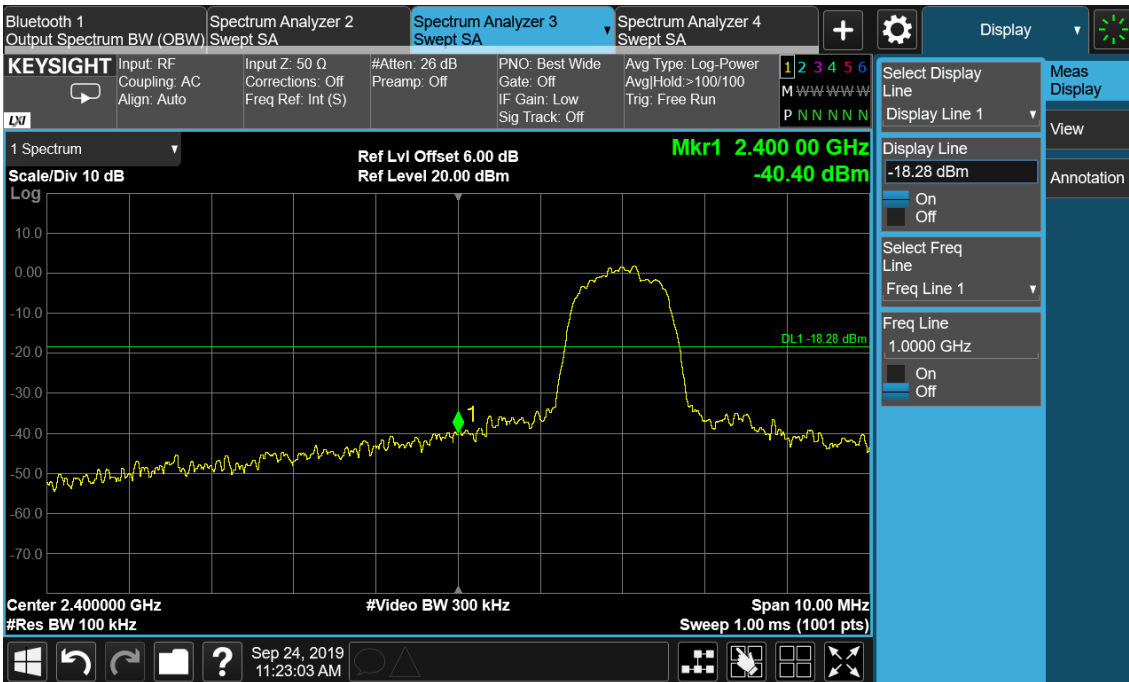
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Figure 19: Conducted Spurious Emission & Authorized-band band-edge, 2402MHz, 8-DPSK Carrier Level



Band Edge



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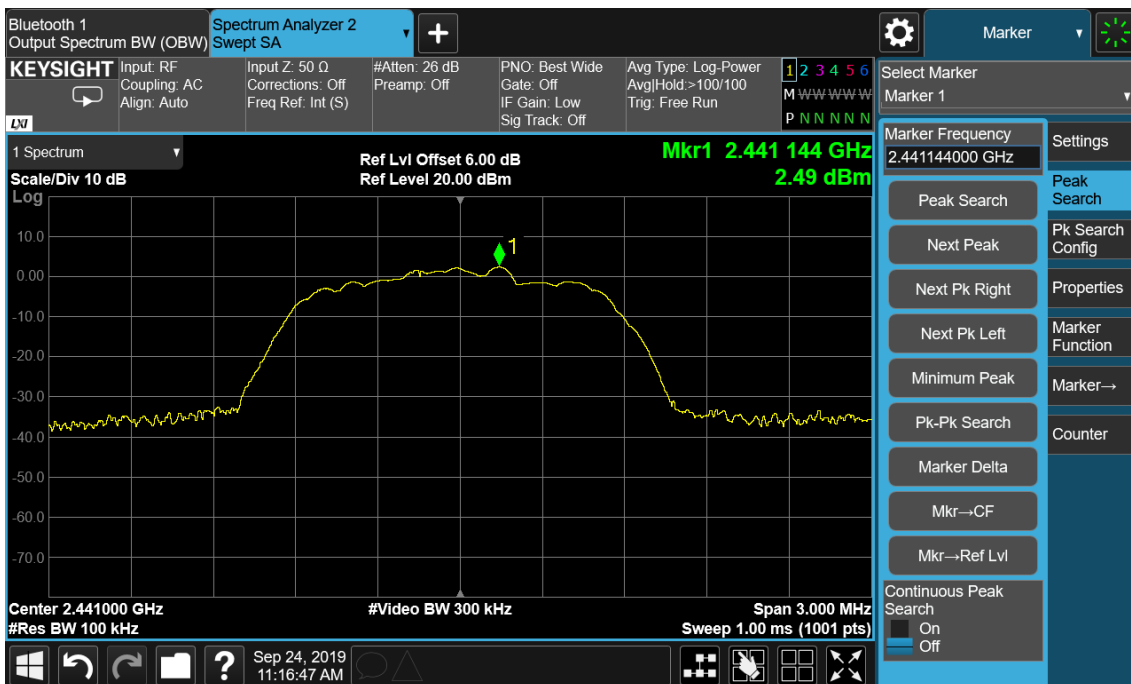
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Conducted spurious emissions 30MHz-25GHz



Figure 20: Conducted Spurious Emission & Authorized-band band-edge, 2441MHz, 8-DPSK Carrier Level



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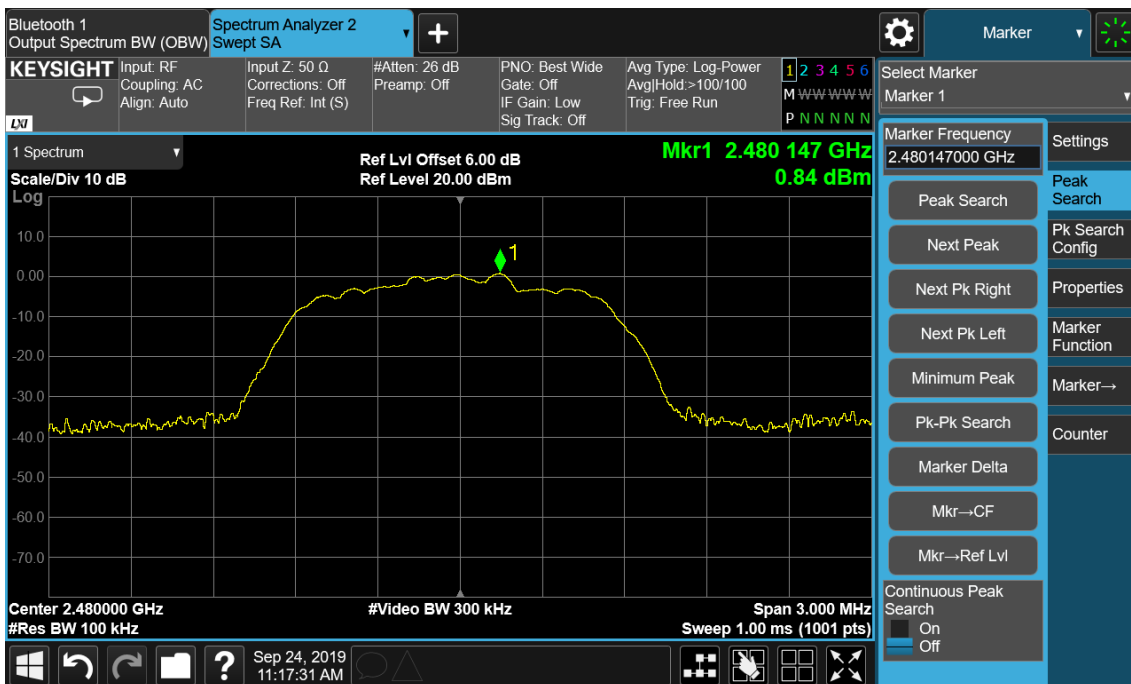
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Conducted spurious emissions 30MHz-25GHz



Figure 21: Conducted Spurious Emission & Authorized-band band-edge, 2480MHz, 8-DPSK Carrier Level



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Band Edge



Conducted spurious emissions 30MHz-25GHz



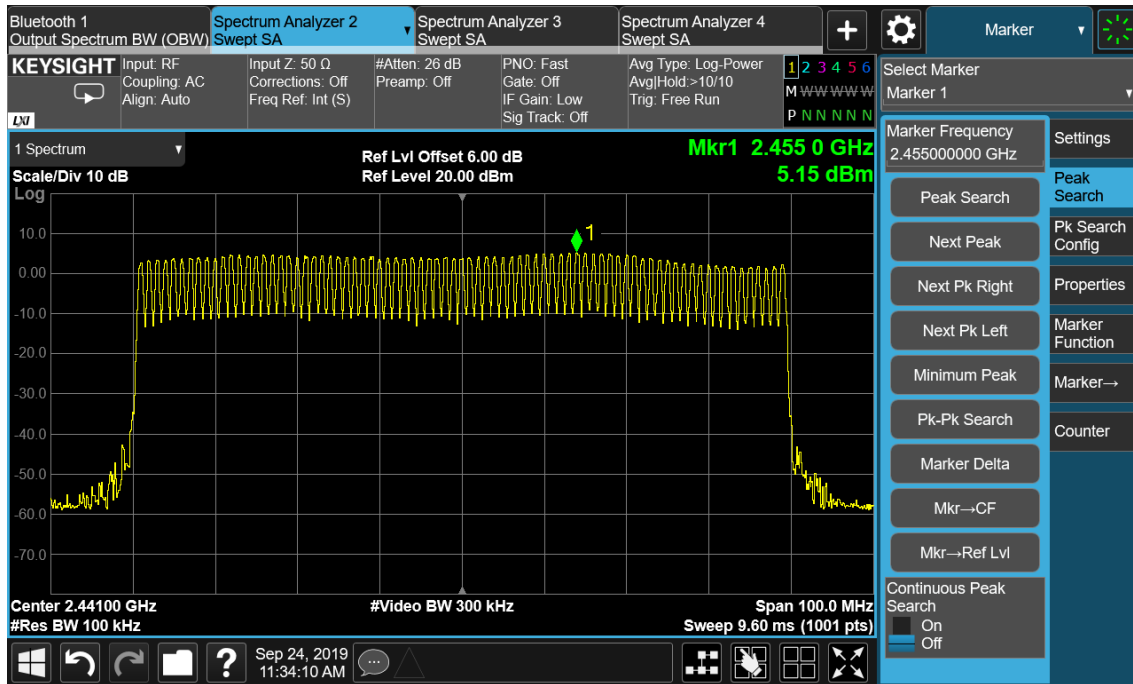
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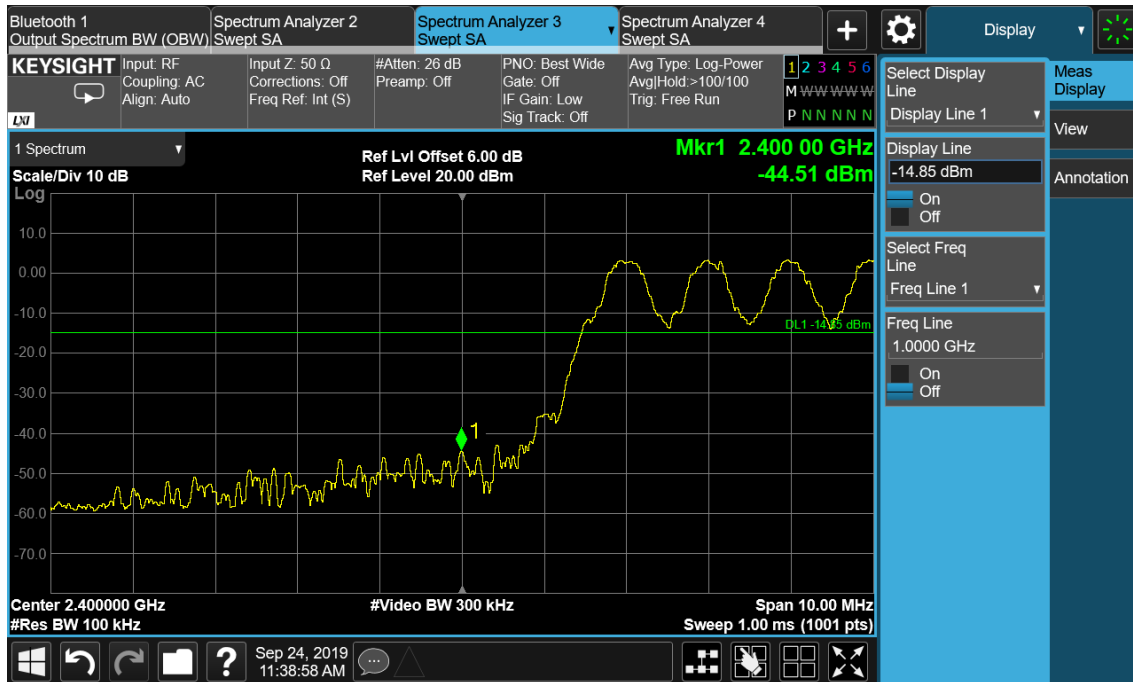
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Figure 22: Conducted Spurious Emission & Authorized-band band-edge, Hopping Mode, GFSK Carrier Level



Band Edge(Low)



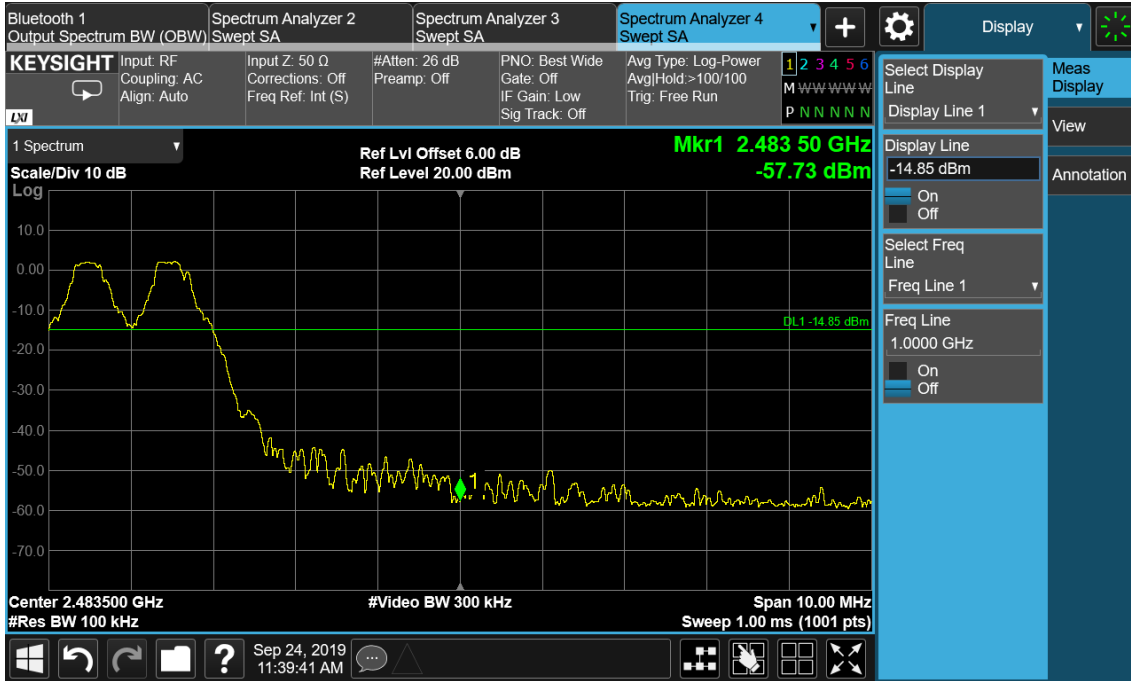
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Band Edge(High)



Conducted spurious emissions 30MHz-25GHz



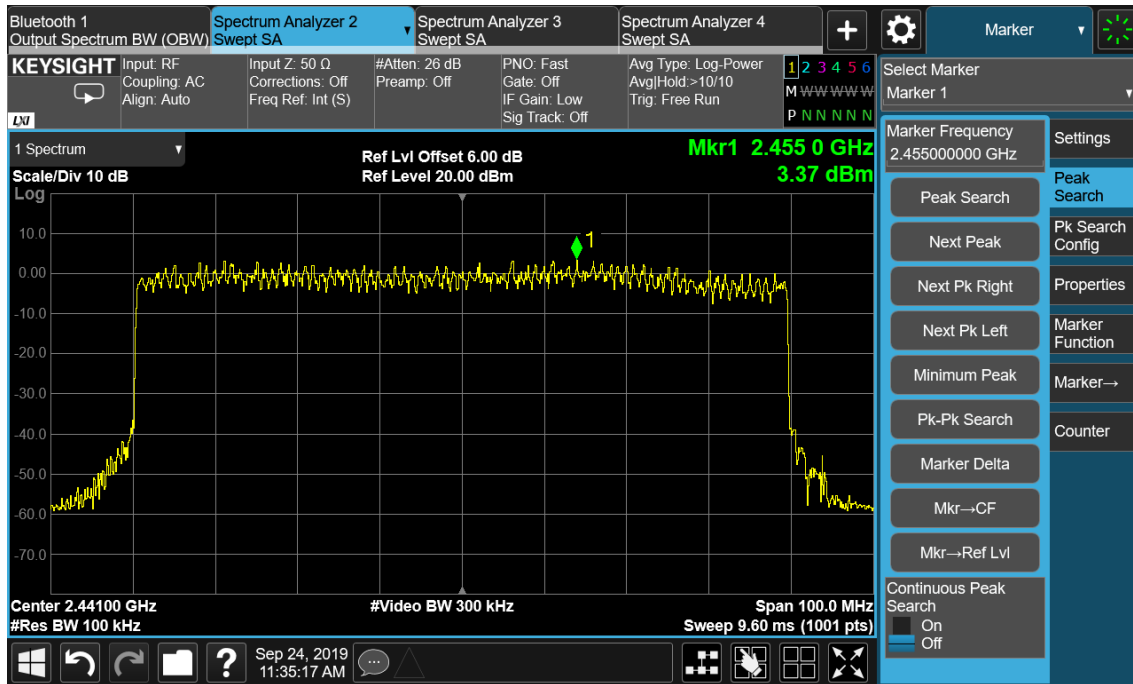
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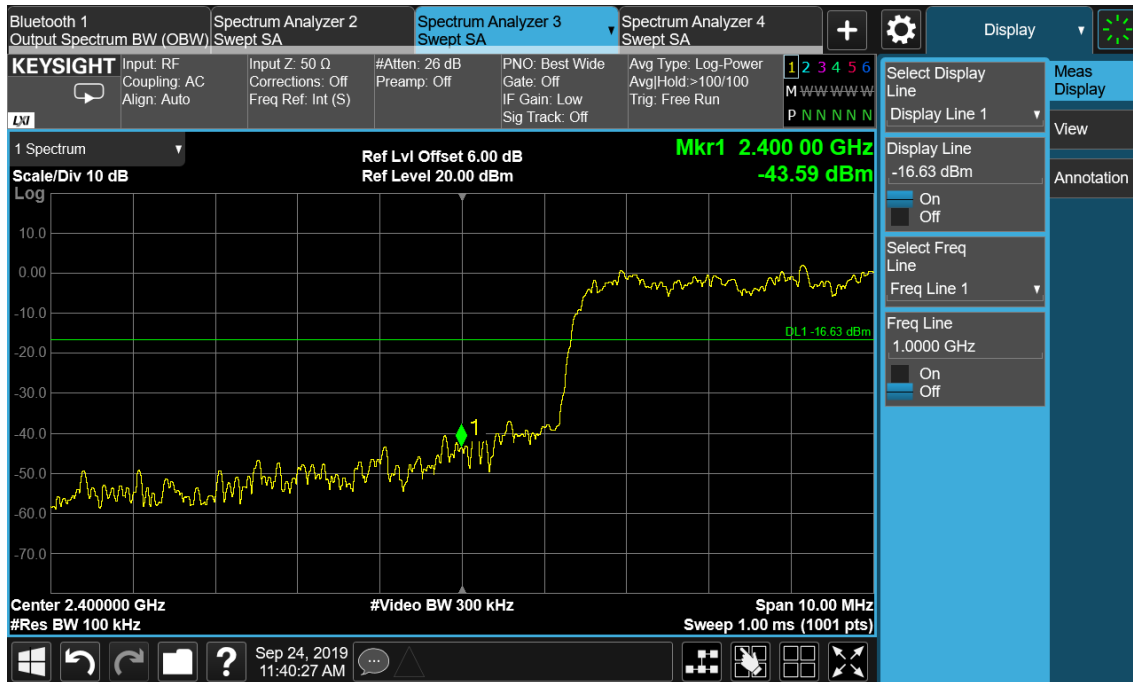
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Figure 23: Conducted Spurious Emission & Authorized-band band-edge, Hopping Mode, 8-DPSK Carrier Level



Band Edge(Low)



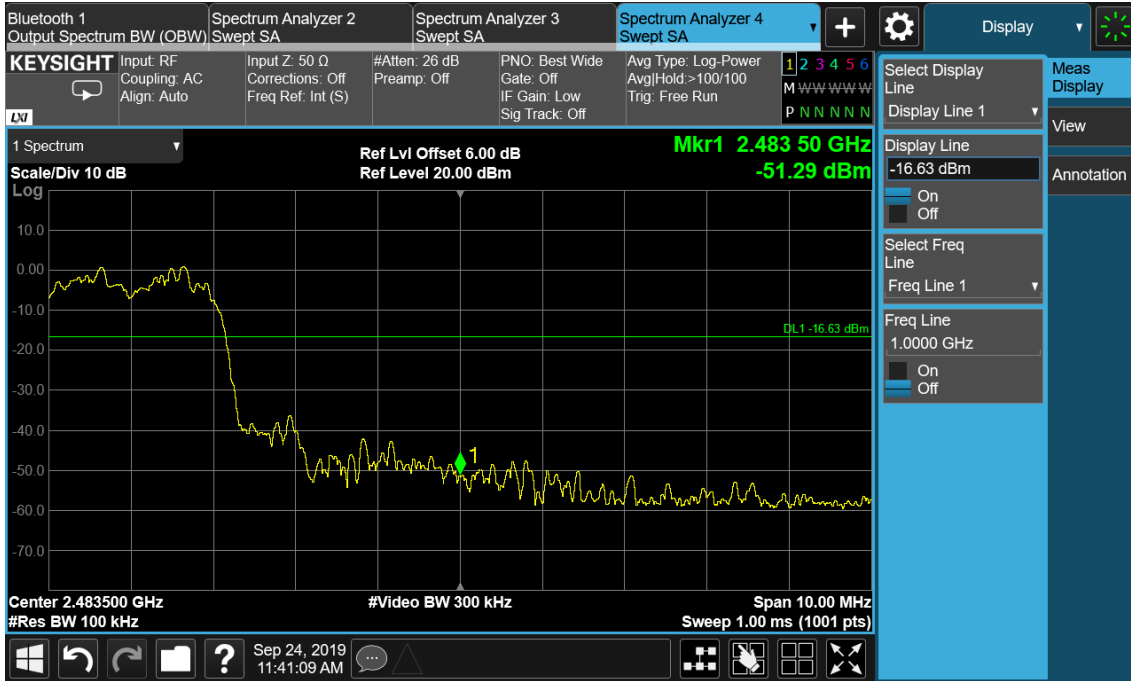
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Band Edge(High)



Conducted spurious emissions 30MHz-25GHz



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4.1.5 Spurious Emission

RESULT:

PASS

Test standard : FCC Part 15.247(d), 15.205, 15.209

Requirement : ANSI C63.10-2013

Kind of test site : 3m Semi-Anechoic Chamber

Test setup

Test Channel : Low/Middle/High

Operation Mode : A

Ambient temperature : 25°C

Relative humidity : 52%

Notes:

1. Test plots please refer to the annex document "EXHIBIT A of SHE19090021-01FE".
2. For 9 kHz ~ 30 MHz, the amplitude of spurious emissions that are attenuated by more than 20dB below the permissible. The value has no need to be reported.
3. The spurious above 18GHz is noise only and 20dB below the limit. The value has no need to be reported.
4. The EUT is working in the Normal link mode below 1 GHz.

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4.1.6 Band Edge (Restricted-band band-edge)

RESULT:

PASS

Test standard	:	FCC Part 15.247(d), 15.205, 15.209 RSS-247 5.5
Requirement	:	ANSI C63.10-2013
Kind of test site	:	3m Semi-Anechoic Chamber

Test setup

Test Channel	:	Low/Middle/High
Operation Mode	:	A.1
Ambient temperature	:	25°C
Relative humidity	:	52%

Note:

1. Test plots please refer to the annex document "EXHIBIT A of SHE19090021-01FE".

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4.1.7 Hopping Frequency Separation

RESULT:

PASS

Test standard : FCC Part 15.247(a)(1)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Test Channel : Hopping

Operation Mode : A.1.a.iv

Ambient temperature : 25°C

Relative humidity : 52%

Table 3: Hopping Frequency Separation

Mode	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
GFSK	2441	1.008	≥ 25kHz or two-thirds of 20dB bandwidth
8-DPSK	2441	1.002	

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Figure 24: Hopping Frequency Separation, Hopping Mode, GFSK

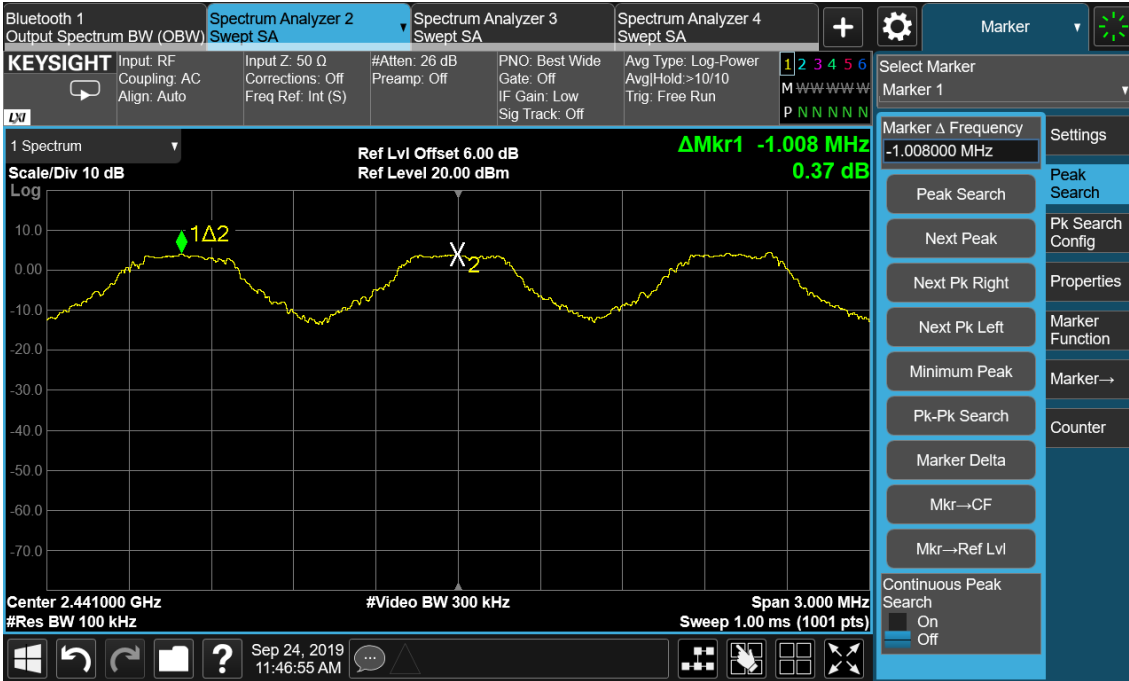
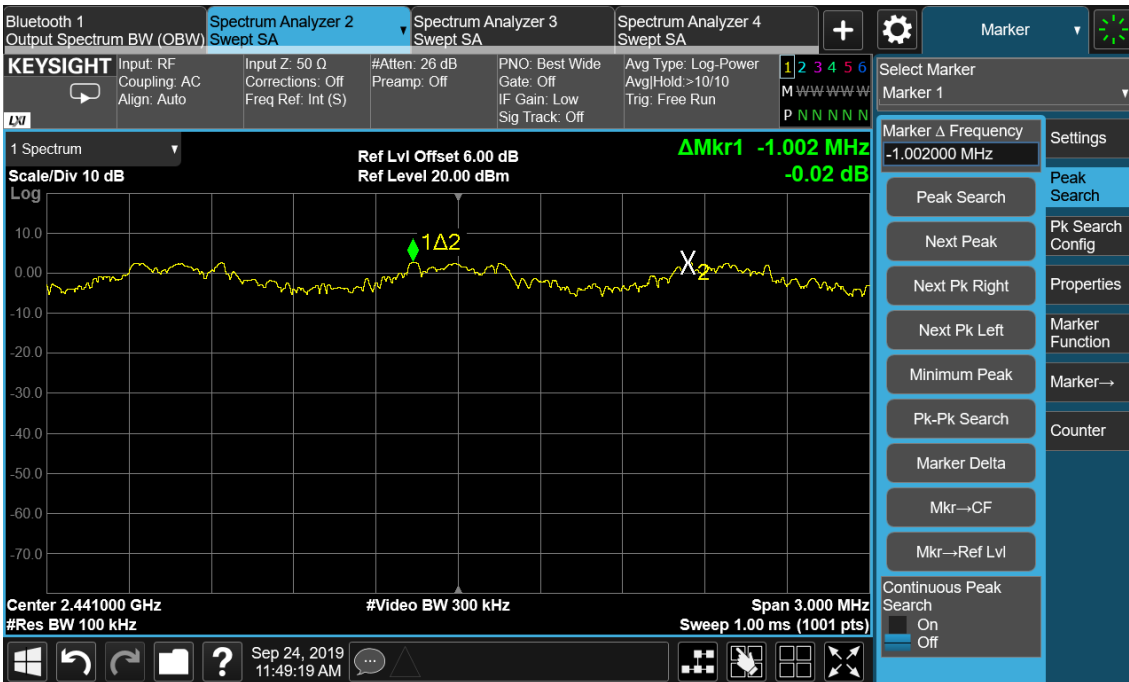


Figure 25: Hopping Frequency Separation, Hopping Mode, 8DPSK



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4.1.8 Number of Hopping Frequency

RESULT:

PASS

Test standard : FCC Part 15.247(a)(1)(iii)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Test Channel : Hopping

Operation Mode : A.1.a.iv

Ambient temperature : 25°C

Relative humidity : 52%

Table 4: Number of Hopping Frequency

Mode	Frequency Range	Measured Quantity of Hopping Channel	Limit
GFSK	2400 – 2483.5	79	≥15
8-DPSK	2400 – 2483.5	79	≥15

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Figure 26: Number of Hopping Frequency, Hopping Mode, GFSK

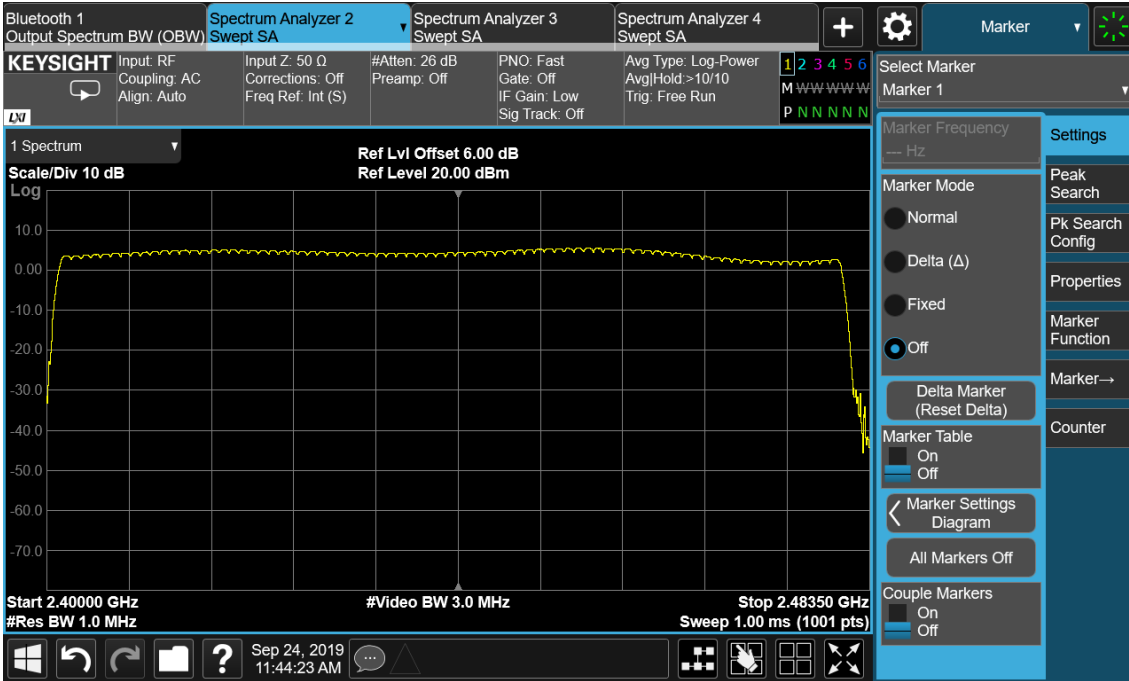
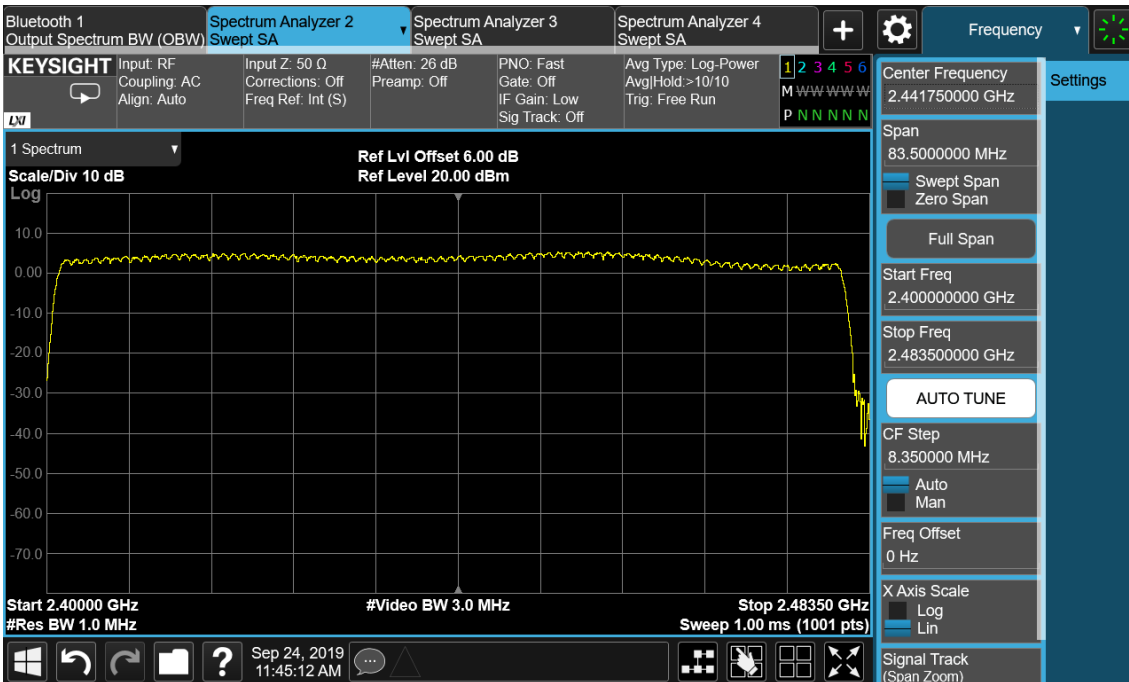


Figure 27: Number of Hopping Frequency, Hopping Mode, 8-DPSK



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4.1.9 Time of Occupancy

RESULT:

PASS

Test standard : FCC Part 15.247(a)(1)(iii)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Test Channel : Middle

Operation Mode : A.1.a

Ambient temperature : 25°C

Relative humidity : 52%

Table 5: Time of Occupancy

Mode	Packet Type	Pulse Time (ms)	Total of Dwell (ms)	Limit (s)
GFSK	DH1	0.386	123.52	0.4
	DH3	1.647	263.52	0.4
	DH5	2.896	308.91	0.4
8-DPSK	DH1	0.391	125.12	0.4
	DH3	1.647	263.52	0.4
	DH5	2.900	309.33	0.4

Note:

For DH1 package type:

Total of Dwell = Pulse Time*(1600/2)/Number of Hopping Frequency*Period

Period = 0.4* Number of Hopping Frequency

For DH3 package type:

Total of Dwell = Pulse Time*(1600/4)/Number of Hopping Frequency*Period

Period = 0.4* Number of Hopping Frequency

For DH5 package type:

Total of Dwell = Pulse Time*(1600/6)/Number of Hopping Frequency*Period

Period = 0.4* Number of Hopping Frequency

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Figure 30: Time of Occupancy, 2441MHz, GFSK DH5

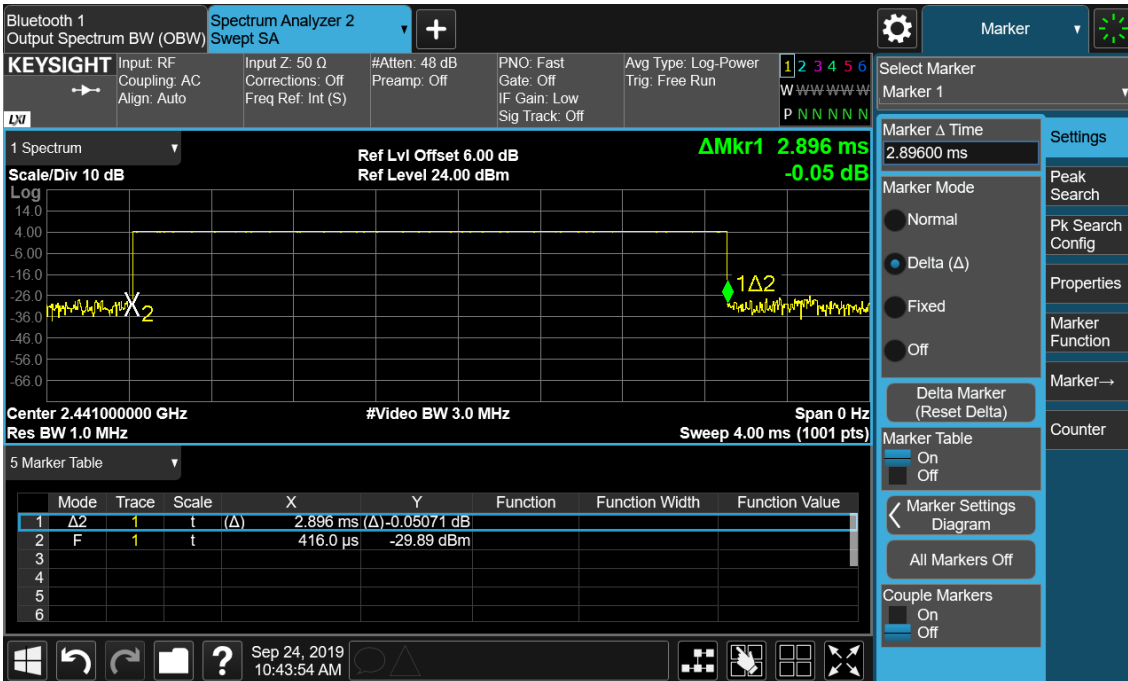
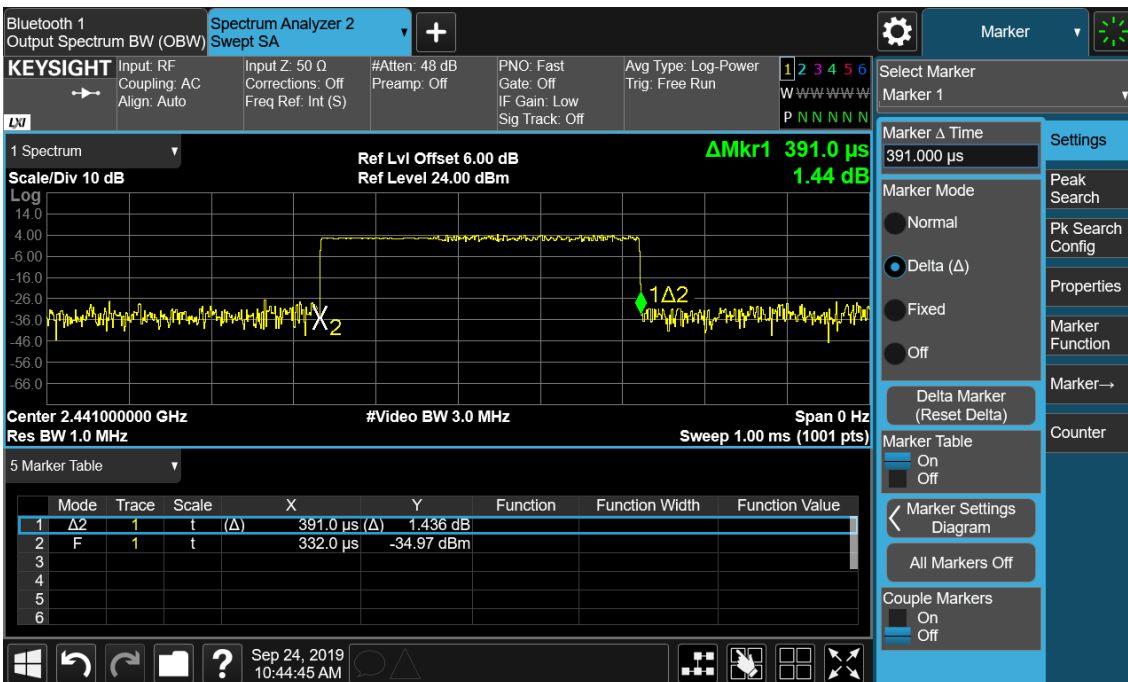


Figure 31: Time of Occupancy, 2441MHz, 8-DPSK DH1



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4.2 Mains Emissions

4.2.1 Conducted Emission on AC Mains

RESULT:

PASS

Test standard : FCC Part 15.207(a)

Requirement : ANSI C63.10-2013

Kind of test site : Shielded room

Test setup

Input Voltage : AC 120V, 60Hz; AC 240V, 50Hz

Operation Mode : A.1.a

Earthing : Not Connected

Ambient temperature : 25°C

Relative humidity : 52%

For details refer to following test plot.

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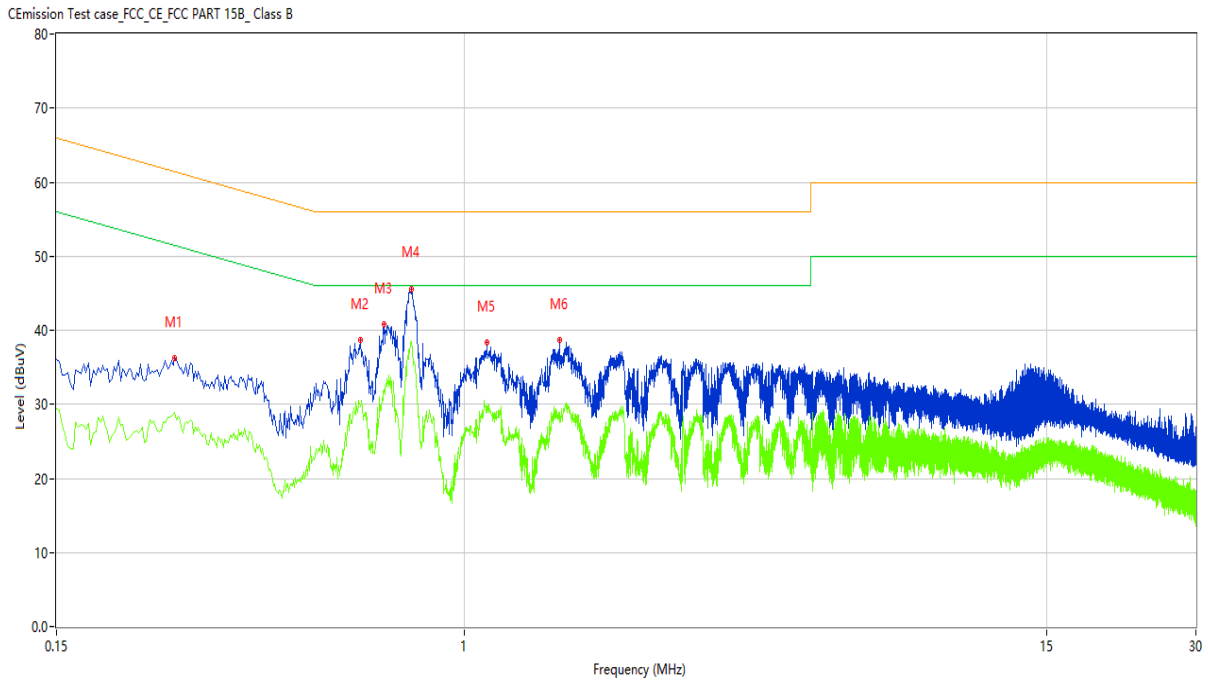
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Note:

The all configurations were tested respectively, but only the worst configuration shown here.

Figure 34: Conducted Emission on AC Mains, L Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.260	36.20	10.14	61.43	-25.23	Peak	L	Pass
1**	0.260	28.87	10.14	51.43	-22.56	AV	L	Pass
2	0.616	38.65	10.15	56.00	-17.35	Peak	L	Pass
2**	0.616	29.74	10.15	46.00	-16.26	AV	L	Pass
3	0.688	40.79	10.15	56.00	-15.21	Peak	L	Pass
3**	0.688	31.94	10.15	46.00	-14.06	AV	L	Pass
4	0.782	46.20	10.15	56.00	-9.80	Peak	L	Pass
4*	0.782	43.26	10.15	56.00	-12.74	QP	L	Pass
4**	0.782	38.41	10.15	46.00	-7.59	AV	L	Pass
5	1.108	38.34	10.16	56.00	-17.66	Peak	L	Pass
5**	1.108	28.90	10.16	46.00	-17.10	AV	L	Pass
6	1.556	38.66	10.17	56.00	-17.34	Peak	L	Pass
6**	1.556	28.66	10.17	46.00	-17.34	AV	L	Pass

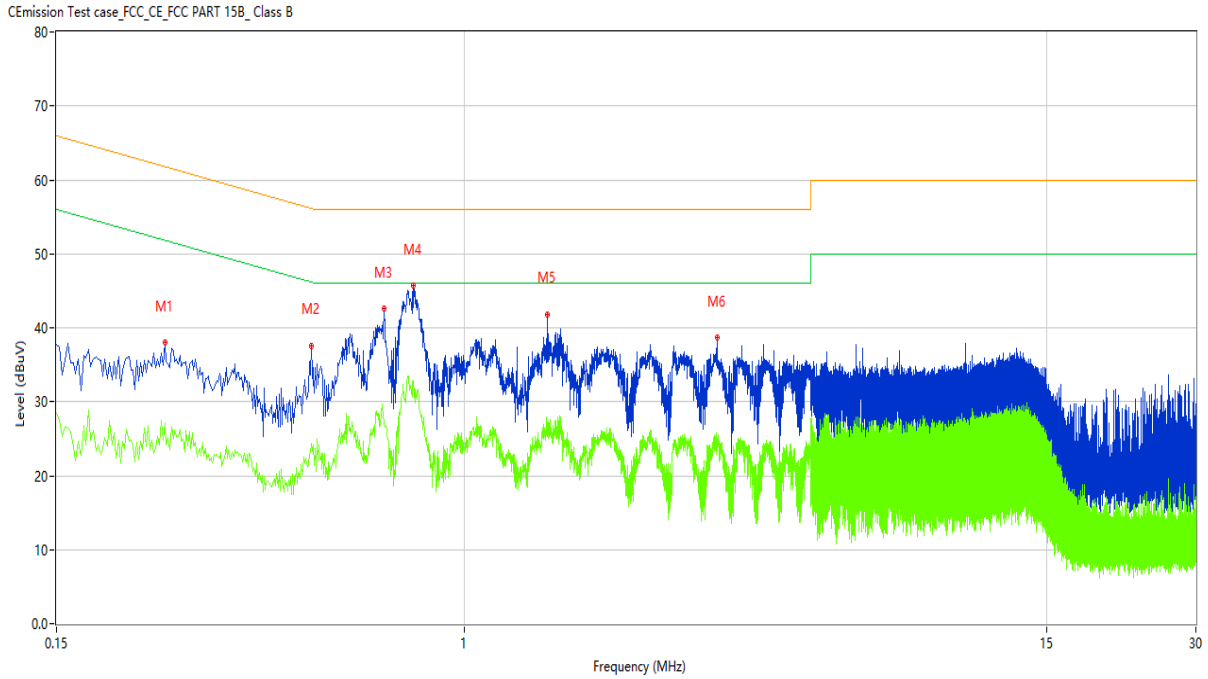
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Figure 35: Conducted Emission on AC Mains, N Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.248	37.98	10.14	61.82	-23.84	Peak	N	Pass
1**	0.248	27.13	10.14	51.82	-24.69	AV	N	Pass
2	0.490	37.59	10.15	56.17	-18.58	Peak	N	Pass
2**	0.490	24.32	10.15	46.17	-21.85	AV	N	Pass
3	0.688	42.58	10.15	56.00	-13.42	Peak	N	Pass
3**	0.688	26.93	10.15	46.00	-19.07	AV	N	Pass
4	0.790	45.32	10.15	56.00	-10.68	Peak	N	Pass
4*	0.790	40.96	10.15	56.00	-15.04	QP	N	Pass
4**	0.790	32.83	10.15	46.00	-13.17	AV	N	Pass
5	1.472	41.79	10.16	56.00	-14.21	Peak	N	Pass
5**	1.472	27.29	10.16	46.00	-18.71	AV	N	Pass
6	3.234	38.63	10.22	56.00	-17.37	Peak	N	Pass
6**	3.234	24.47	10.22	46.00	-21.53	AV	N	Pass

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5 Appendixes

5.1 Photographs of the Sample



Front of the sample



Rear of the sample

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5.2 Set-up for Conducted Emissions



5.3 Set-up for Conducted RF test at Antenna Port



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5.4 Set-up for Spurious Emissions below 1GHz



5.5 Set-up for Spurious Emissions above 1GHz



End of the report