RADIO TEST REPORT

The device described below is tested by Dongguan Nore Testing Center Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results, data evaluation, test procedures, and equipment of configurations shown in this report were made in accordance with the procedures in ANSI C63.10(2013).

Applicant	:	Yantai Trial Retail Engineering Co., Ltd
Address	:	4th Floor, Building G, No.300 Changjiang Road, Economic and Technological Development Zone, Yantai, Shandong, China
Manufacturer /Factory	:	Shenzhen shindy technology Co., LTD
Address	:	Bldg A10, Silicon Valley Power Low-Carbon Industrial Park, Guiyue Road,Zhangge Community, Guanlan Town, Longhua Distrct, Shenzhen
E.U.T.	:	Retail AI Camera Z2
Brand Name	:	Retail Eye
Model No.	:	Retail Eye-Z2
FCC ID	:	2AUB6-AICAM-02
Measurement Standard	:	FCC PART 15.247
Date of Receiver	:	August 16, 2019
Date of Test	:	August 17, 2019 to September 23, 2019
Date of Report	:	September 23, 2019

This Test Report is Issued Under the Authority of :

Prepared by	Approved & Authorized Signer
Sundiy jiang / Engineer	Iori Fan / Authorized Signatory

This test report is for the customer shown above and their specific product only. This report applies to above tested sample only and shall not be reproduced in part without written approval of Dongguan Nore Testing Center Co., Ltd.

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Revision History of This Test Report

Report Number	Description	Issued Date
NTC1908143FV00	Initial Issue	2019-09-23

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test

Product Name	:	Retail AI Camera Z2
Main Model Name	:	Retail Eye-Z2
Brand Name	:	Retail Eye
E.U.T. Type	:	Class A
Rating	:	DC 5V From Micro USB Port DC 3.7V From internal battery
Adapter	:	Manufacturer: Jihongda M/N: JHD-AP015J-050300BA-C Input: AC100-120V, ~50/60Hz, 0.45A Output: DC 5V 3A
Test voltage	:	AC 120V 60Hz, AC 240V 60Hz (Only the worst case was recorded in this report)
Cable	:	DC Line: 1.20m unshielded.
Hardware version	:	V01
Software version	:	V01
Note	:	This report only applies to bluetooth function.

Technical parameters (Bluetooth function)

Bluetooth Version	:	V2.1(BDR+EDR)
Frequency Range	:	2402-2480MHz
Modulation	:	GFSK, π/4-DQPSK, 8DPSK
Number of Channel	:	79
Channel space	:	1MHz
Date Rate	:	1Mbps for GFSK 2Mbps for π/4-DQPSK 3Mbps for 8DPSK
Antenna Type	:	PIFA antenna
Antenna Gain	:	2.5 dBi (Declaration by manufacturer)

Channel List for Bluetooth

Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
1	2402	21	2422	41	2442	61	2462
2	2403	22	2423	42	2443	62	2463
3	2404	23	2424	43	2444	63	2464
4	2405	24	2425	44	2445	64	2465
5	2406	25	2426	45	2446	65	2466
6	2407	26	2427	46	2447	66	2467
7	2408	27	2428	47	2448	67	2468
8	2409	28	2429	48	2449	68	2469
9	2410	29	2430	49	2450	69	2470
10	2411	30	2431	50	2451	70	2471
11	2412	31	2432	51	2452	71	2472
12	2413	32	2433	52	2453	72	2473
13	2414	33	2434	53	2454	73	2474
14	2415	34	2435	54	2455	74	2475
15	2416	35	2436	55	2456	75	2476
16	2417	36	2437	56	2457	76	2477
17	2418	37	2438	57	2458	77	2478
18	2419	38	2439	58	2459	78	2479
19	2420	39	2440	59	2460	79	2480
20	2421	40	2441	60	2461		

Note: According to section 15.31(m), regards to the operating frequency range over 10MHz, the Lowest, middle, and the Highest frequency of channel were selected to perform the test. The selected frequency and test software see below:

Channel	Frequency MHz
1	2402
40	2441
79	2480

Test SW version	EngineerMode.apk

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AUB6-AICAM-02** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rule.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters.

1.4 Equipment Modifications

Not available for this EUT intended for grant.

1.5 Support Device

Monitor	:	Manufacturer: DELL M/N: S2240Tb S/N: CN-0FP53P-74261-3AL-0CYU
Adapter (For monitor)	:	Manufacturer: CWT M/N: KPL-050F-VI I/P:AC100-240V50/60Hz,1.7A O/P:12V4.17A 50W
Mouse	:	Manufacturer: DELL M/N:MS116p Input:5V100mA CE, FCC: DOC,IC,VCCI,RCM

1.6 Test Facility and Location

Site Description

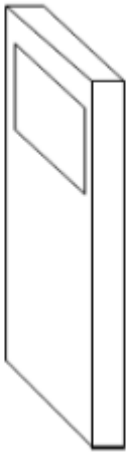
EMC Lab	:	Listed by CNAS, August 13, 2018 The certificate is valid until August 13, 2024 The Laboratory has been assessed and proved to be in compliance with CNAS/CL01 The Certificate Registration Number is L5795. Listed by A2LA, November 01, 2017 The certificate is valid until December 31, 2019 The Laboratory has been assessed and proved to be in compliance with ISO17025 The Certificate Registration Number is 4429.01 Listed by FCC, November 06, 2017 The Designation Number is CN1214 Test Firm Registration Number: 907417 Listed by Industry Canada, June 08, 2017 The Certificate Registration Number. Is 46405-9743
Name of Firm	:	Dongguan Nore Testing Center Co., Ltd. (Dongguan NTC Co., Ltd.)
Site Location	:	Building D, Gaosheng Science and Technology Park, Hongtu Road, Nancheng District, Dongguan City, Guangdong Province, China

1.7 Summary of Test Results

FCC Rules	Description Of Test	Uncertainty	Result
§15.247(a)(1)	Channel Separation test	±1.42 x10^{-4}%	Compliant
§15.247(a)(1)	20dB Bandwidth	±1.42 x10^{-4}%	Compliant
§15.247(a)(1)(iii)	Hopping Channel Number	±1.42 x10^{-4}%	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	±5%	Compliant
§15.247(b)	Max Peak output Power test	±1.06dB	Compliant
§15.247(d)	Band edge test	±1.70dB	Compliant
§15.207 (a)	AC Power Conducted Emission	±1.06dB	Compliant
§15.247(d),§15.209, §15.205	Radiated Emission	±3.70dB	Compliant
§15.203	Antenna Requirement	N/A	Compliant
§15.247(d)	Conducted Spurious Emission	±1.70dB	Compliant

Note: The EUT operating multiple positions, therefore the EUT shall be performed three orthogonal planes. The worst plane is X.

Example:

X Plane	Y Plane	Z Plane
		

2. System Test Configuration

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 Special Accessories

Not available for this EUT intended for grant.

2.3 Description of test modes

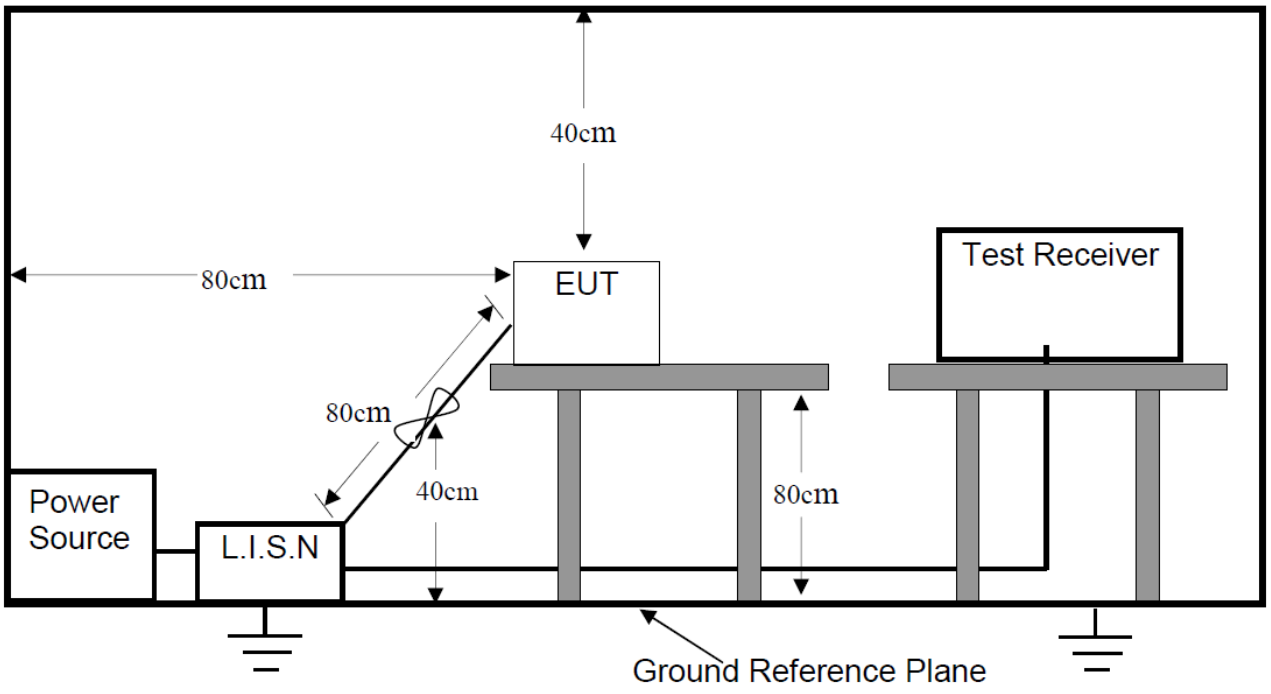
The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and normal mode is programmed. The Lowest, middle and highest channel were chosen for testing, and all packets DH1, DH3, DH5, 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5 mode in all modulation type GFSK, π/4-DQPSK and 8DPSK were tested.

2.4 EUT Exercise

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

3. Conducted Emissions Test

3.1 Test SET-UP (Block Diagram of Configuration)



3.2 Test Condition

Test Requirement: FCC Part 15.207

Frequency Range: 150KHz ~ 30MHz

Detector: RBW 9KHz, VBW 30KHz

Operation Mode: TX, TX+ Charging

3.3 Measurement Results

PASS

Please refer to the following pages of the worst case: GFSK High Channel.

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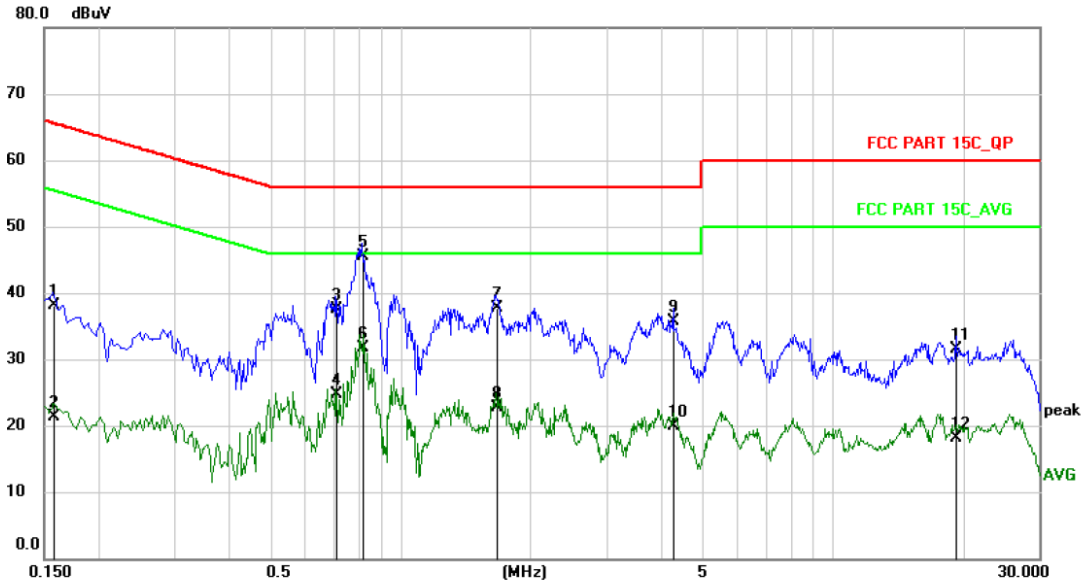
Web: Http://www.ntc-c.com

Conducted Emission Measurement

File :Retail Eye-Z2-new Data :#1 Date: 2019/9/23 Time: 22:30:20



Site
Limit: FCC PART 15C_QP
EUT: Retail AI Camera Z2
M/N: Retail Eye-Z2
Mode: Charging+TX(BT)
Note:

Phase: *L1*
Power: AC120V/60Hz

Temperature: 26
Humidity: 50 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1580	27.50	10.60	38.10	65.57	-27.47	QP	
2		0.1580	10.70	10.60	21.30	55.57	-34.27	AVG	
3		0.7100	26.84	10.66	37.50	56.00	-18.50	QP	
4		0.7100	14.04	10.66	24.70	46.00	-21.30	AVG	
5	*	0.8139	34.93	10.67	45.60	56.00	-10.40	QP	
6		0.8139	21.03	10.67	31.70	46.00	-14.30	AVG	
7		1.6700	27.00	10.70	37.70	56.00	-18.30	QP	
8		1.6700	12.10	10.70	22.80	46.00	-23.20	AVG	
9		4.2738	24.99	10.71	35.70	56.00	-20.30	QP	
10		4.2738	9.19	10.71	19.90	46.00	-26.10	AVG	
11		19.2900	20.84	10.76	31.60	60.00	-28.40	QP	
12		19.2900	7.34	10.76	18.10	50.00	-31.90	AVG	

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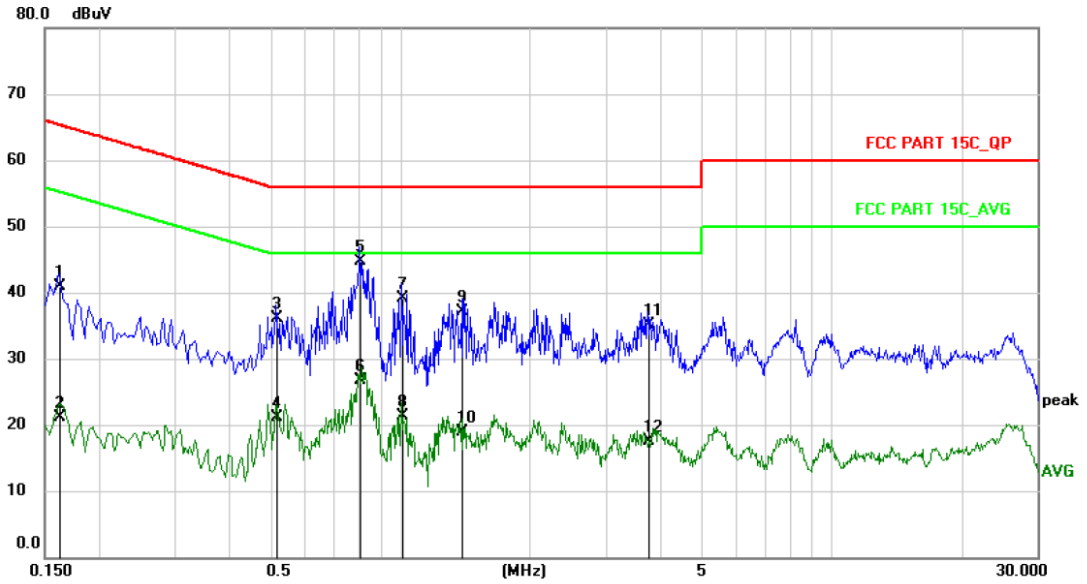
Conducted Emission Measurement

File :Retail Eye-Z2-new Data :#2 Date: 2019/9/23 Time: 22:32:35



Site
Limit: FCC PART 15C_QP
EUT: Retail AI Camera Z2
M/N: Retail Eye-Z2
Mode: Charging+TX(BT)
Note:

Phase: N
Power: AC120V/60Hz

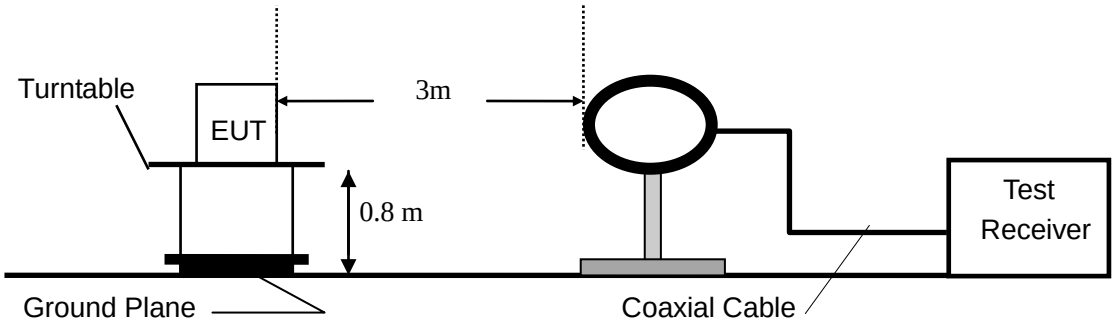
Temperature: 26
Humidity: 50 %

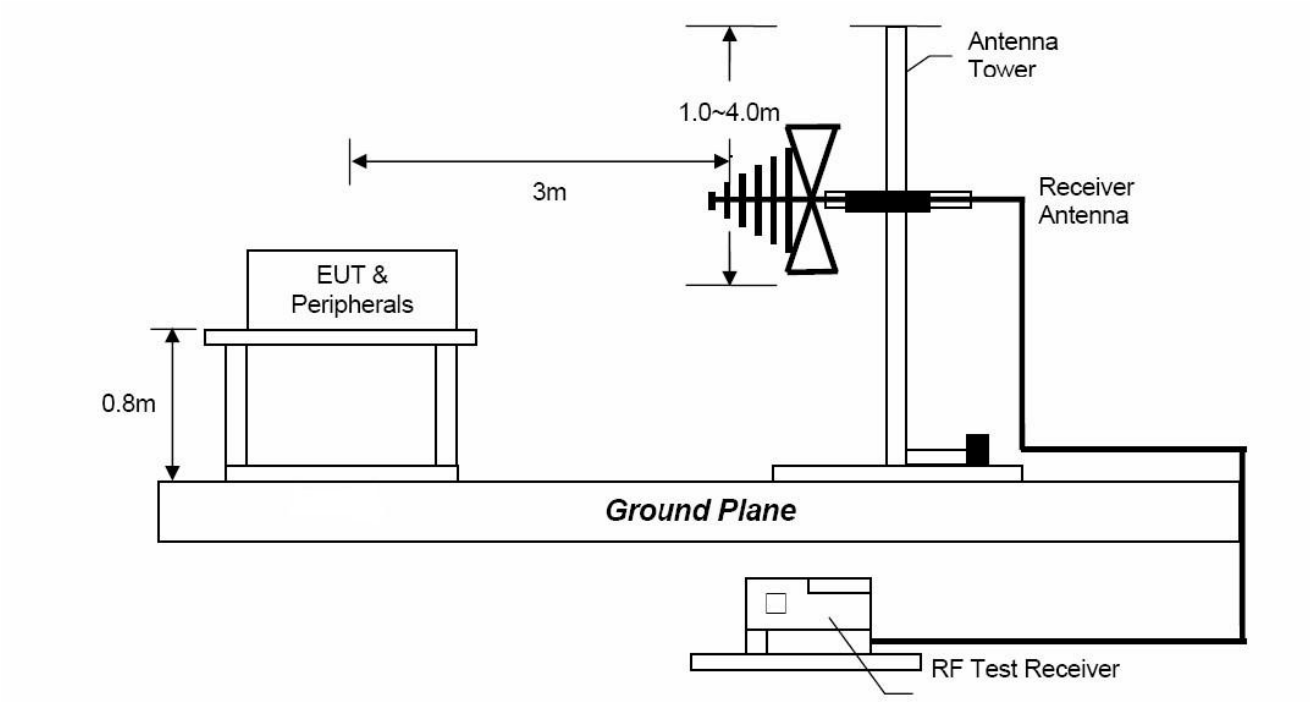
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	30.30	10.60	40.90	65.36	-24.46	QP	
2		0.1620	10.60	10.60	21.20	55.36	-34.16	AVG	
3		0.5180	25.57	10.63	36.20	56.00	-19.80	QP	
4		0.5180	10.47	10.63	21.10	46.00	-24.90	AVG	
5	*	0.8059	34.13	10.67	44.80	56.00	-11.20	QP	
6		0.8059	16.13	10.67	26.80	46.00	-19.20	AVG	
7		1.0100	28.50	10.70	39.20	56.00	-16.80	QP	
8		1.0100	10.60	10.70	21.30	46.00	-24.70	AVG	
9		1.3900	26.40	10.70	37.10	56.00	-18.90	QP	
10		1.3900	8.20	10.70	18.90	46.00	-27.10	AVG	
11		3.7420	24.49	10.71	35.20	56.00	-20.80	QP	
12		3.7420	6.89	10.71	17.60	46.00	-28.40	AVG	

4. Radiated Emission Test

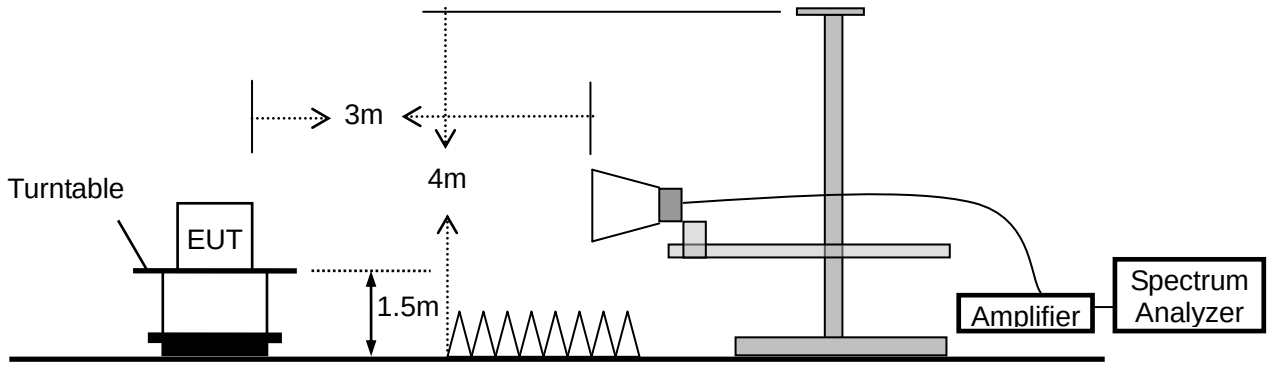
4.1 Test SET-UP (Block Diagram of Configuration)

4.1.1 Radiated Emission Test Set-Up, Frequency Below 30MHz





4.1.2 Radiated Emission Test Set-Up, Frequency above 1GHz



4.2 Measurement Procedure

a. Blow 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.
b. For the radiated emission test above 1GHz:
   The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
f. A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Band (MHz)	Level	Resolution Bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	3 MHz
	Average	1 MHz	10 Hz

4.3 Limit

Frequency range MHz	Distance Meters	Field Strengths Limit (15.209) μV/m
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960	3	500

Remark : (1) Emission level (dB)μV = 20 log Emission level μV/m

(2) The smaller limit shall apply at the cross point between two frequency bands.

(3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

(4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

4.4 Measurement Results

Please refer to following plots of the worst case: GFSK High Channel.

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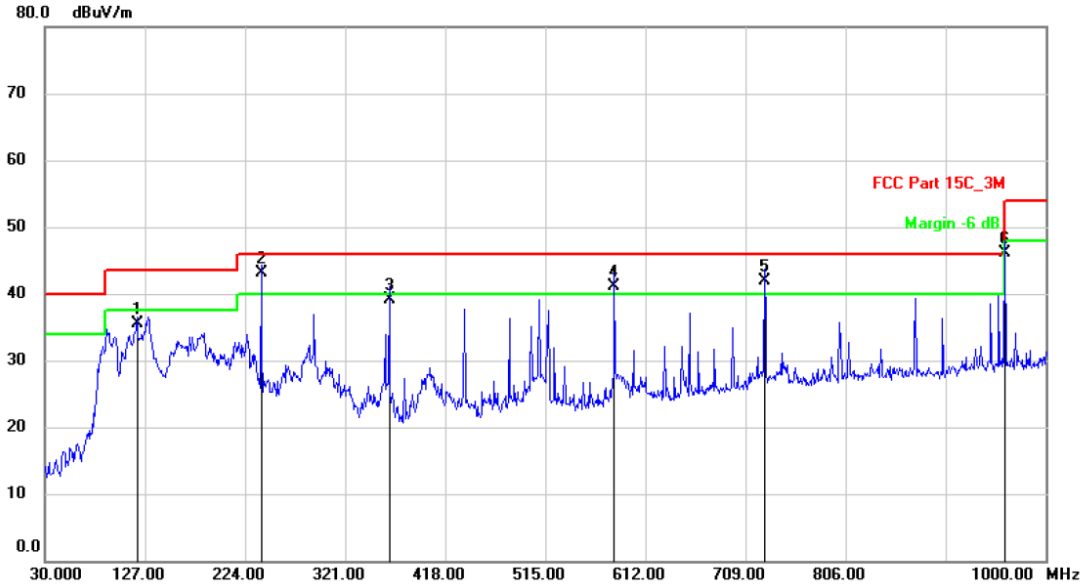
Radiated Emission Measurement

File :Retail Eye-Z2 Data :#5 Date: 2019/8/15 Time: 16:52:22



Site: 3m Chamber
Limit: FCC Part 15C_3M
EUT: Retail AI Camera Z2
M/N: Retail Eye-Z2
Mode: TX(BT)+ Charging
Note:

Polarization: ***Horizontal***
Power: AC120V/60Hz
Distance: 3m

Temperature: 26
Humidity: 47 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		119.2400	49.41	-13.89	35.52	43.50	-7.98	QP			
2	*	239.5200	55.14	-12.06	43.08	46.00	-2.92	QP			
3		363.6800	48.25	-9.15	39.10	46.00	-6.90	QP			
4	!	581.9300	46.61	-5.51	41.10	46.00	-4.90	QP			
5	!	727.4300	44.97	-3.12	41.85	46.00	-4.15	QP			
6		960.2300	46.32	-0.23	46.09	54.00	-7.91	QP			

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

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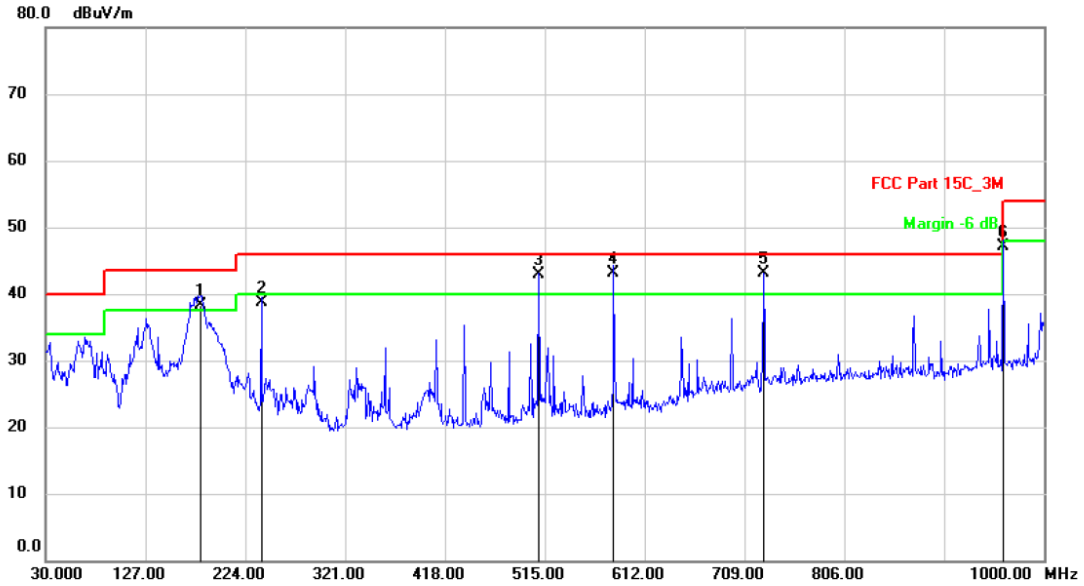
Web: Http://www.ntc-c.com

Radiated Emission Measurement

File :Retail Eye-Z2 Data :#6 Date: 2019/8/15 Time: 16:54:26



Site: 3m Chamber
Limit: FCC Part 15C_3M
EUT: Retail AI Camera Z2
M/N: Retail Eye-Z2
Mode: TX(BT)+ Charging
Note:

Polarization: ***Vertical***
Power: AC120V/60Hz
Distance: 3m

Temperature: 26
Humidity: 47 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	!	180.3500	55.37	-17.12	38.25	43.50	-5.25	QP			
2		239.5200	53.78	-15.06	38.72	46.00	-7.28	QP			
3	!	509.1800	51.75	-8.75	43.00	46.00	-3.00	QP			
4	*	581.9300	50.70	-7.51	43.19	46.00	-2.81	QP			
5	!	727.4300	46.17	-3.12	43.05	46.00	-2.95	QP			
6		960.2300	47.31	-0.23	47.08	54.00	-6.92	QP			

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

Modulation:	GFSK (the worst case)		
Frequency Range:	1-25GHz	Test Date :	August 30, 2019
Test Result:	PASS	Temperature :	24 ℃
Measured Distance:	3m	Humidity :	47 %
Test By:	Sance		

Freq. (MHz)	Ant.Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
4804	V	46.33	31.48	6.30	52.63	37.78	74.00	54.00	-21.37	-16.22
7206	V	45.04	30.85	10.44	55.48	41.29	74.00	54.00	-18.52	-12.71

4804	H	46.61	31.83	6.30	52.91	38.13	74.00	54.00	-21.09	-15.87
7206	H	45.65	30.97	10.44	56.09	41.41	74.00	54.00	-17.91	-12.59

Operation Mode: TX Mode (Mid)										
4882	V	46.13	31.52	6.60	52.73	38.12	74.00	54.00	-21.27	-15.88
7323	V	45.04	30.88	10.55	55.59	41.43	74.00	54.00	-18.41	-12.57

4882	H	46.71	31.92	6.60	53.31	38.52	74.00	54.00	-20.69	-15.48
7323	H	45.92	31.12	10.55	56.47	41.67	74.00	54.00	-17.53	-12.33

Operation Mode: TX Mode (High)										
4960	V	45.90	31.18	6.89	52.79	38.07	74.00	54.00	-21.21	-15.93
7440	V	45.64	30.97	10.60	56.24	41.57	74.00	54.00	-17.76	-12.43

4960	H	46.33	31.73	6.89	53.22	38.62	74.00	54.00	-20.78	-15.38
7440	H	45.78	30.99	10.60	56.38	41.59	74.00	54.00	-17.62	-12.41

Note:
(1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level + Factor
(3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
(4) Data of measurement within this frequency range shown " ---" in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
(5) Measurement uncertainty : ±3.7dB.
(6) Horn antenna used for the emission over 1000MHz.

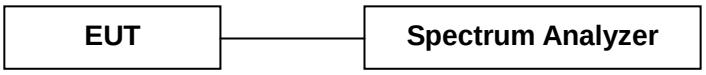
5. Channel Separation test

5.1 Measurement Procedure

Minimum Hopping Channel Carrier Frequency Separation, FCC Rule 15.247(a)(1):

Connect EUT antenna terminal to the spectrum analyzer with a low loss cable, and using the MARKER and Max-Hold function to record the separation of two adjacent channels.

5.2 Test SET-UP (Block Diagram of Configuration)

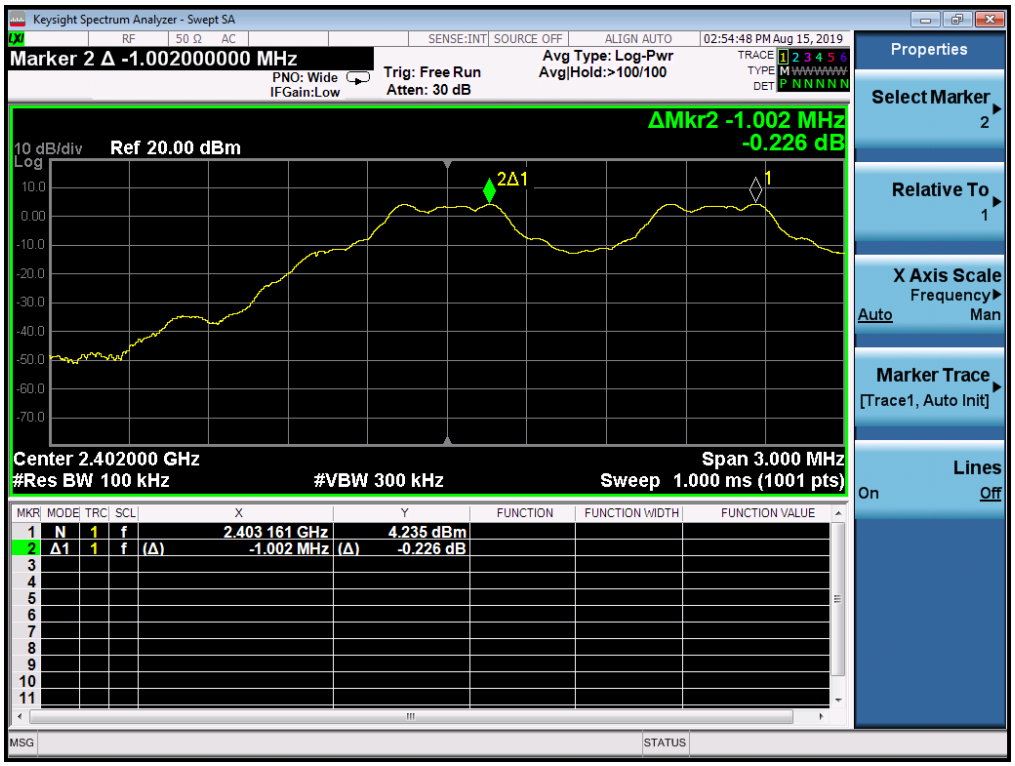


5.3 Measurement Results

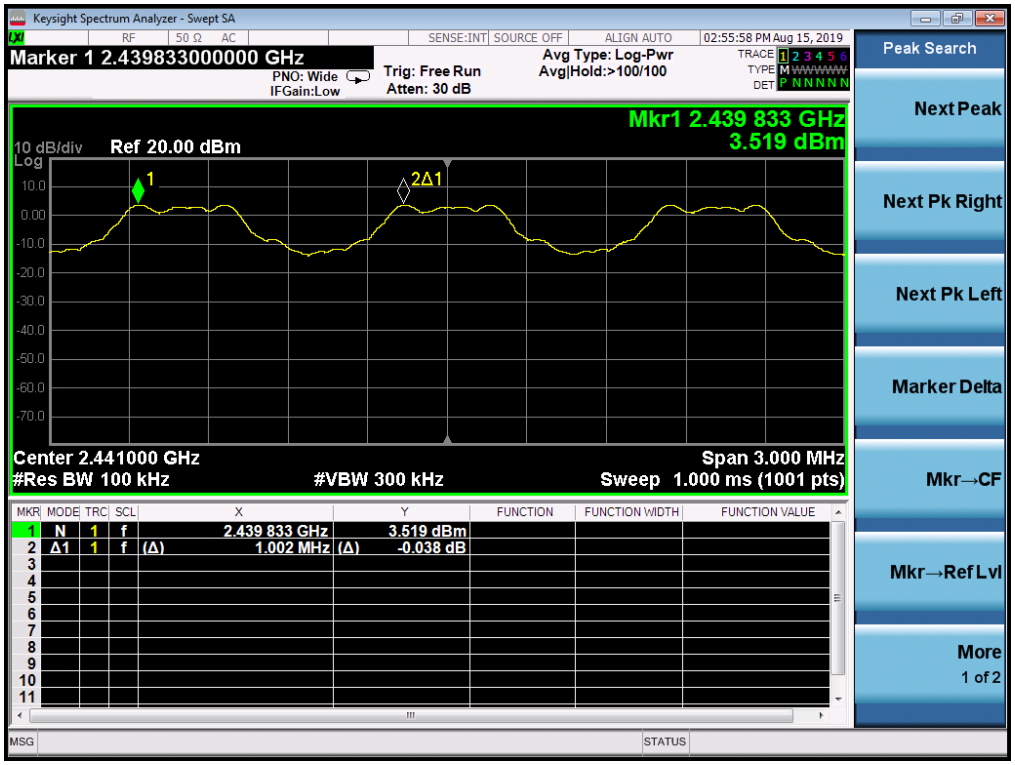
Modulation:	GFSK, π/4-DQPSK, 8DPSK		
RBW:	100KHz	VBW:	300KHz
Packet:	DH5, 2-DH5, 3-DH5	Spectrum Detector:	PK
Test By:	Lee	Test Date :	August 15, 2019
Temperature :	22 ℃	Humidity :	53 %
Test Result:	PASS		

Channel number	Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit 2/3 20dB Bandwidth (KHz)
GFSK			
Lowest	2402	1002	>597.87
Middle	2441	1002	>597.00
Highest	2480	1002	>594.80
π/4-DQPSK			
Lowest	2402	1002	>758.67
Middle	2441	1002	>759.33
Highest	2480	1002	>758.00
8DPSK			
Lowest	2402	1002	>760.67
Middle	2441	1002	>762.00
Highest	2480	1002	>760.67

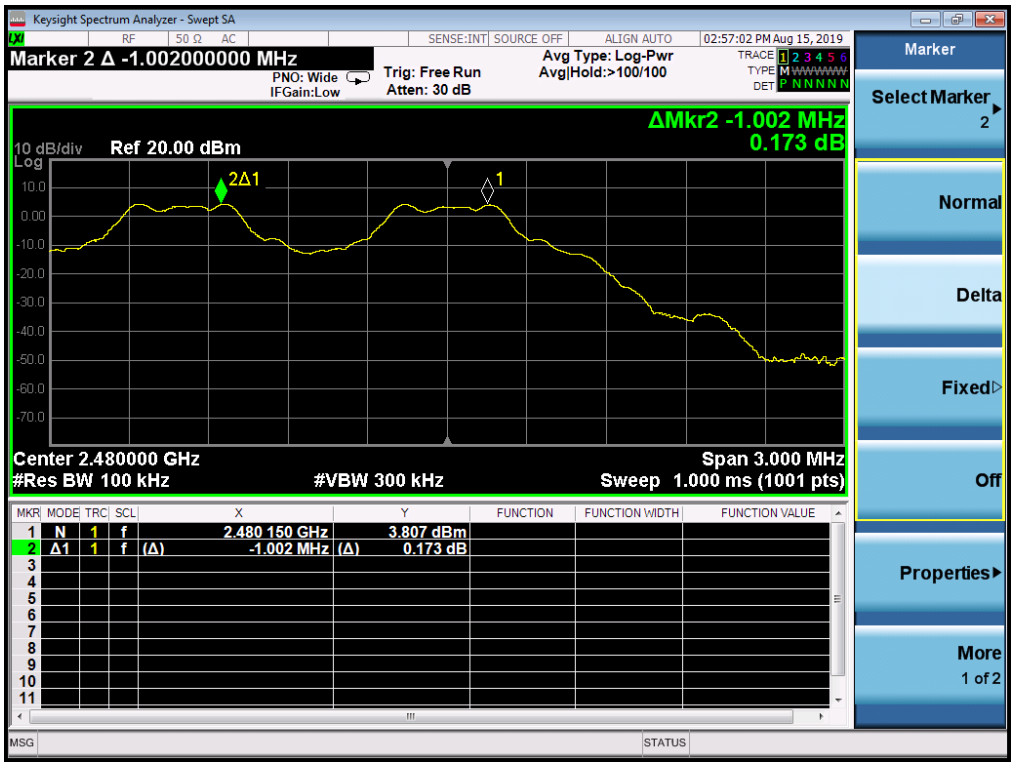
GFSK Lowest Channel



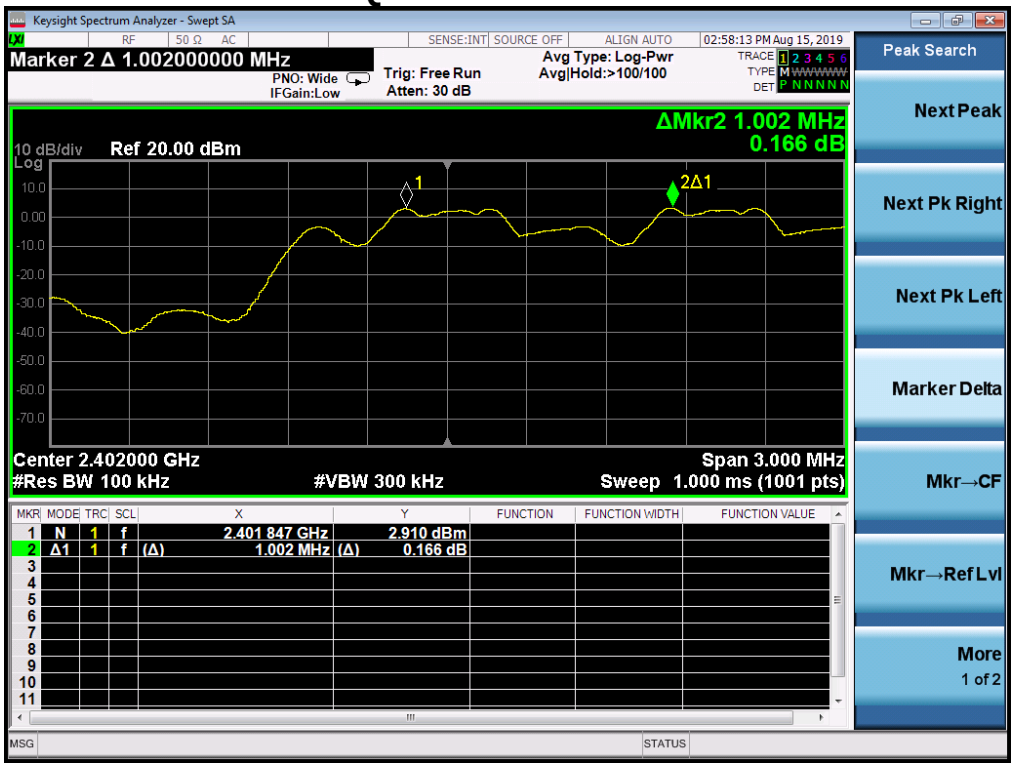
GFSK Middle Channel



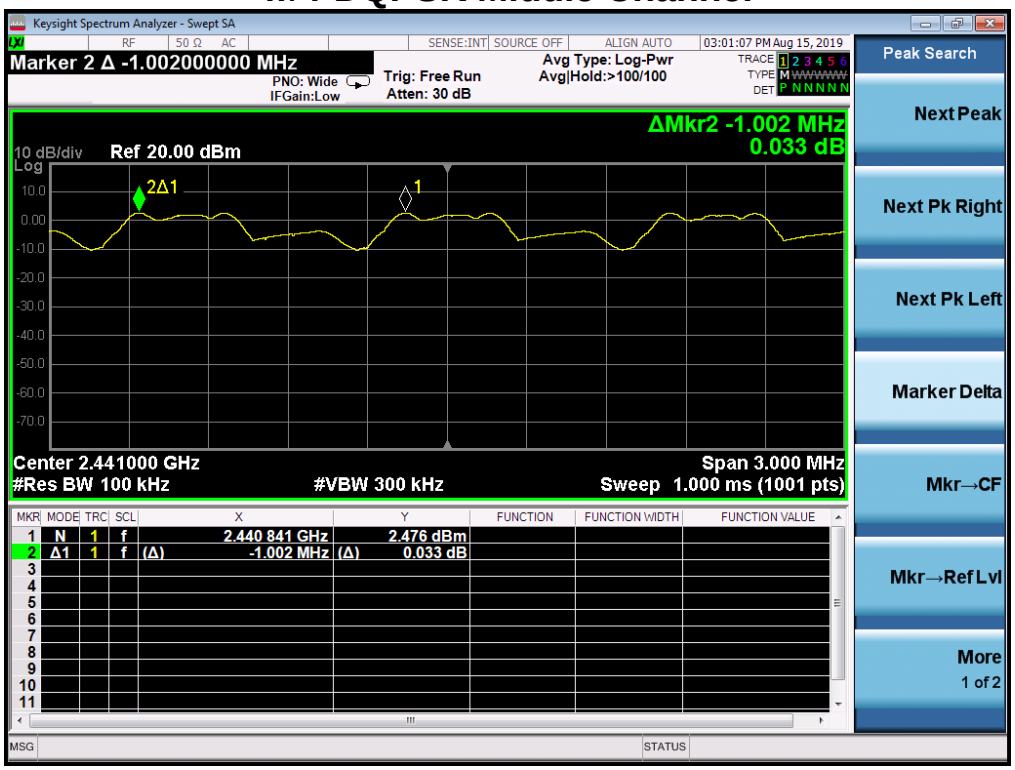
GFSK Highest Channel



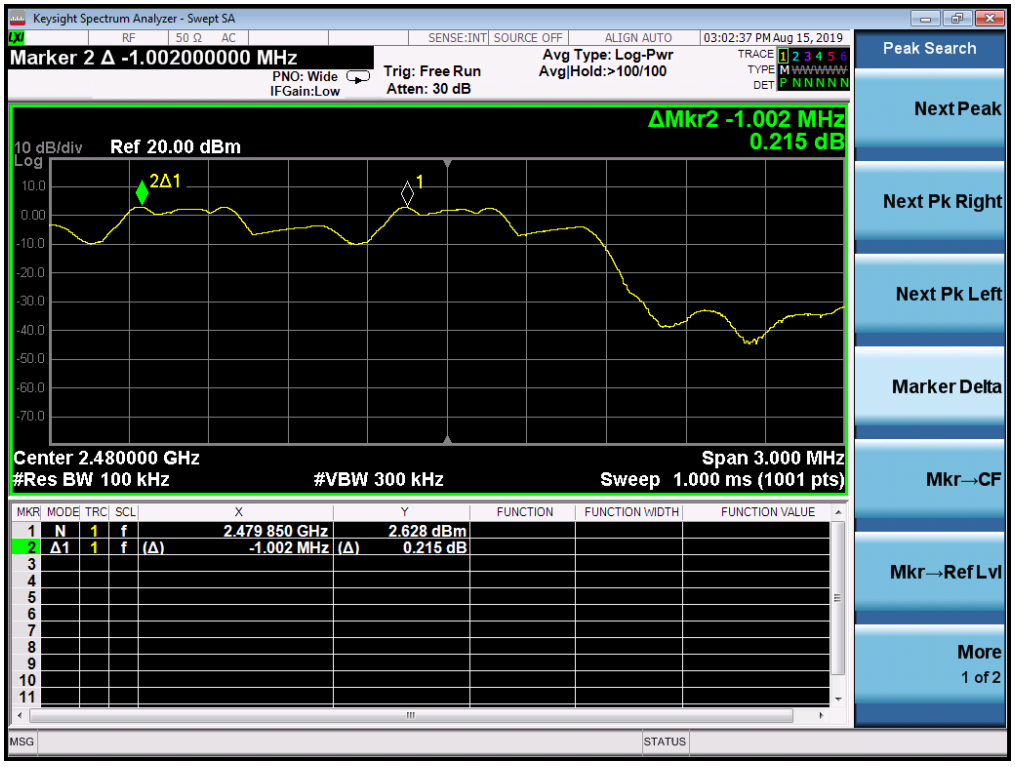
π/4-DQPSK Lowest Channel



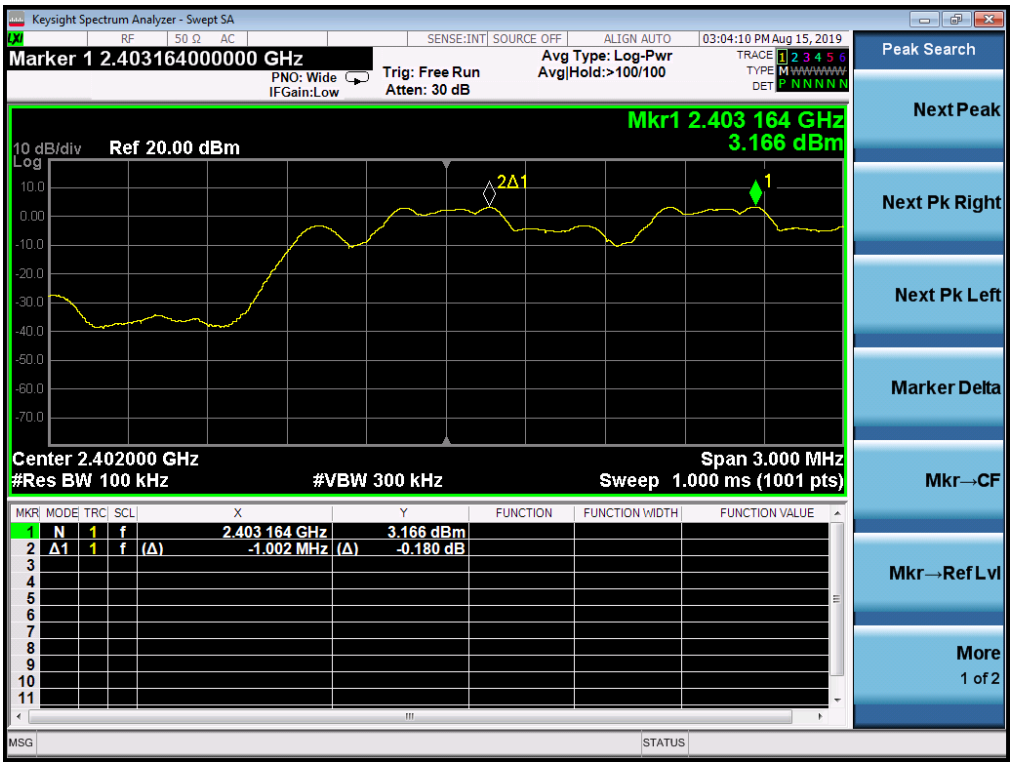
π/4-DQPSK Middle Channel



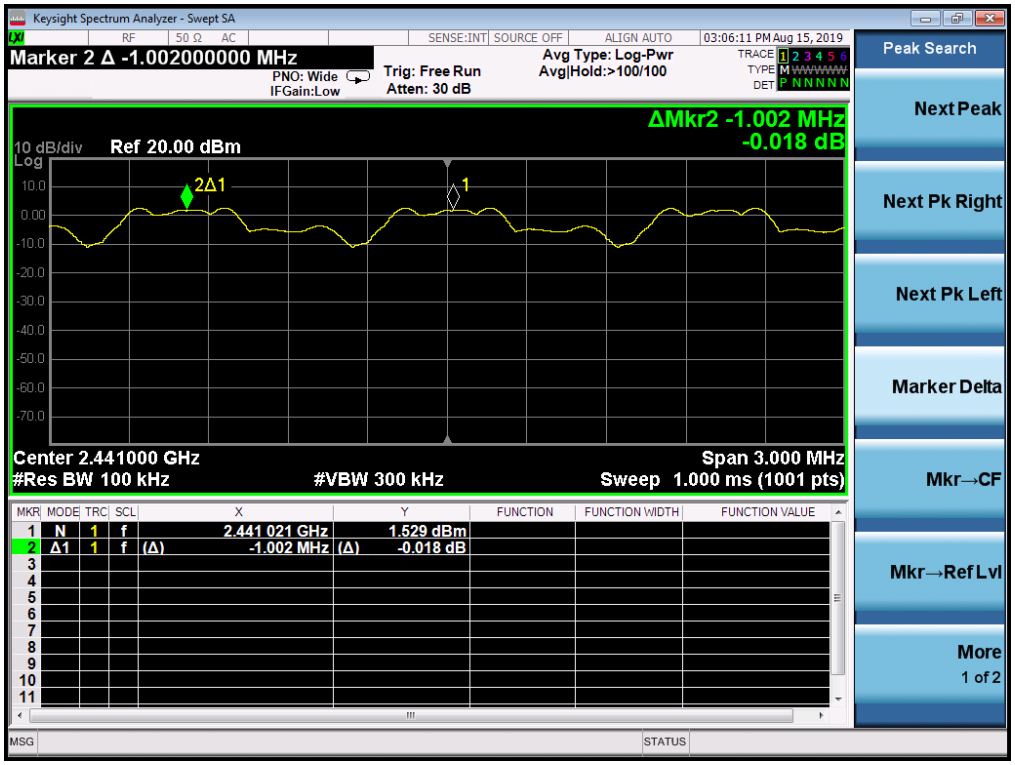
π/4-DQPSK Highest Channel



8DPSK Lowest Channel



8DPSK Middle Channel



8DPSK Highest Channel

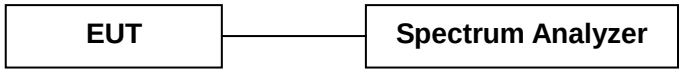
6. 20dB Bandwidth

6.1 Measurement Procedure

Maximum 20dB RF Bandwidth, FCC Rule 15.247(a)(1):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

6.2 Test SET-UP (Block Diagram of Configuration)



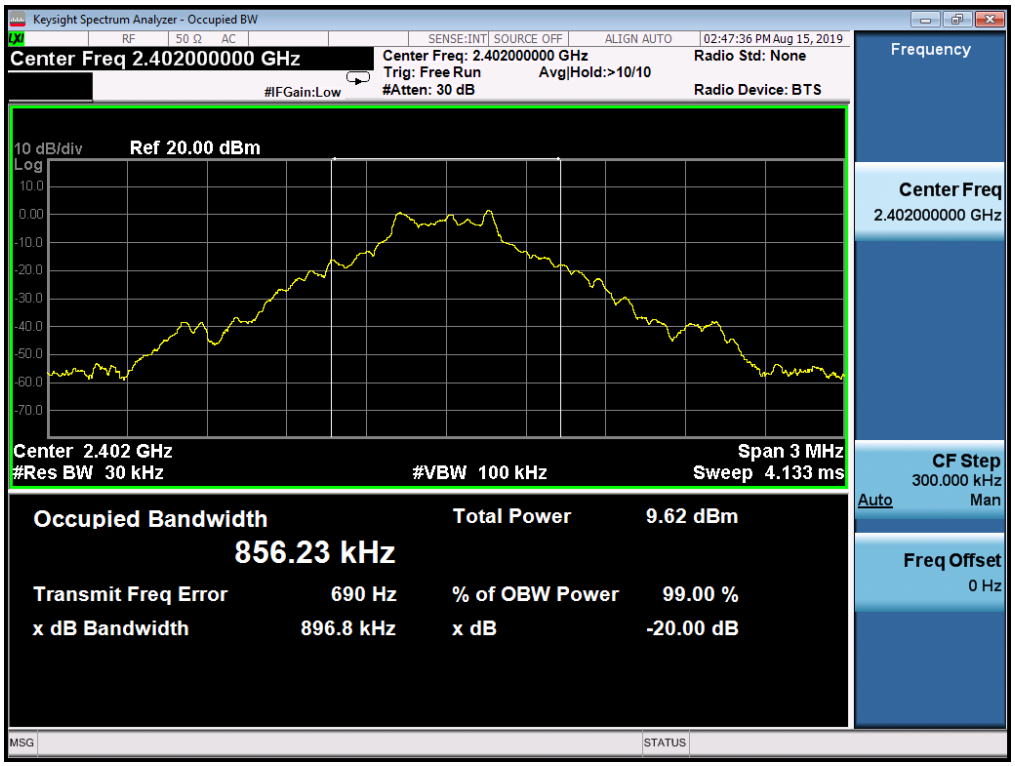
6.3 Measurement Results

Refer to attached data chart.

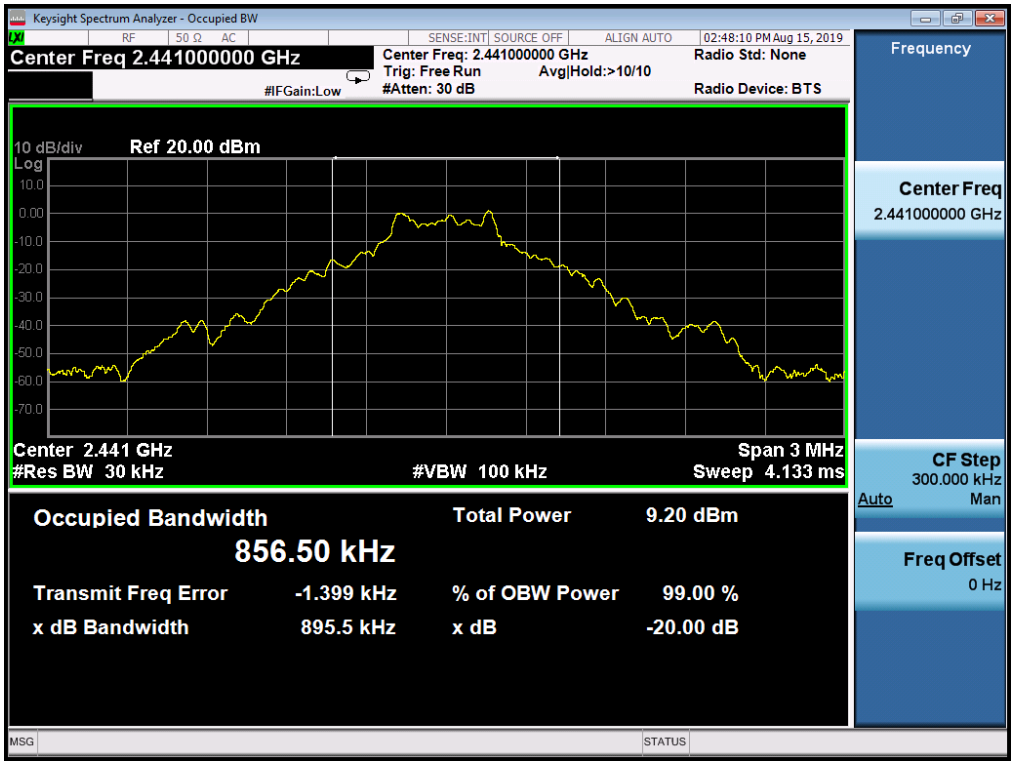
Modulation:	GFSK, π/4-DQPSK, 8DPSK		
RBW:	30KHz	VBW:	100KHz
Packet:	DH5, 2-DH5, 3-DH5	Spectrum Detector:	PK
Test By:	Lee	Test Date :	August 15, 2019
Temperature :	22 ℃	Humidity :	53 %
Test Result:	PASS		

Channel frequency (MHz)	20dB Down BW(kHz)
GFSK	
2402	896.8
2441	895.5
2480	892.2
π/4-DQPSK	
2402	1138
2441	1139
2480	1137
8DPSK	
2402	1141
2441	1143
2480	1141

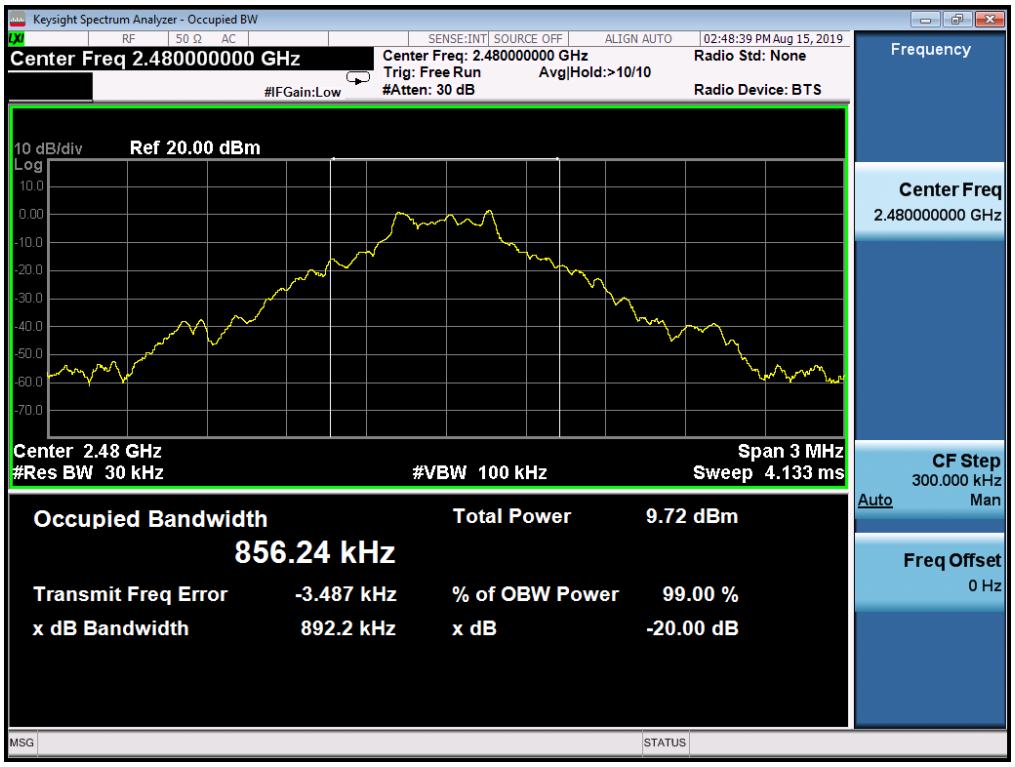
GFSK Lowest Channel



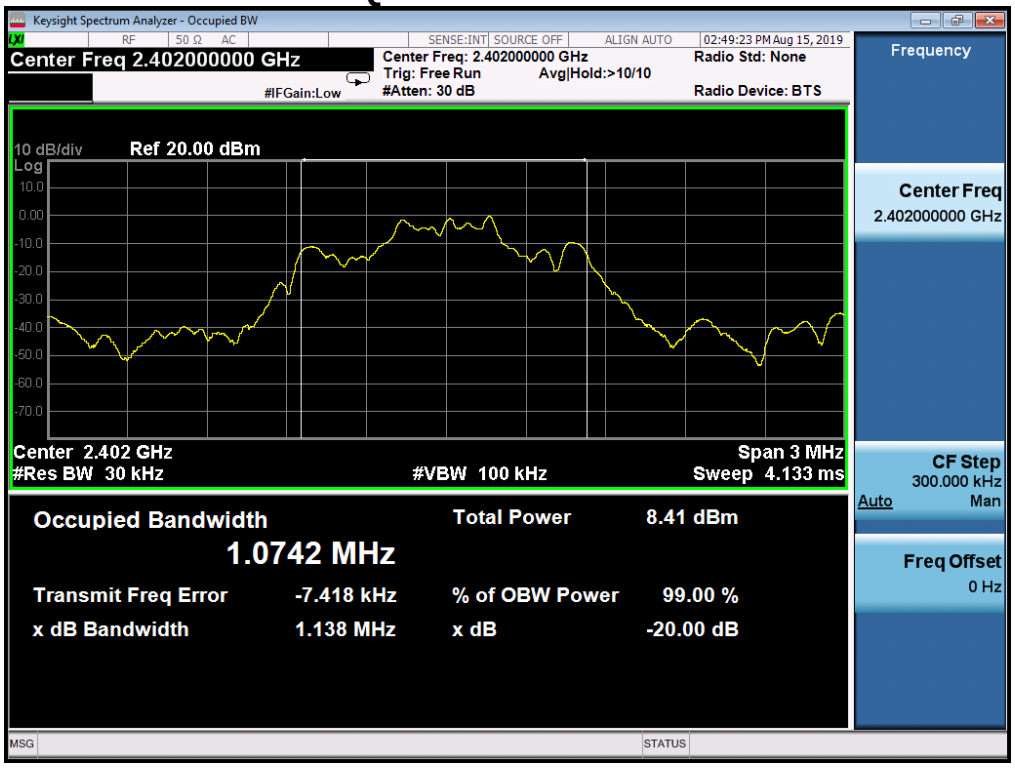
GFSK Middle Channel



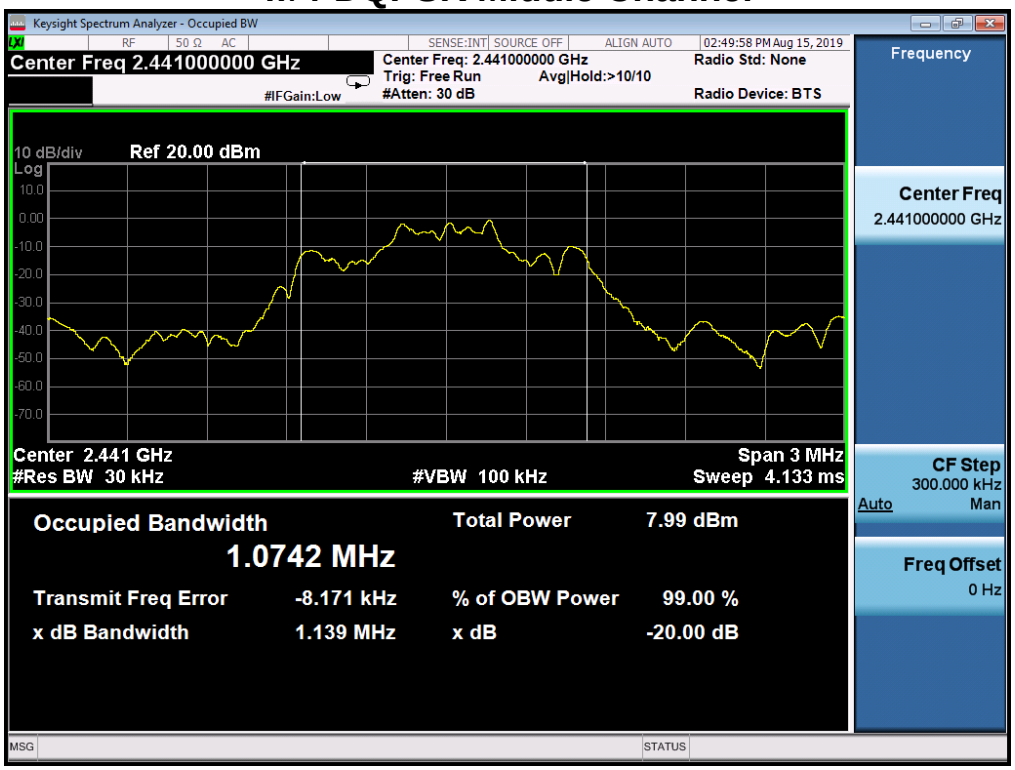
GFSK Highest Channel



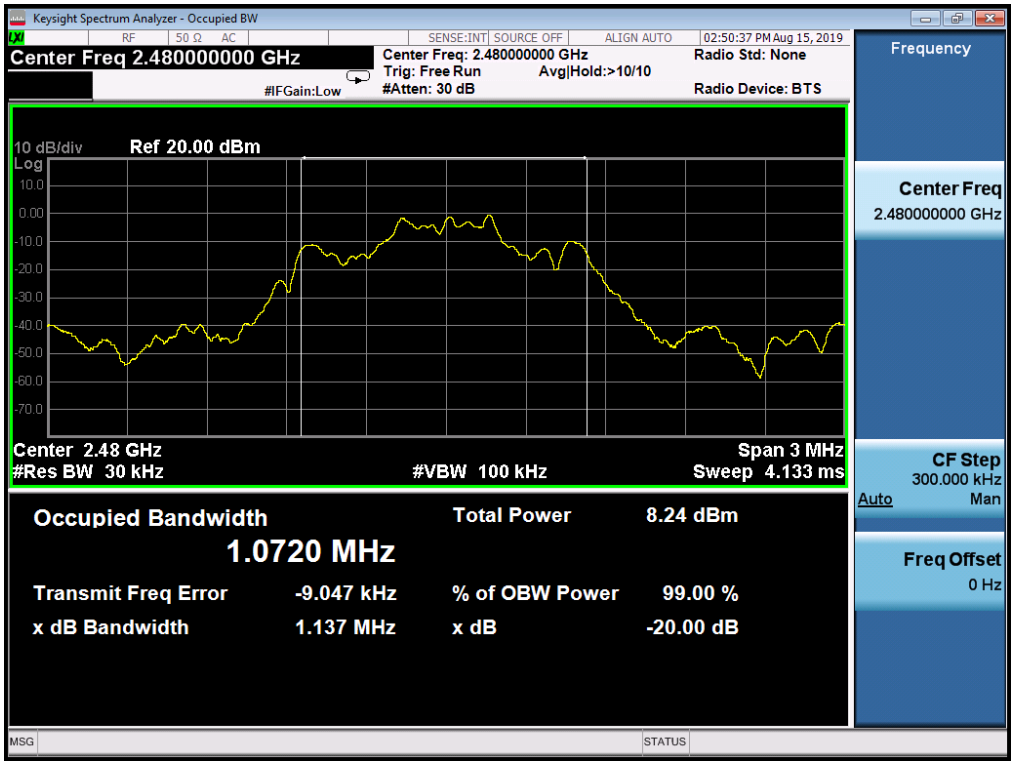
π/4-DQPSK Lowest Channel



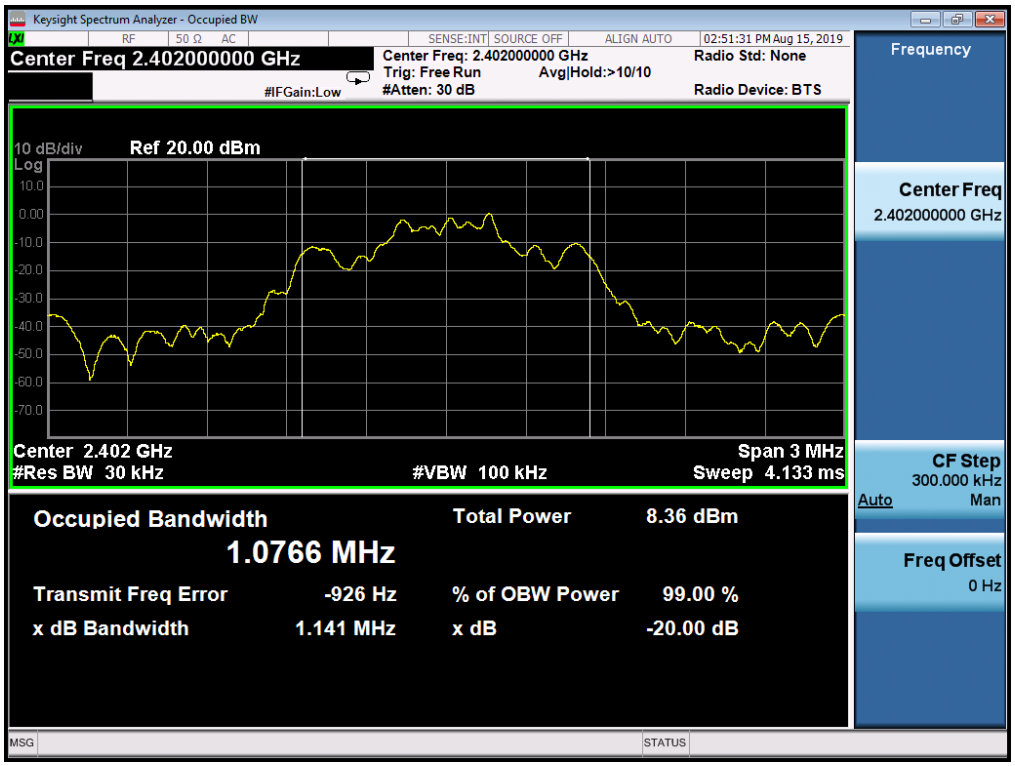
π/4-DQPSK Middle Channel



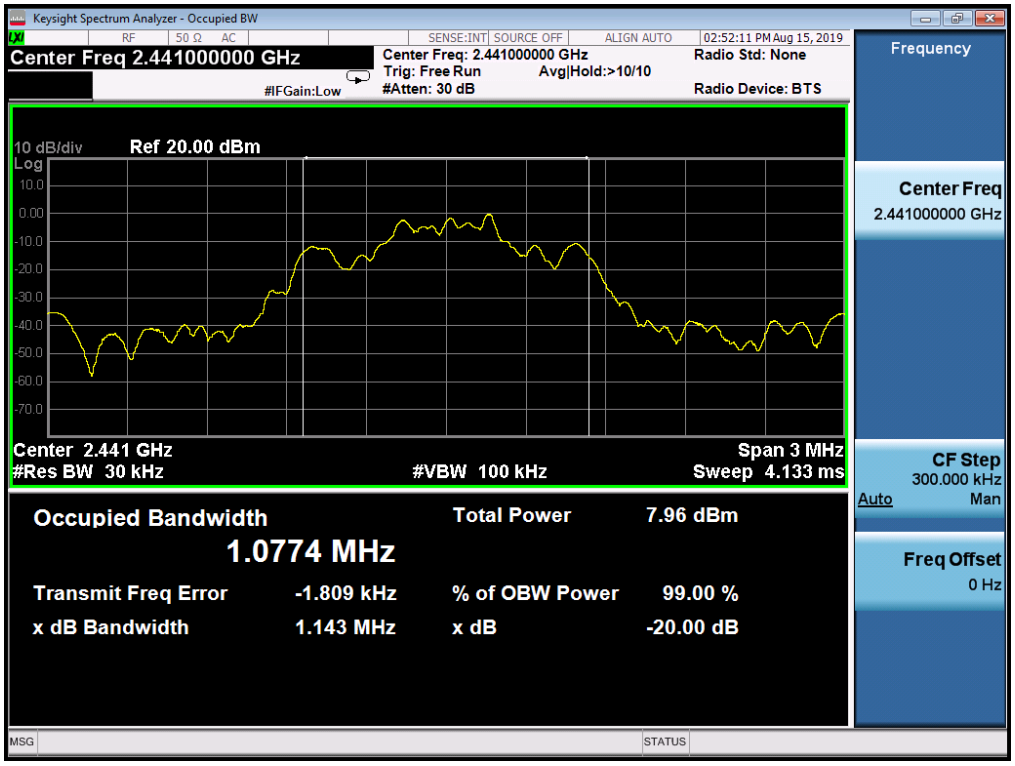
π/4-DQPSK Highest Channel



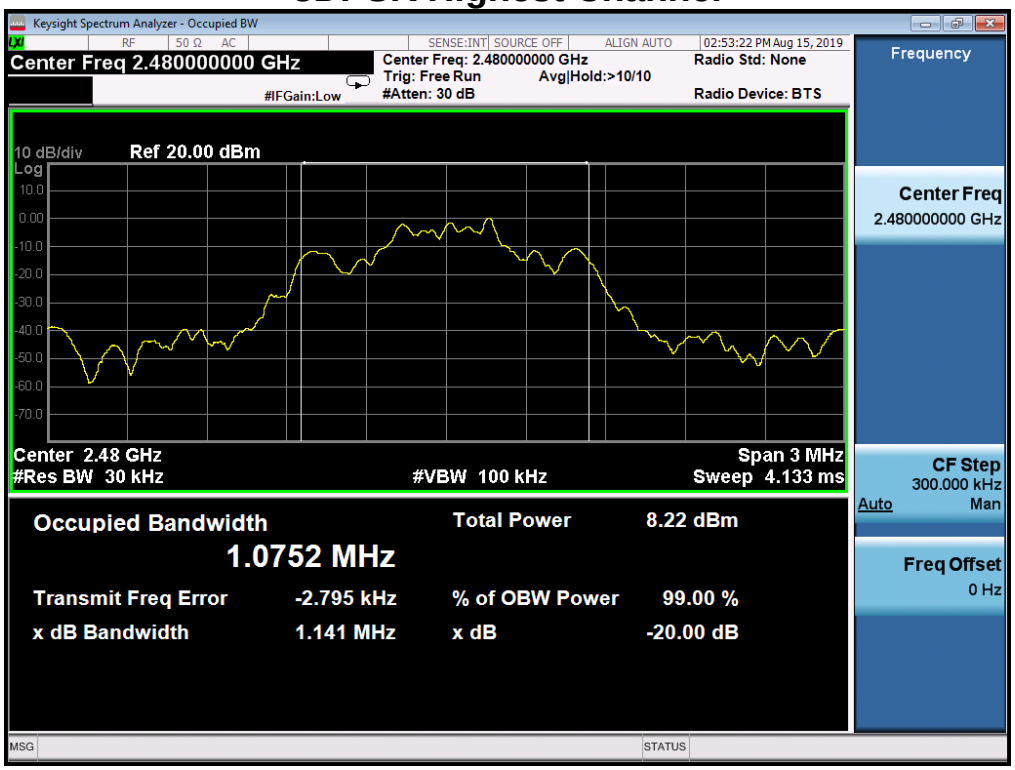
8DPSK Lowest Channel



8DPSK Middle Channel



8DPSK Highest Channel



7. Hopping Channel Number

7.1 Measurement Procedure

Minimum Number of Hopping Frequencies, FCC Rule 15.247(a)(1)(iii):

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, and the spectrum analyzer set to MAX HOLD readings were taken for 3-5 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

7.2 Test SET-UP (Block Diagram of Configuration)

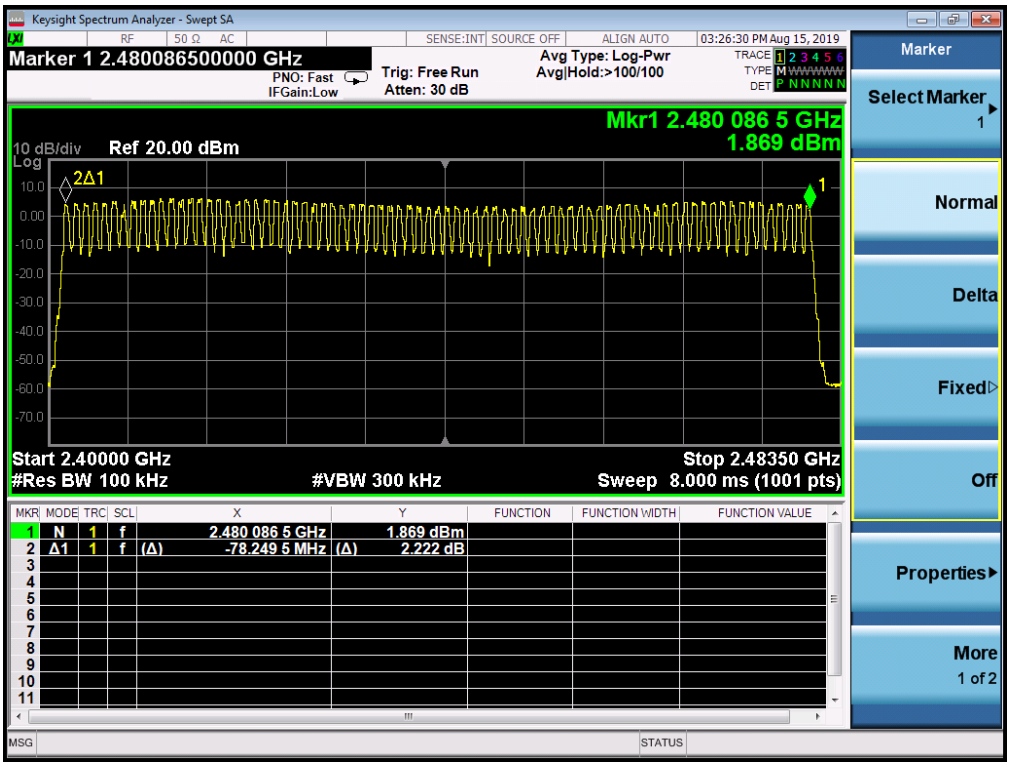
EUT —— **Spectrum Analyzer**

7.3 Measurement Results

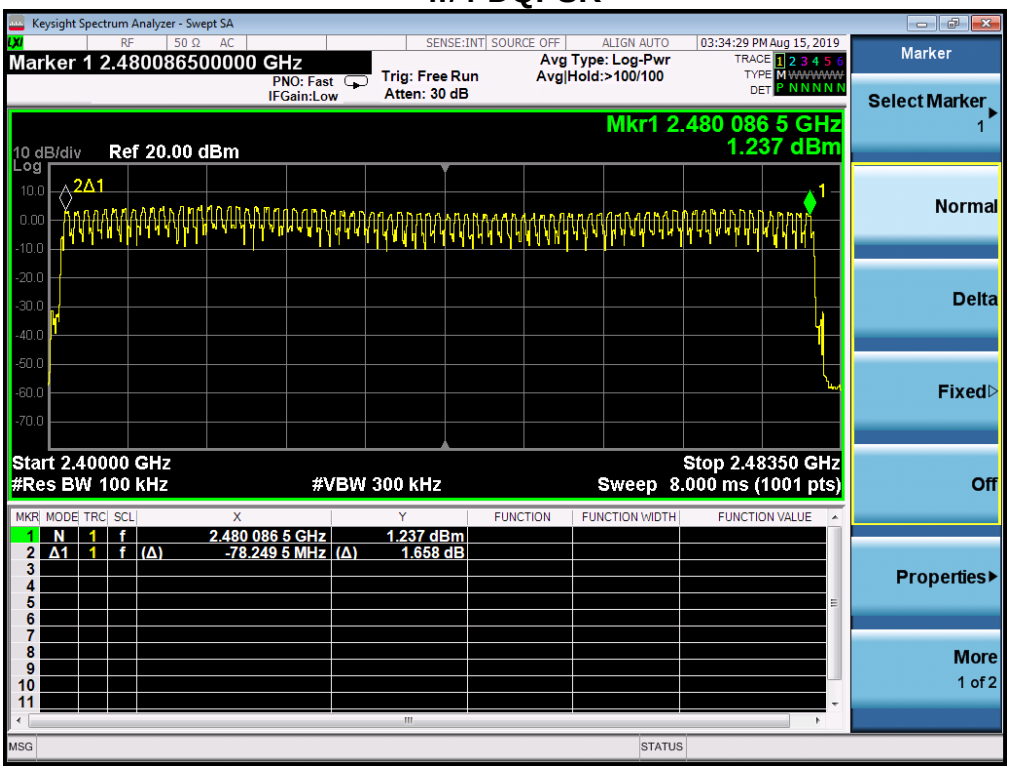
Modulation	GFSK, π/4-DQPSK, 8DPSK		
RBW:	100KHz	VBW:	300KHz
Packet:	DH5, 2-DH5, 3-DH5	Spectrum Detector:	PK
Test By:	Lee	Test Date :	August 15, 2019
Temperature :	22 ℃	Humidity :	53 %
Test Result:	PASS		

Hopping Channel Frequency Range	Number of Hopping Channels	Limit
2402-2480	79	≥15

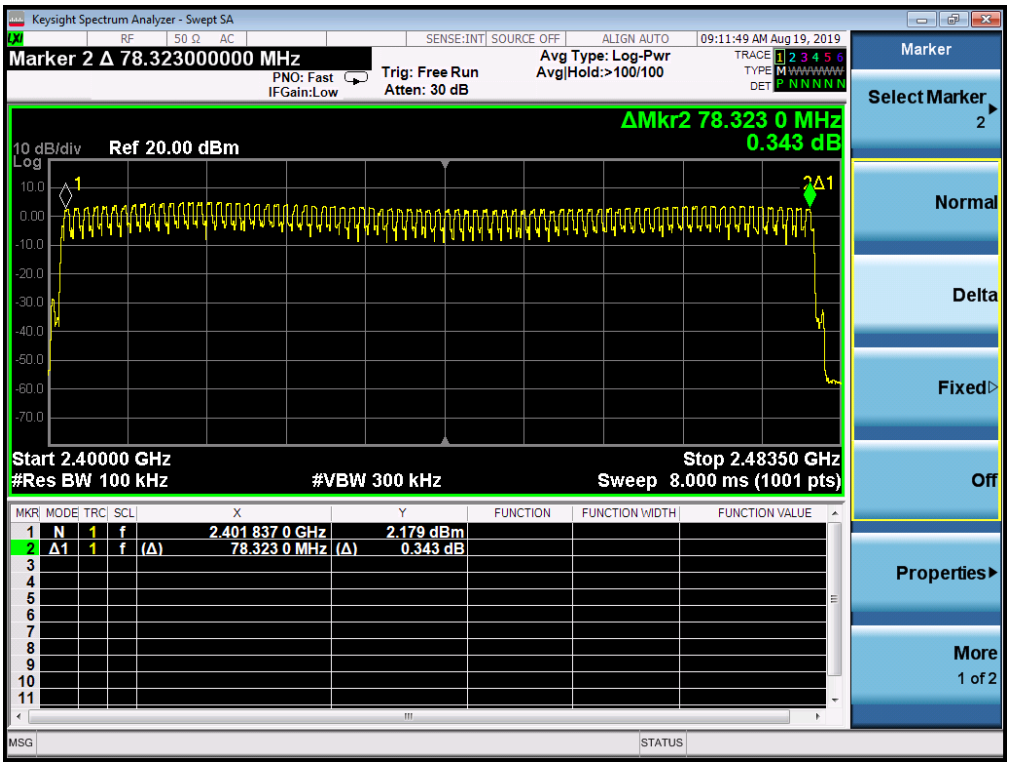
GFSK



π/4-DQPSK



8DPSK


Keysight Spectrum Analyzer - Swept SA
Marker 2 Δ 78.323000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
09:11:49 AM Aug 19, 2019
ΔMkr2 78.323 0 MHz
0.343 dB
10 dB/div Ref 20.00 dBm
Log
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)
1 N 1 f 2.401 837 0 GHz 2.179 dBm
2 Δ1 1 f (Δ) 78.323 0 MHz (Δ) 0.343 dB
Marker
Select Marker 2
Normal
Delta
Fixed
Off
Properties
More 1 of 2

8. Time of Occupancy (Dwell Time)

8.1 Measurement Procedure

Average Channel Occupancy Time, FCC Ref:15.247(a)(1)(iii):

Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.
The spectrum analyzer center frequency was set to one of the known hopping channels. The Sweep was set to 10 ms, the SPAN was set to Zero SPAN. The time duration of the transmissions so captured was measured with the Marker Delta function

8.2 Measurement Results

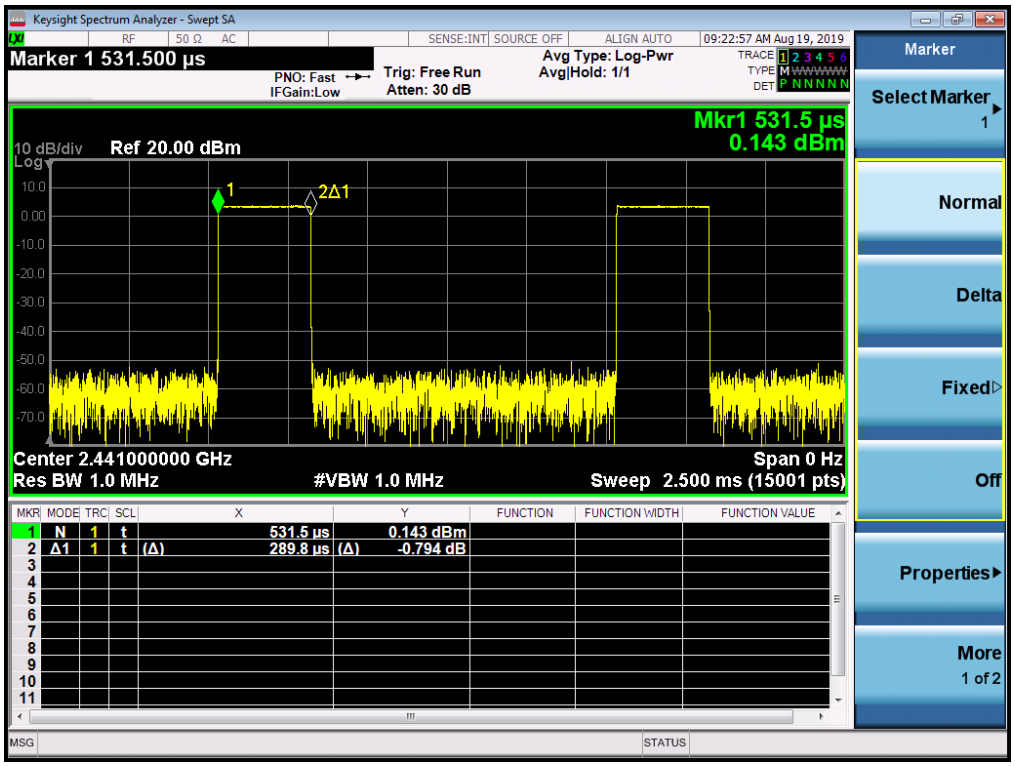
The maximum number of hopping channels in 31.6s (0.4s/Channel x 79 Channel)

Refer to attached data chart.

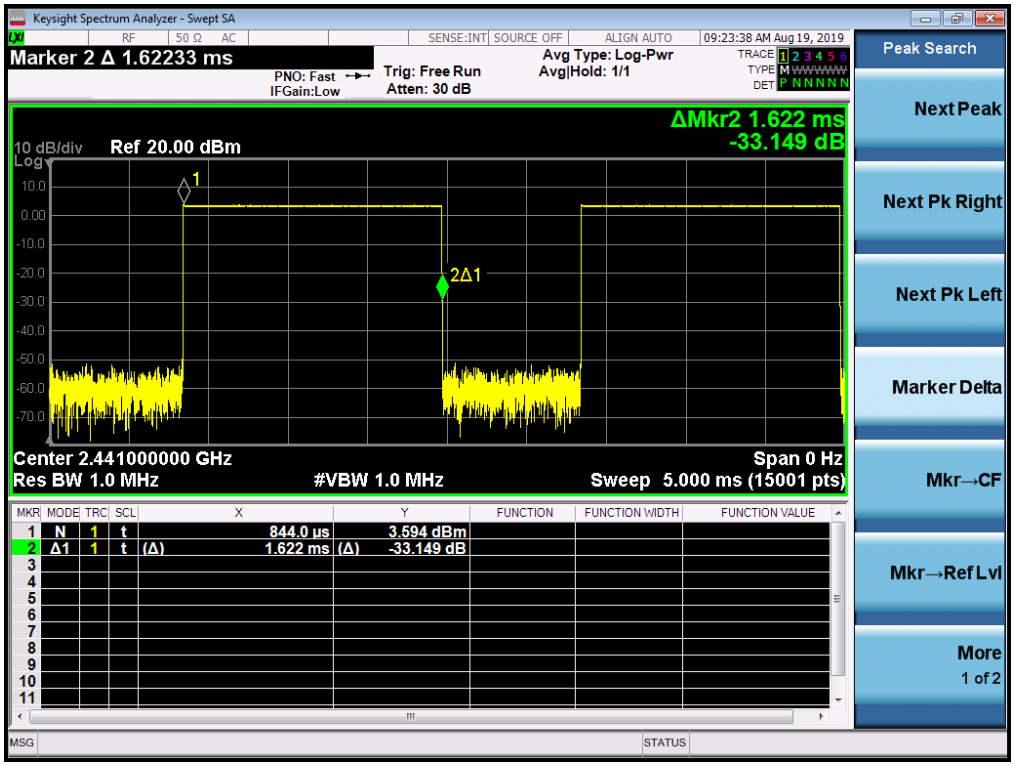
Modulation :	GFSK, π/4-DQPSK, 8DPSK		
RBW :	1MHz	VBW :	1MHz
Spectrum Detector:	PK	Test By:	Lee
Test Date :	August 19, 2019	Temperature :	22℃
Test Result:	PASS	Humidity :	53 %

Packet	Frequency (MHz)	Result (msec)			Limit (msec)
GFSK					
DH1	2441	0.2898	(ms)*(1600/(2*79))*31.6=	92.736	400
DH3	2441	1.6220	(ms)*(1600/(4*79))*31.6=	259.520	400
DH5	2441	2.8690	(ms)*(1600/(6*79))*31.6=	306.023	400
π/4-DQPSK					
2-DH1	2441	0.2303	(ms)*(1600/(2*79))*31.6=	73.696	400
2-DH3	2441	1.6300	(ms)*(1600/(4*79))*31.6=	260.800	400
2-DH5	2441	2.8780	(ms)*(1600/(6*79))*31.6=	306.987	400
8DPSK					
3-DH1	2441	0.2023	(ms)*(1600/(2*79))*31.6=	64.736	400
3-DH3	2441	1.6290	(ms)*(1600/(4*79))*31.6=	260.640	400
3-DH5	2441	2.8810	(ms)*(1600/(6*79))*31.6=	307.307	400

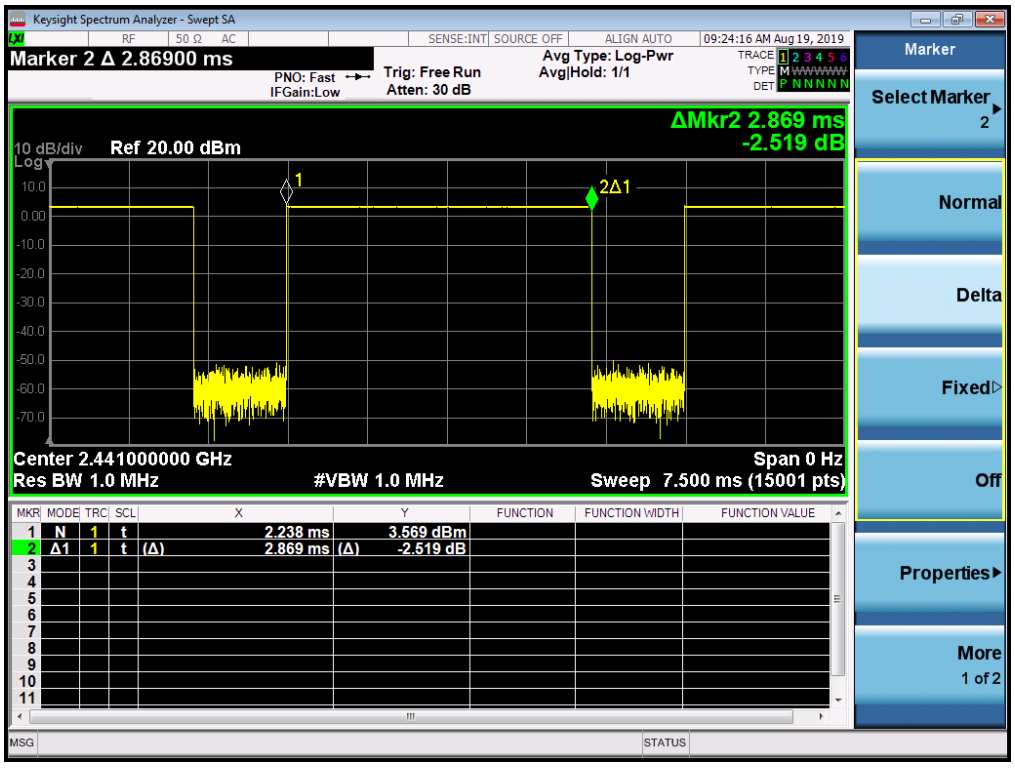
GFSK DH1



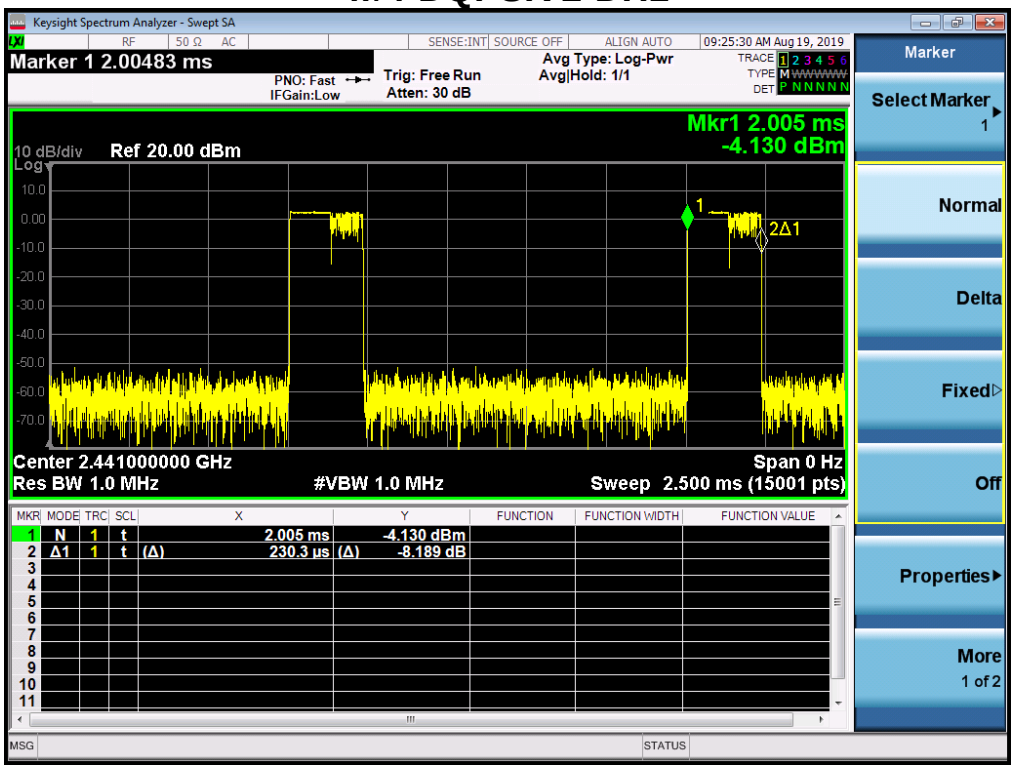
GFSK DH3



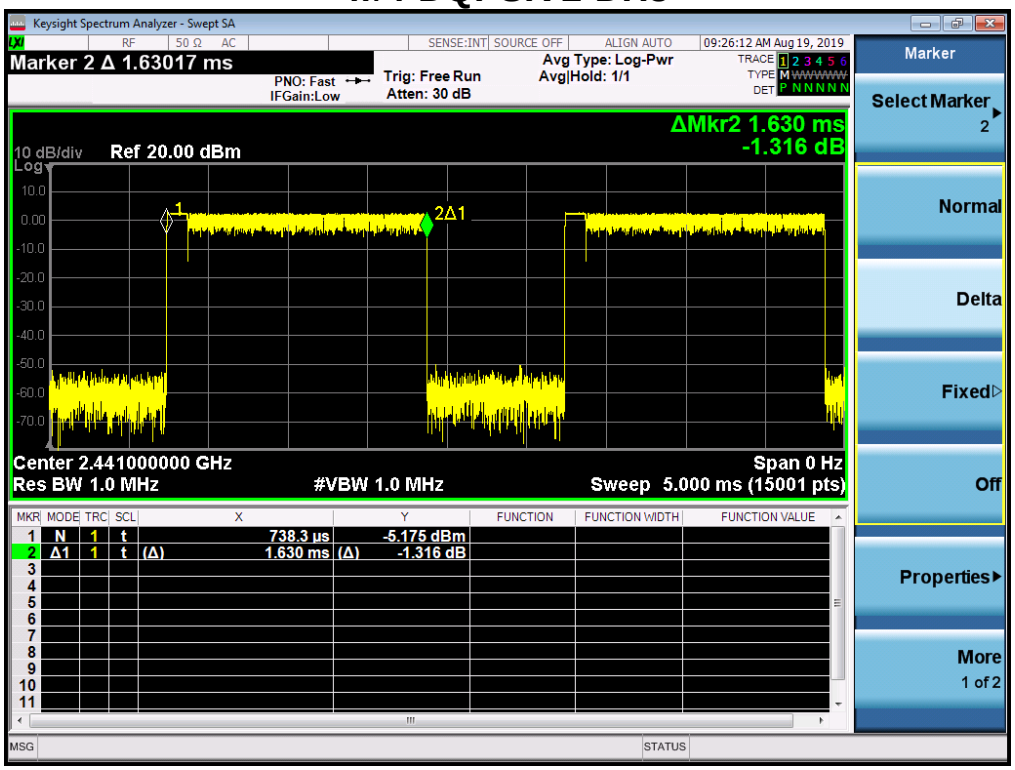
GFSK DH5



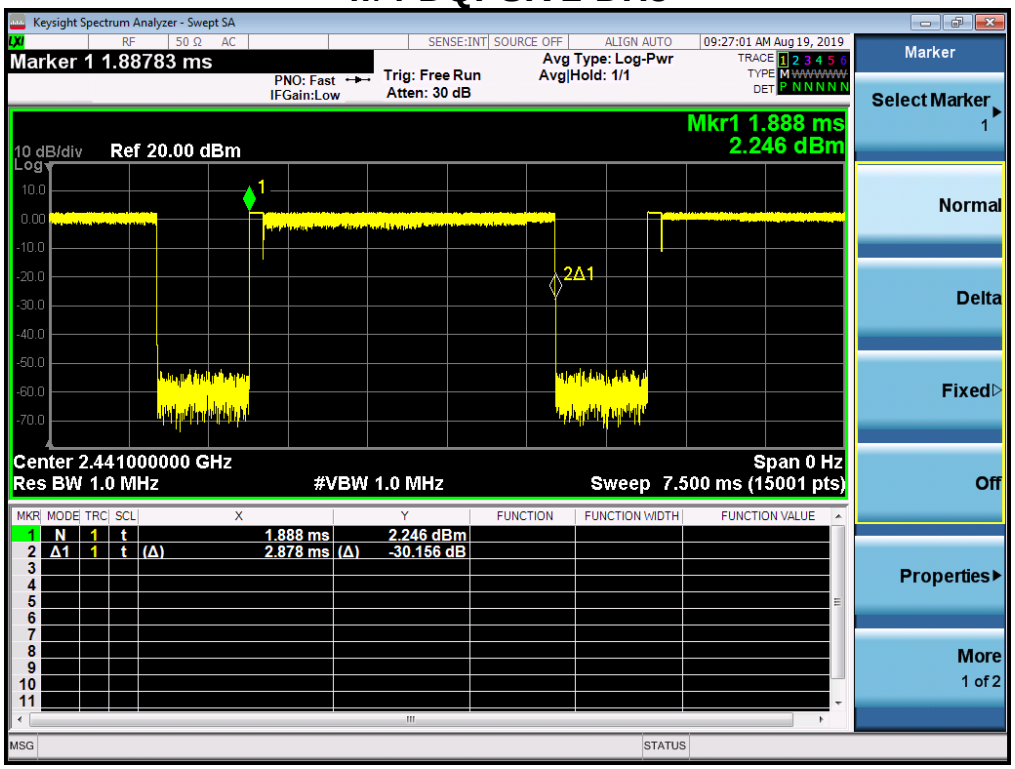
π/4-DQPSK 2-DH1



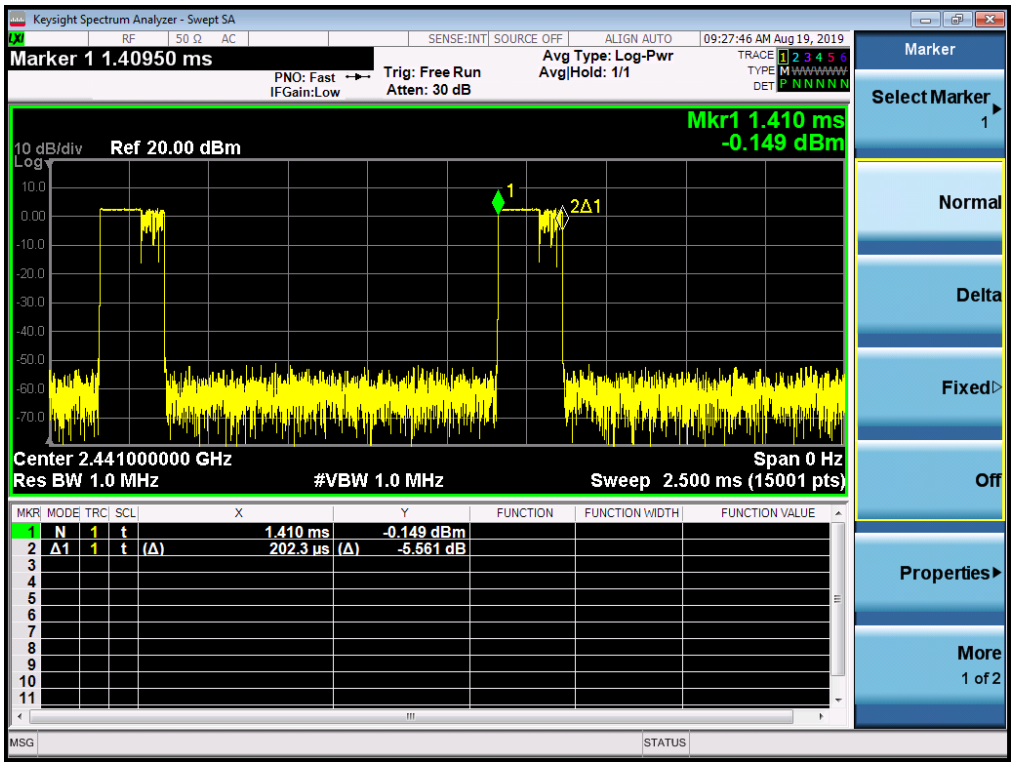
π/4-DQPSK 2-DH3



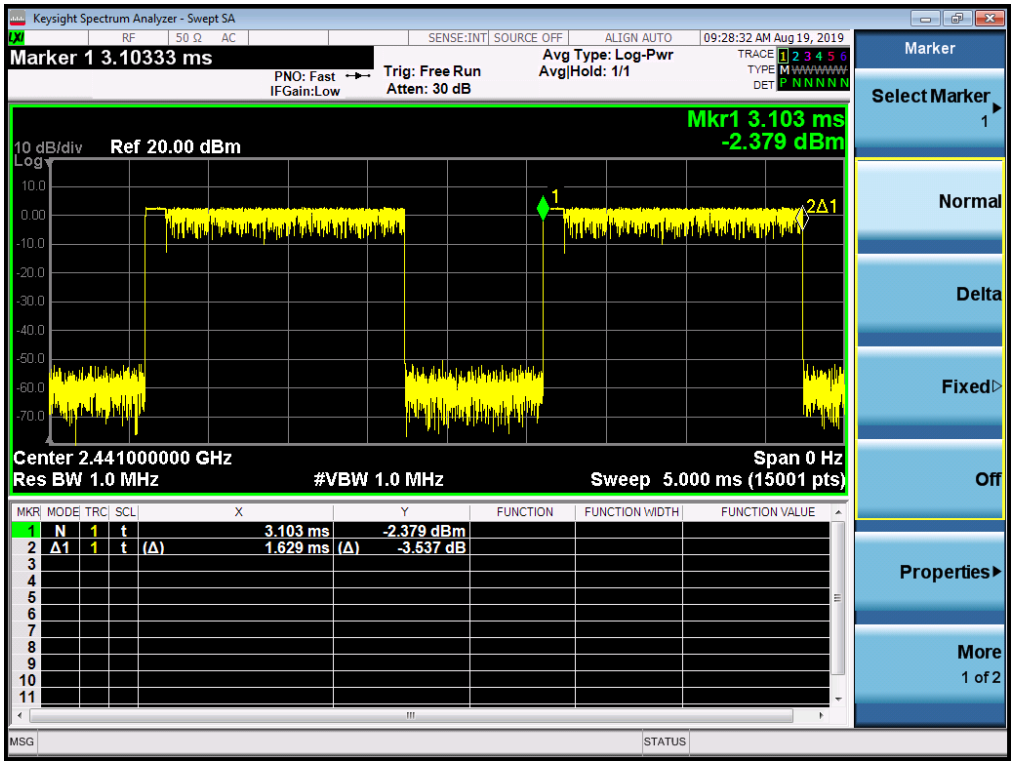
π/4-DQPSK 2-DH5



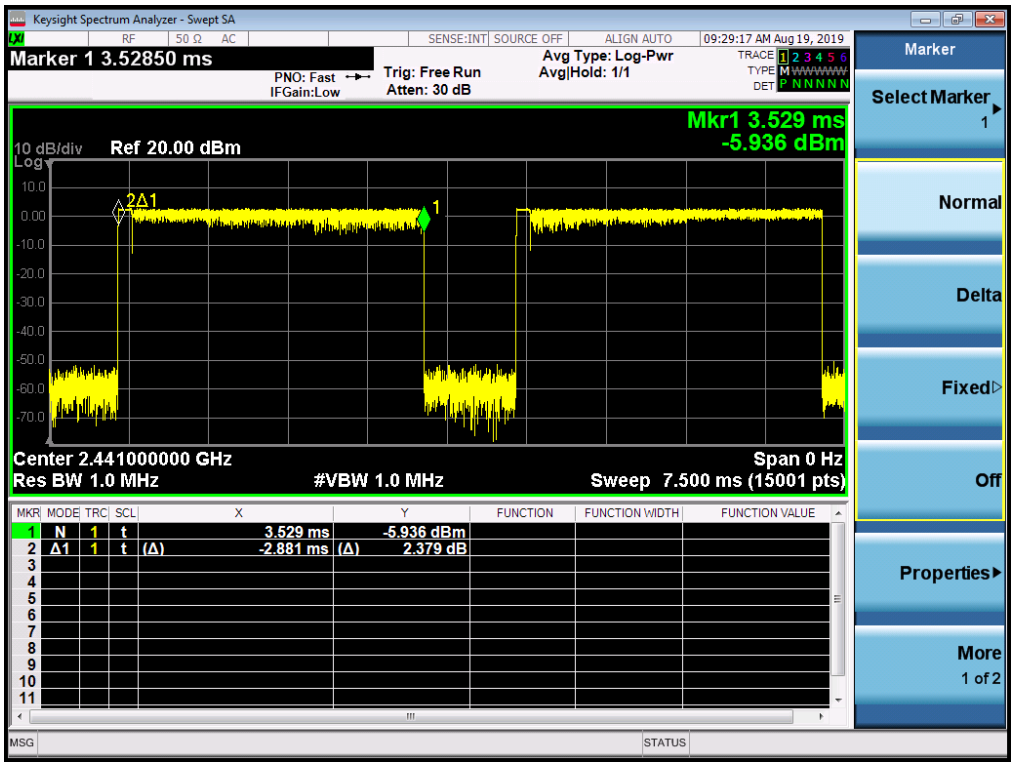
8DPSK 3-DH1



8DPSK 3-DH3



8DPSK 3-DH5


Keysight Spectrum Analyzer - Swept SA
Marker 1 3.52850 ms
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 1/1
09:29:17 AM Aug 19, 2019
Mkr1 3.529 ms
-5.936 dBm
10 dB/div
Ref 20.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 7.500 ms (15001 pts)
1 N 1 t 3.529 ms -5.936 dBm
2 Δ1 1 t (Δ) -2.881 ms (Δ) 2.379 dB
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2

9. MAXIMUM PEAK OUTPUT POWER

9.1 Measurement Procedure

Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(1):

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum. The analyzer was set for RBW > 20dB bandwidth and power was read directly in dBm. Cable loss was considered during this measurement.

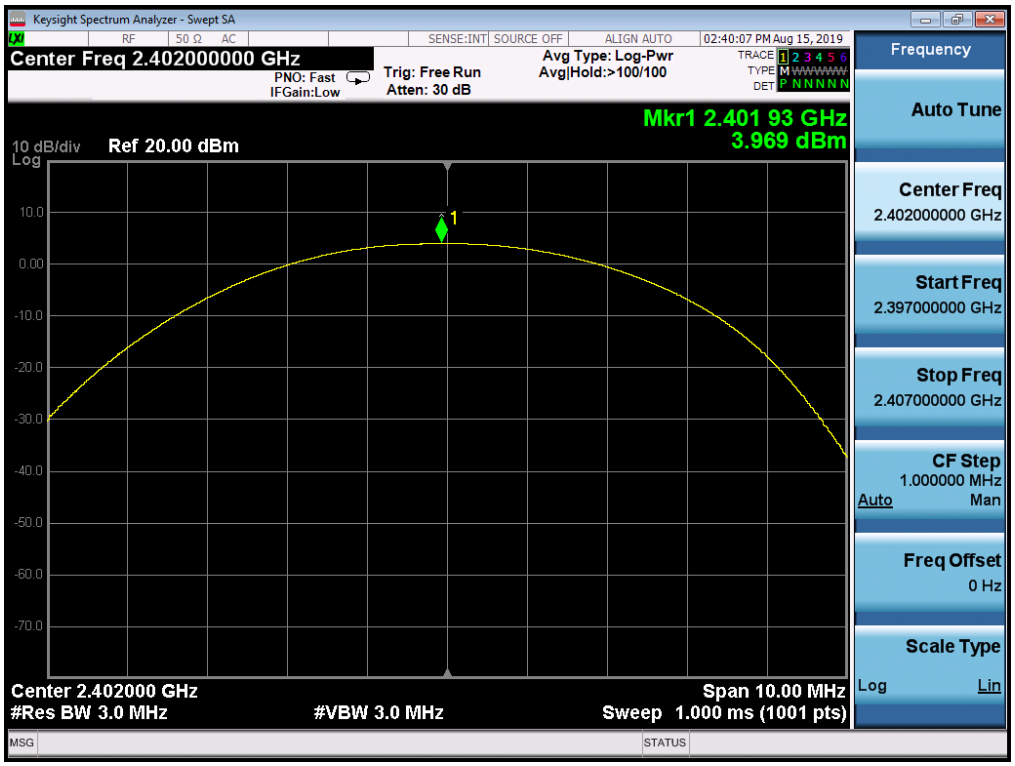
9.2 Measurement Results

Refer to attached data chart.

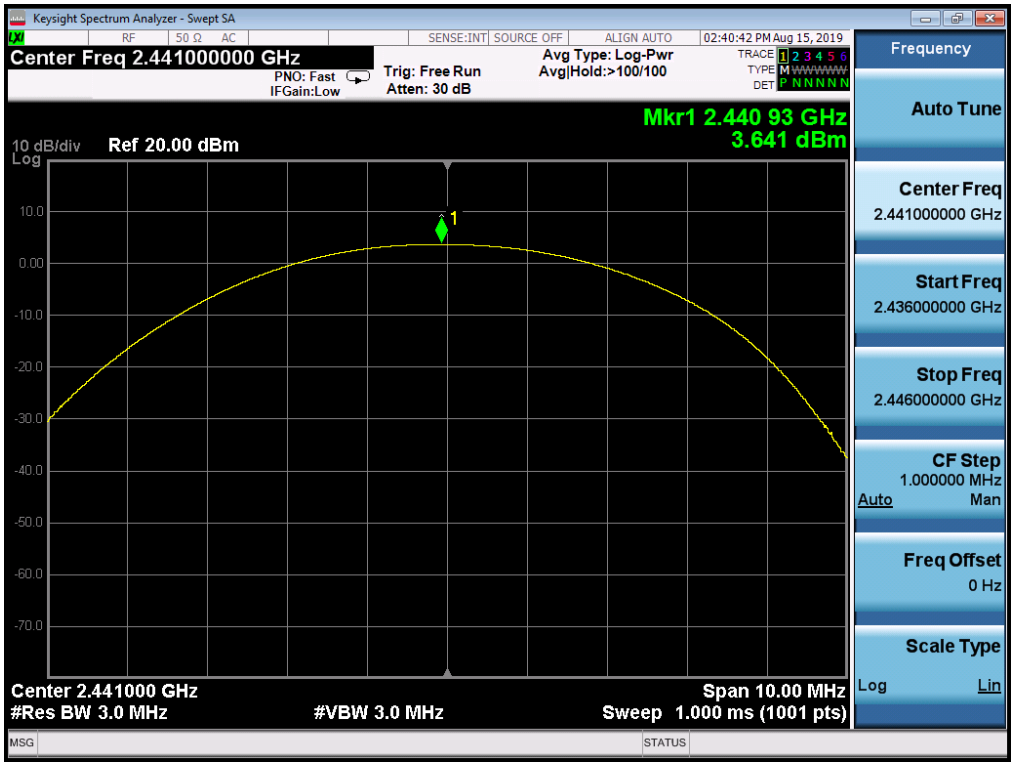
Modulation :	GFSK, π/4-DQPSK, 8DPSK		
RBW :	3MHz	VBW :	3MHz
Spectrum Detector:	PK	Test Date :	August 15, 2019
Test By:	Lee	Temperature :	22 ℃
Test Result:	PASS	Humidity :	53 %

Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(dBm)	Pass/Fail
GFSK				
2402.00	3.969	2.49402	21	PASS
2441.00	3.641	2.31260	21	PASS
2480.00	4.264	2.66932	21	PASS
π/4-DQPSK				
2402.00	3.032	2.01002	21	PASS
2441.00	2.766	1.89060	21	PASS
2480.00	3.068	2.02675	21	PASS
8DPSK				
2402.00	2.987	1.98930	21	PASS
2441.00	2.623	1.82936	21	PASS
2480.00	2.874	1.93821	21	PASS

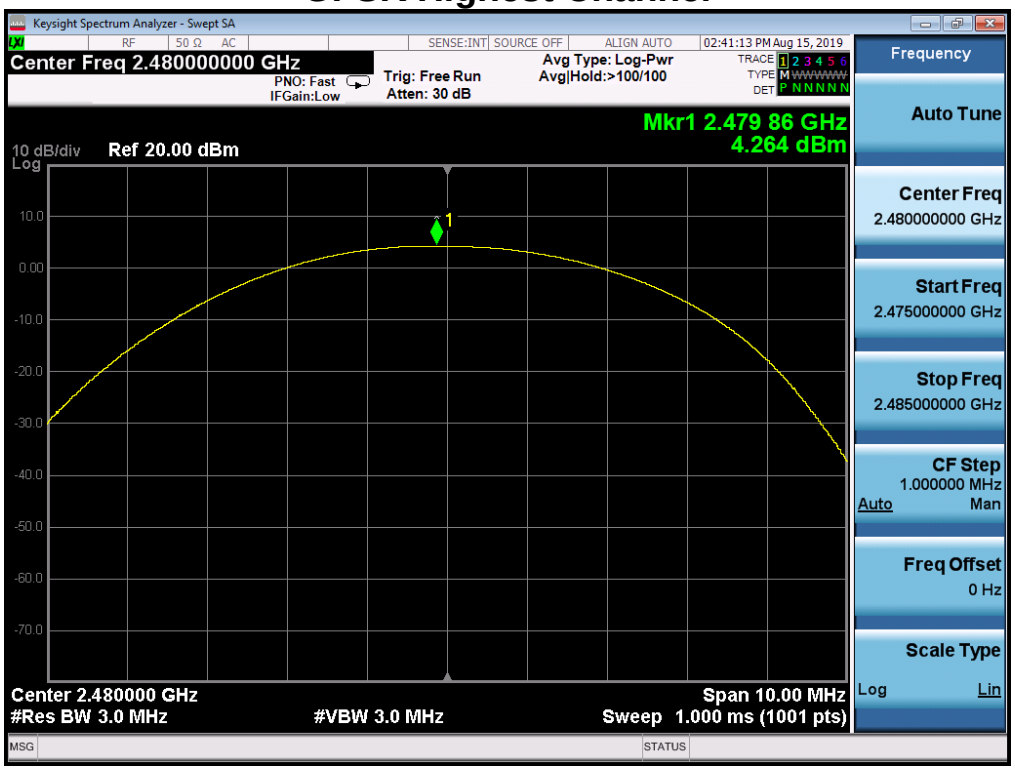
GFSK Lowest Channel



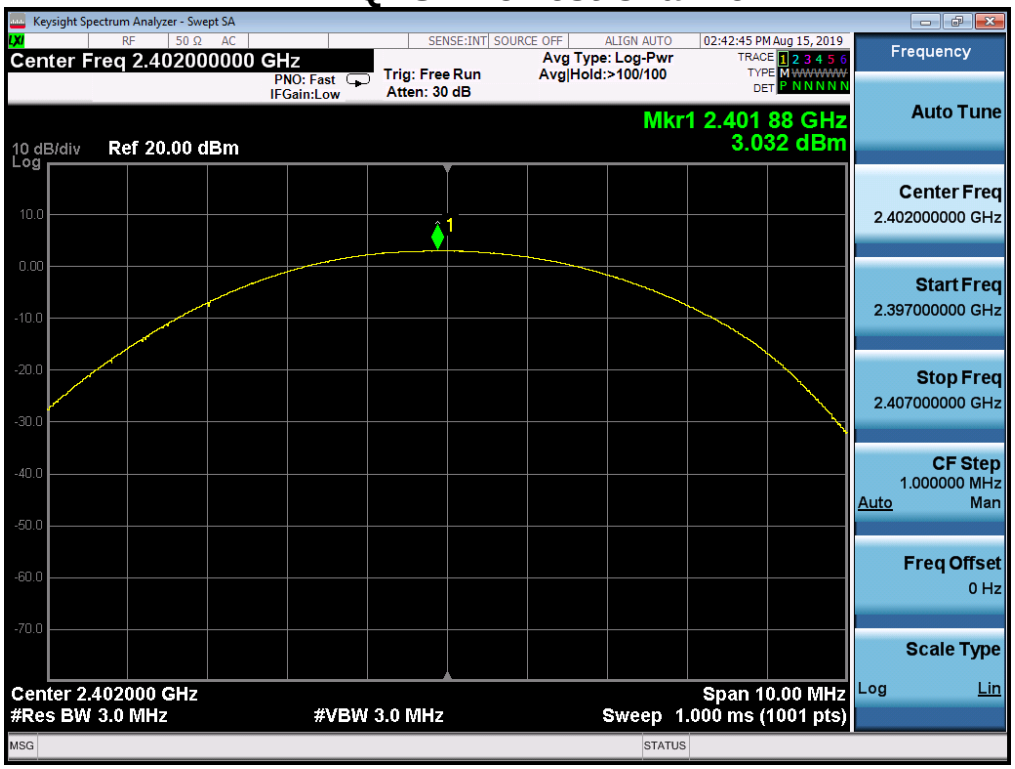
GFSK Middle Channel



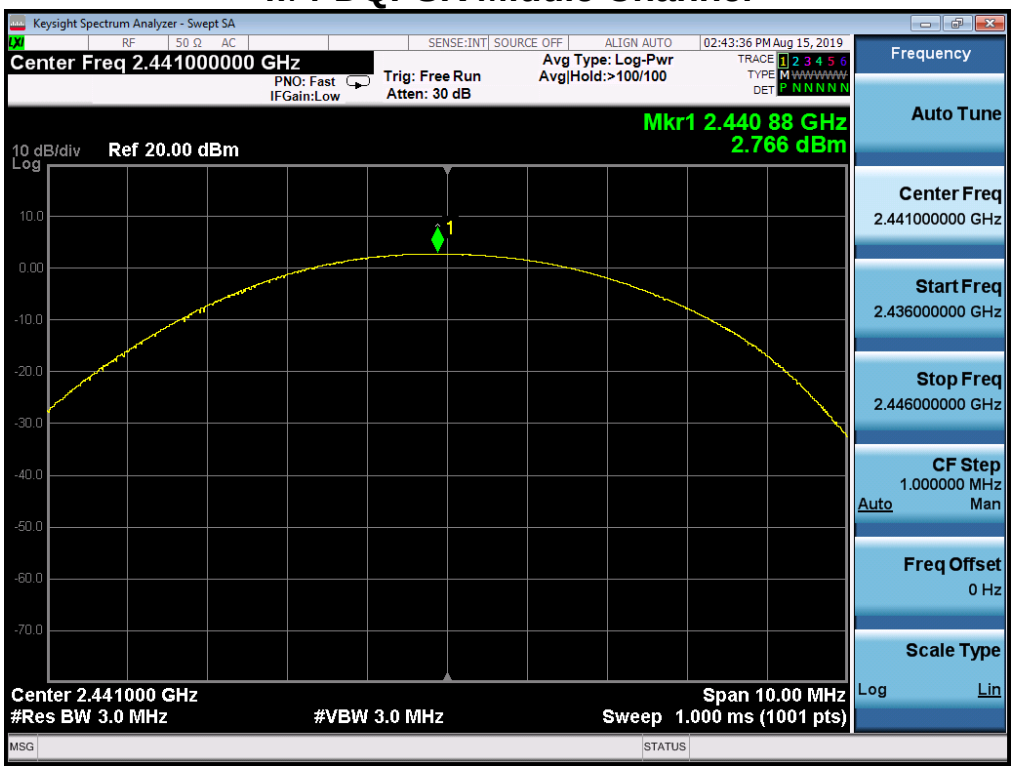
GFSK Highest Channel



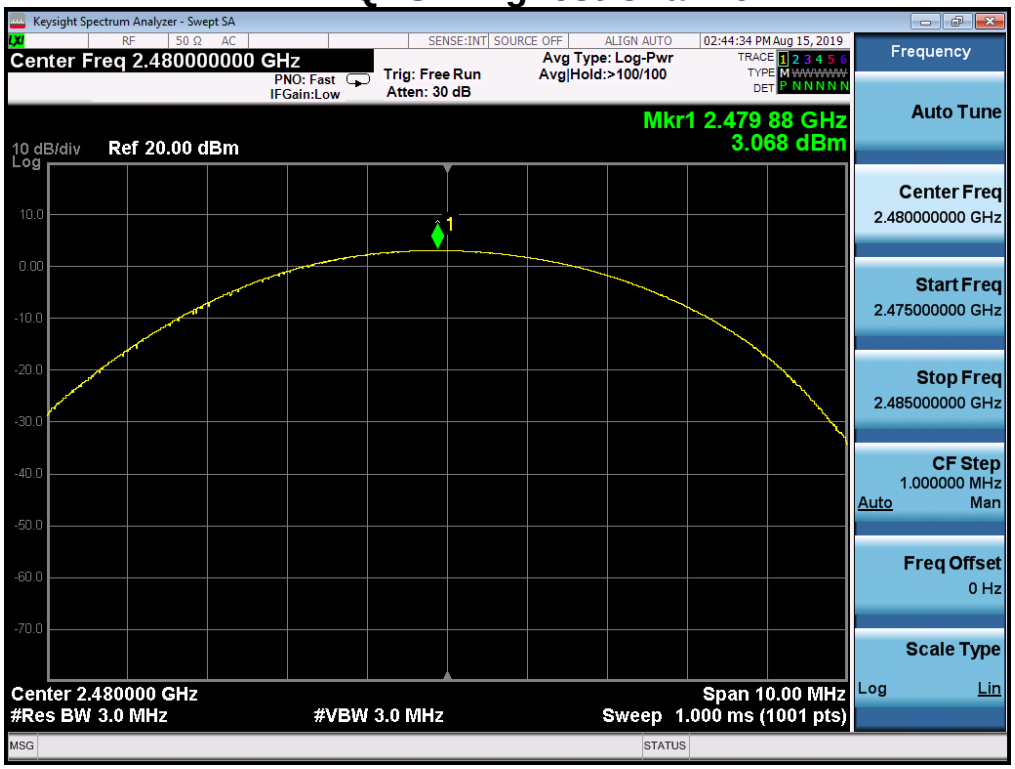
π/4-DQPSK Lowest Channel



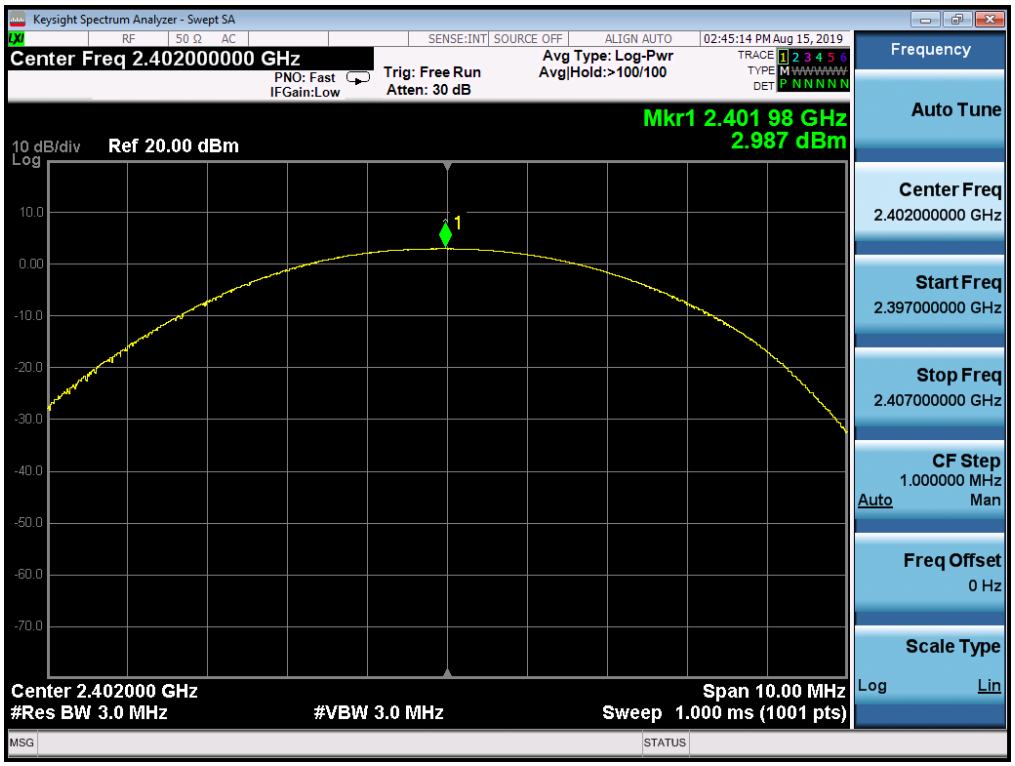
π/4-DQPSK Middle Channel



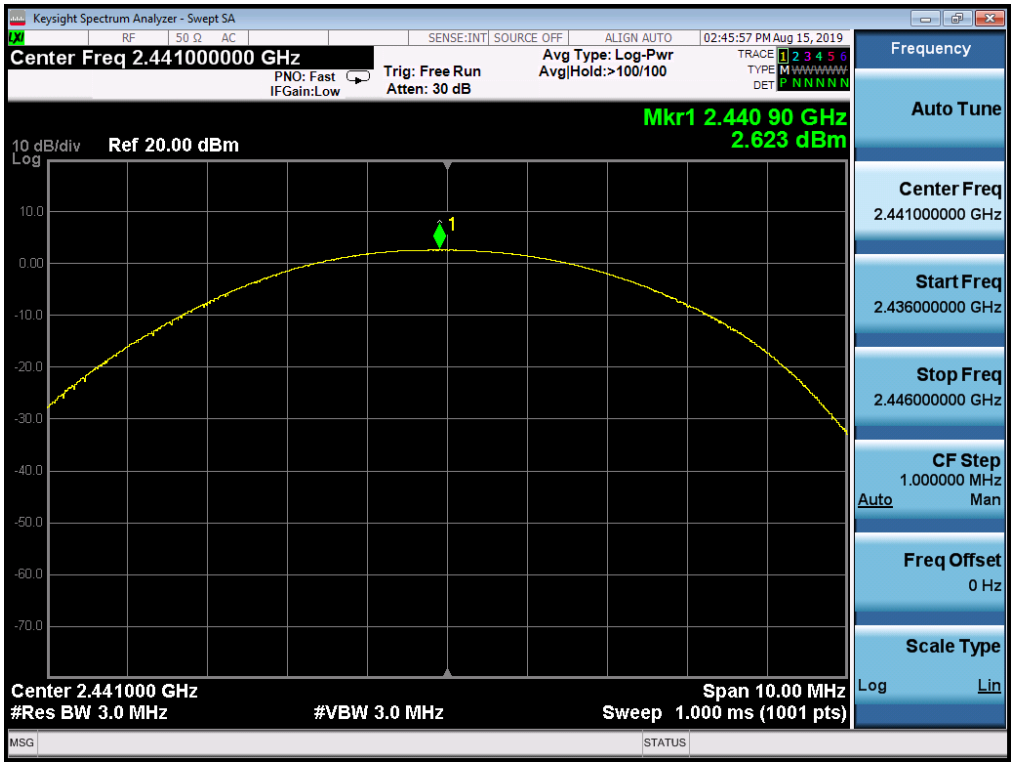
π/4-DQPSK Highest Channel



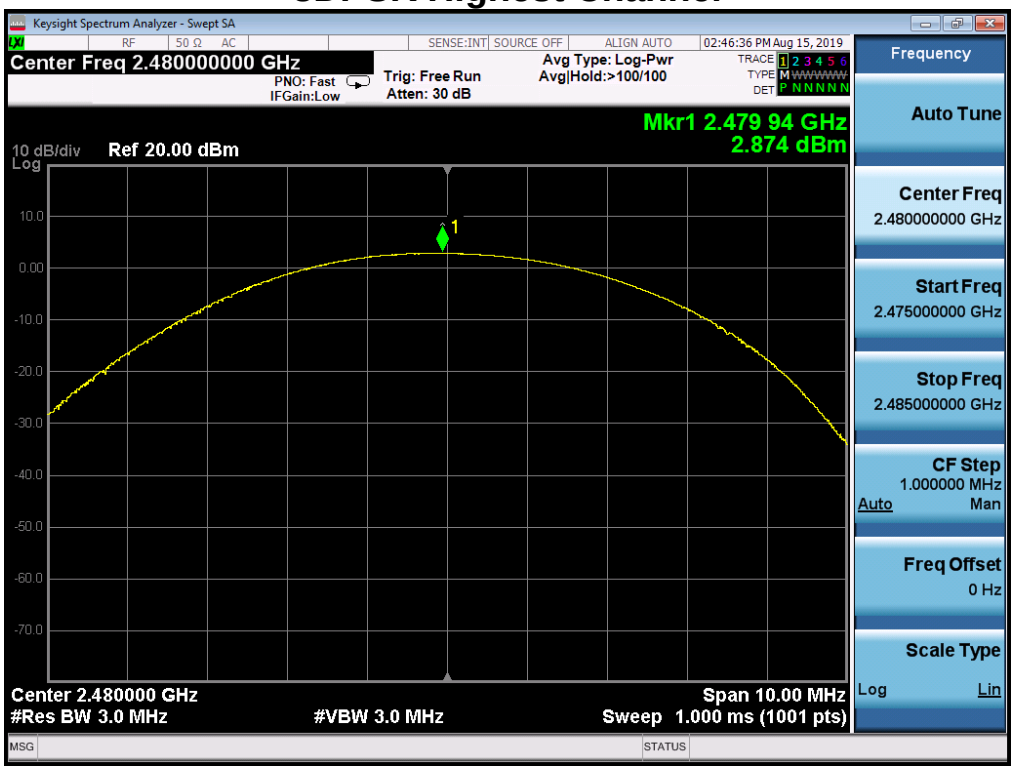
8DPSK Lowest Channel



8DPSK Middle Channel



8DPSK Highest Channel



10. Band Edge

10.1 Measurement Procedure

Out of Band Conducted Emissions, FCC Rule 15.247(d):

The transmitter output is connected to spectrum analyzer. The resolution bandwidth is set to100KHz, and the video bandwidth set to 300KHz.

10.2 Limit

15.247(d)In any 100KHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

10.3 Measurement Results

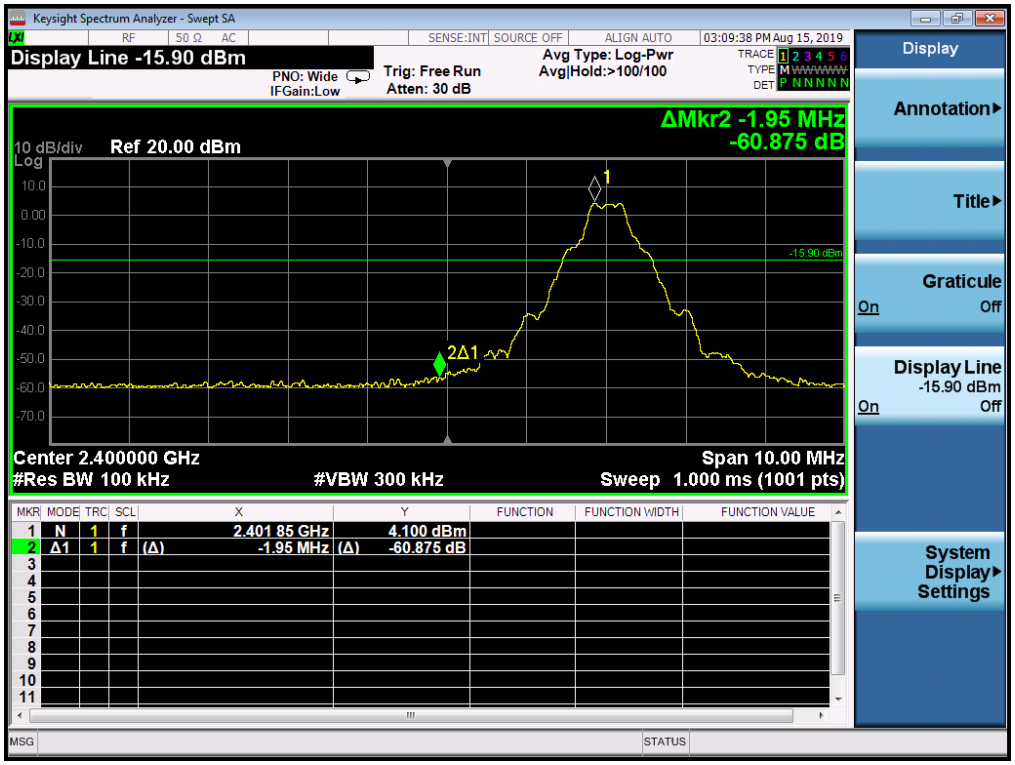
Please see below test table and plots.
For Radiated Emission
The worst case: GFSK
Hopping-on mode

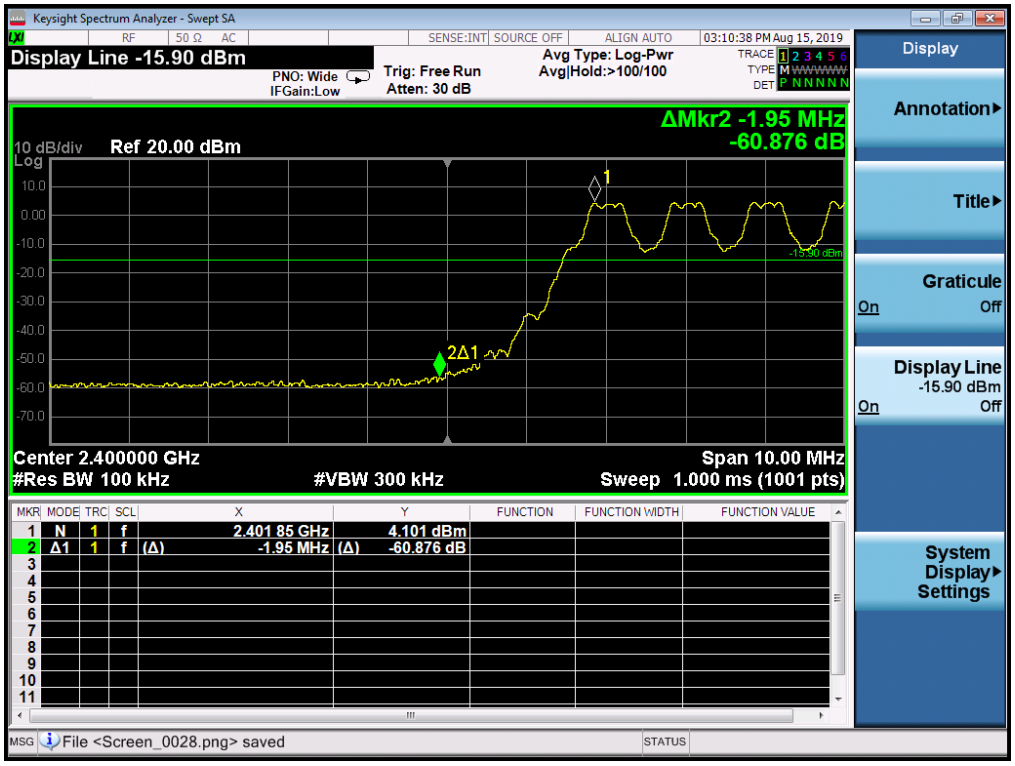
Freq. (MHz)	Ant.Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
2390.000	H	57.04	34.01	0.09	57.13	34.10	74.00	54.00	-16.87	-19.90
2390.000	V	52.87	32.69	0.09	52.96	32.78	74.00	54.00	-21.04	-21.22
2483.500	H	60.68	36.43	0.34	61.02	36.77	74.00	54.00	-12.98	-17.23
2483.500	V	61.54	37.34	0.34	61.88	37.68	74.00	54.00	-12.12	-16.32

Note: (1) Emission Level= Reading Level + Factor
(2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
(3) Horn antenna used for the emission over 1000MHz.

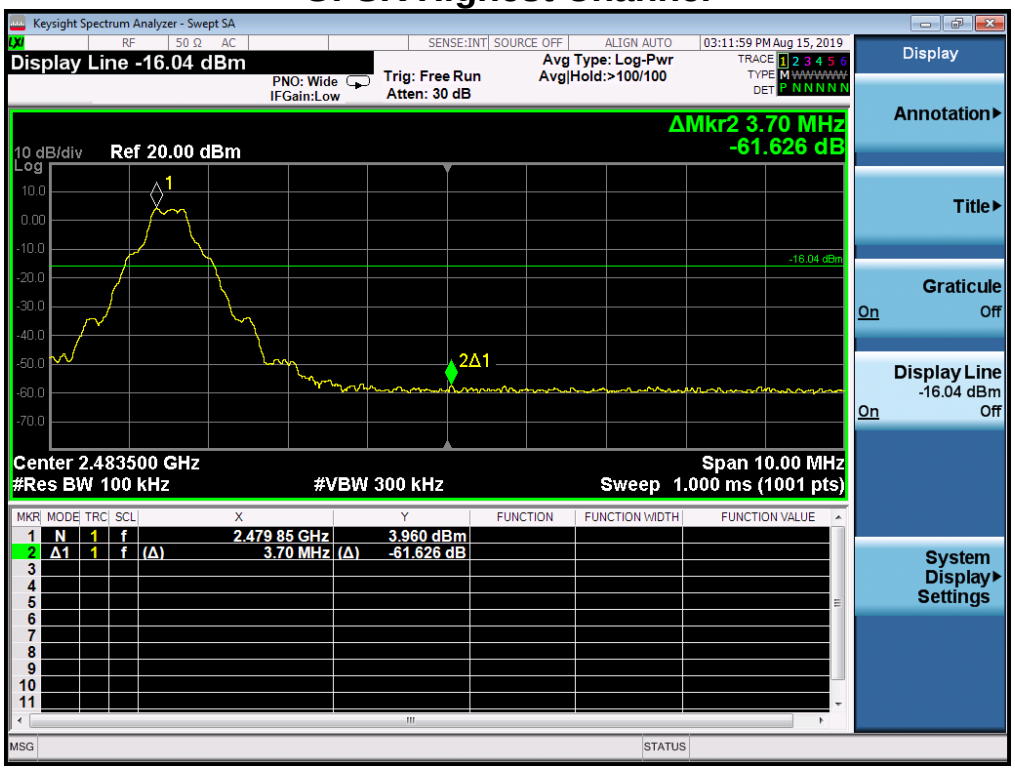
For RF Conducted

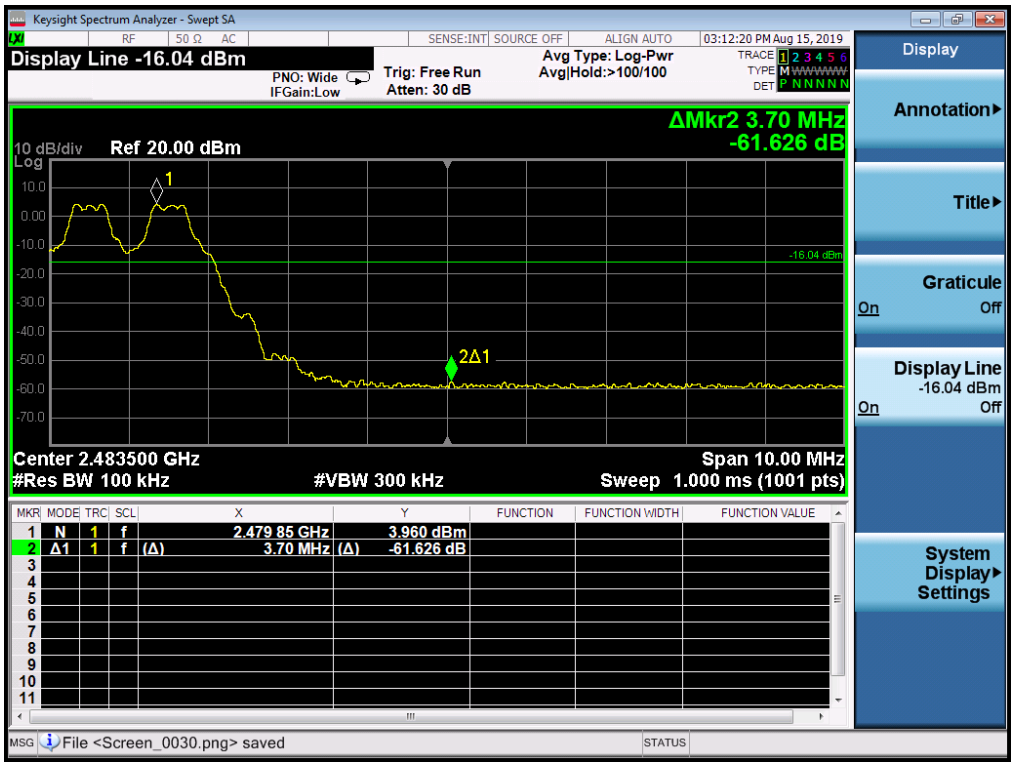
GFSK Lowest Channel





GFSK Highest Channel



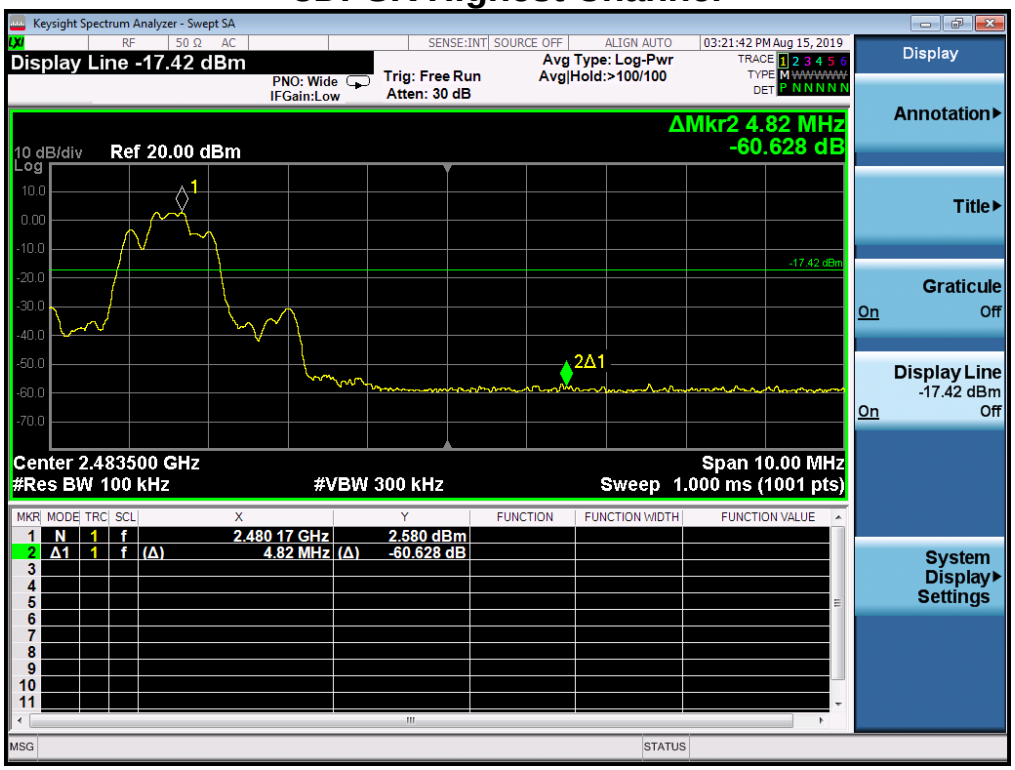


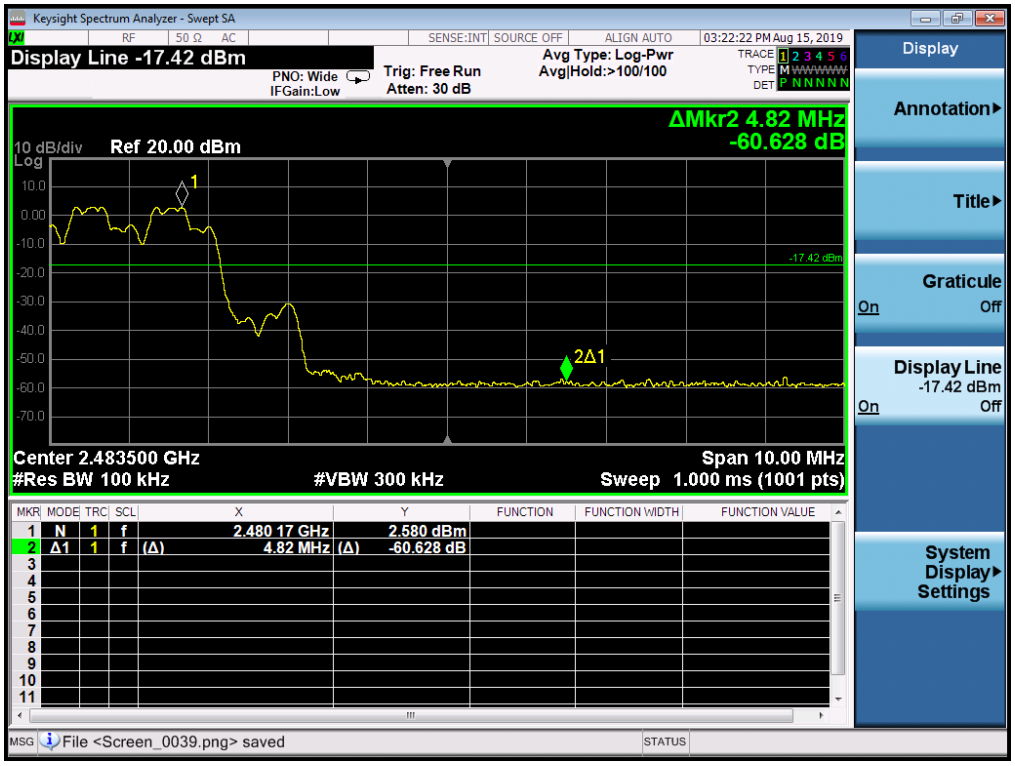
π/4-DQPSK Lowest Channel

π/4-DQPSK Highest Channel

8DPSK Lowest Channel

8DPSK Highest Channel





11. Antenna Application

11.1 Antenna requirement

According to of FCC part 15C section 15.203 and 15.240:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
Systems operating in the 2400-2483.5MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

11.2 Measurement Results

The antenna is PIFA antenna and no consideration of replacement, and the best case gain of the antenna is 2.5dBi. Therefore, the antenna is consider meet the requirement.

12. Conducted Spurious Emissions

12.1 Measurement Procedure

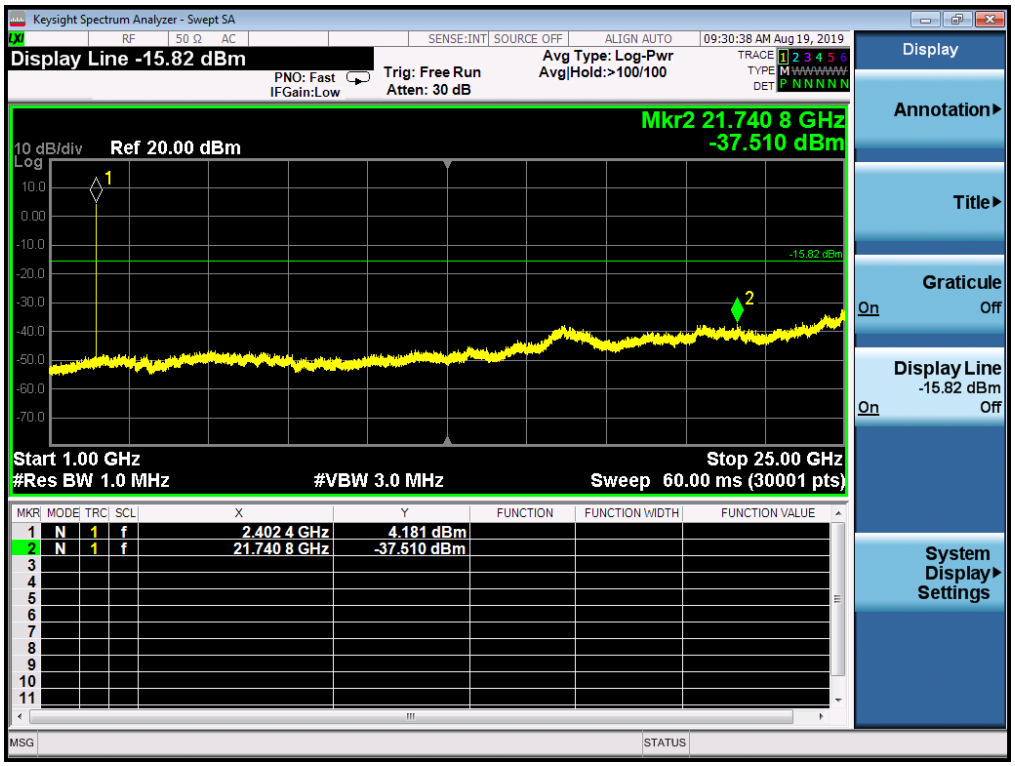
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

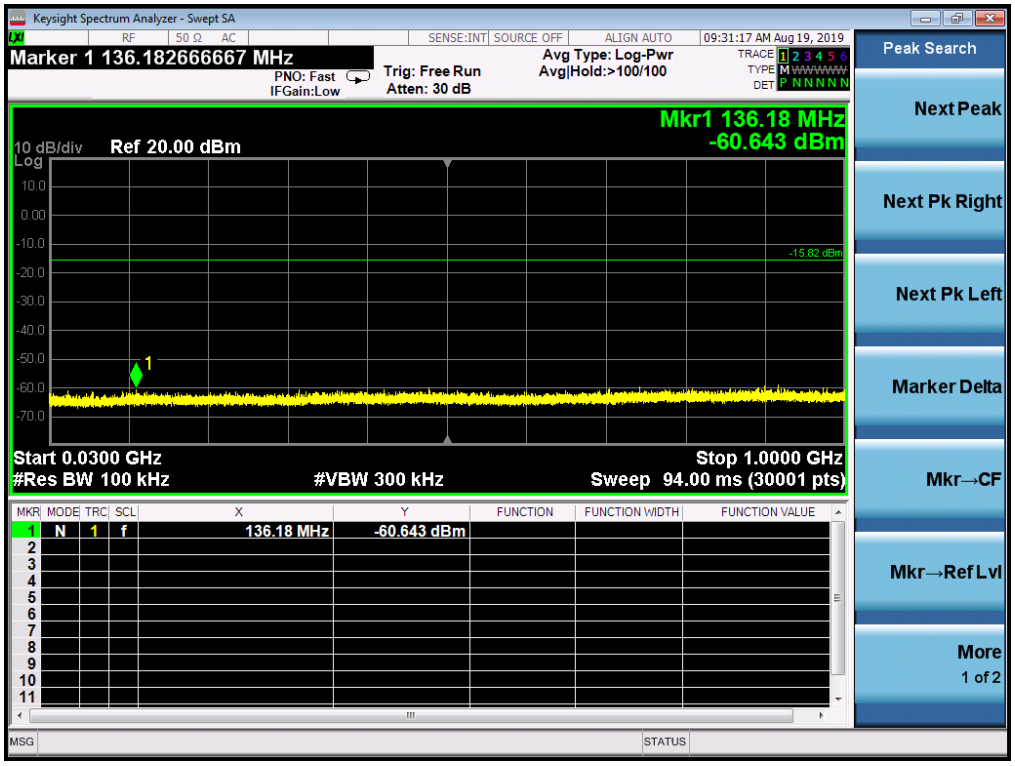
The transmitter output is connected to spectrum analyzer. All spurious emission and up tp the tenth harmonic was measured and they were found to be at least 20dB below the highest level of the desired power in the pass band.

12.2. Measurement Results

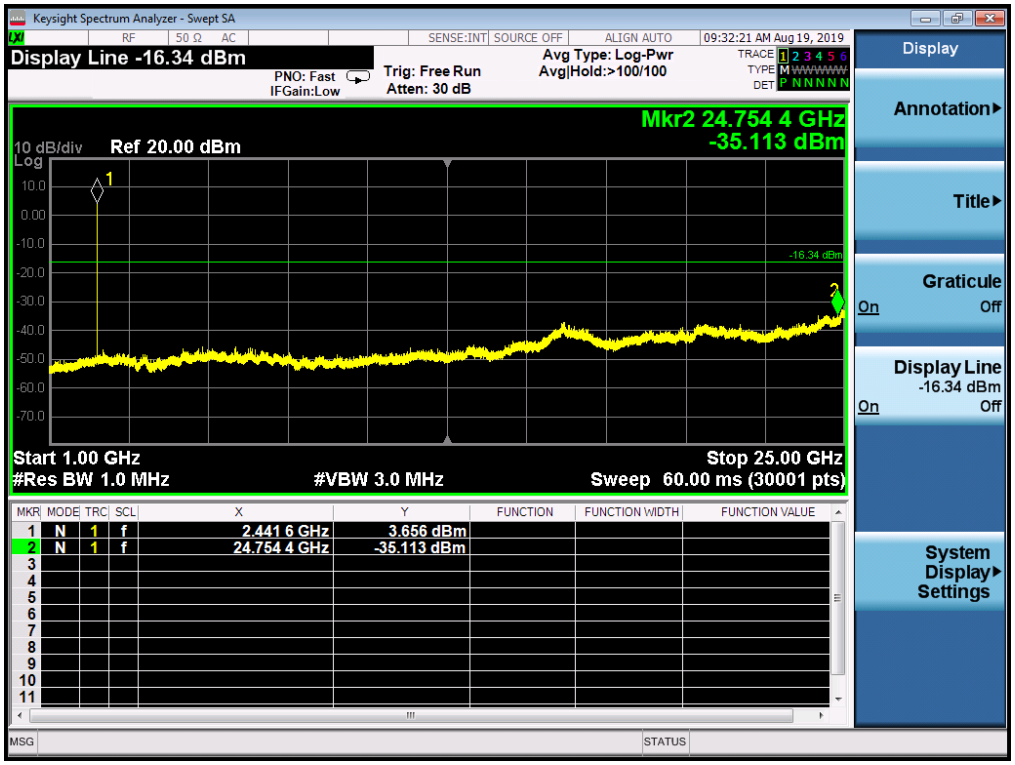
Please refer to following plots, the worst case (GFSK) was shown.

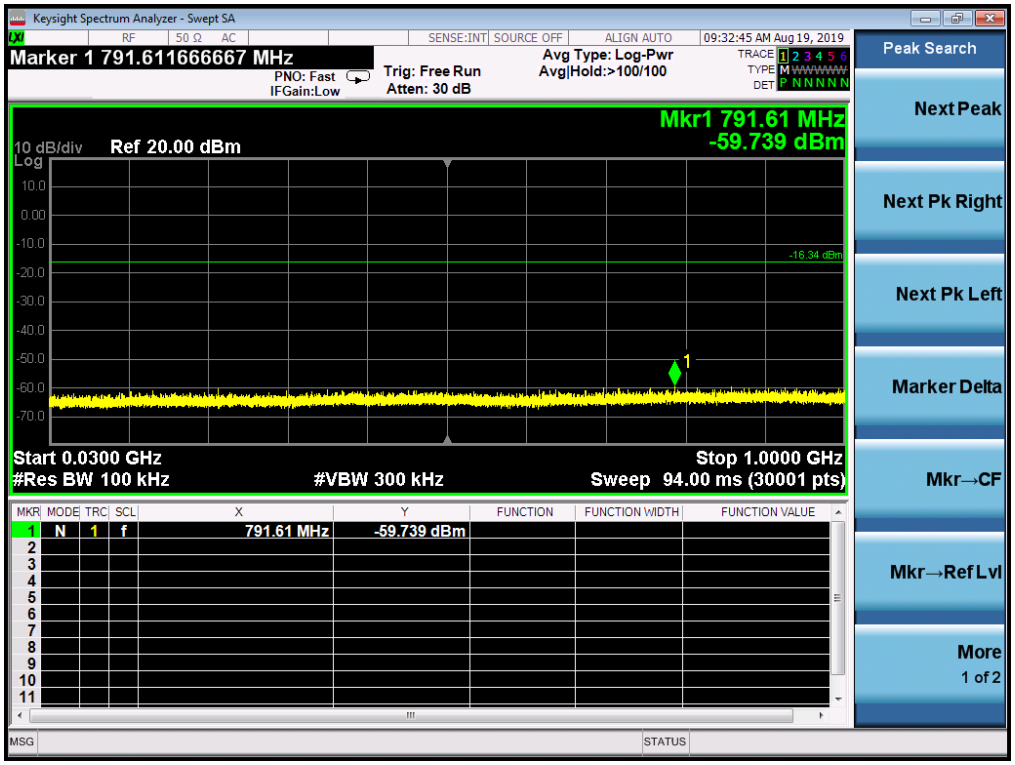
Lowest Channel



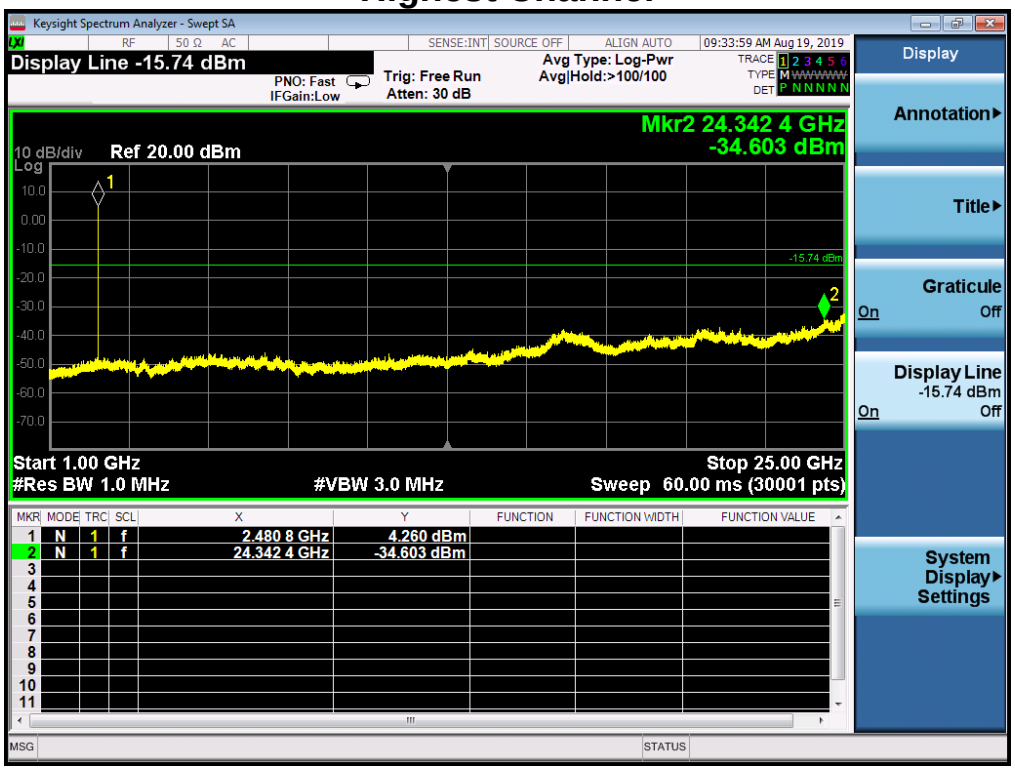


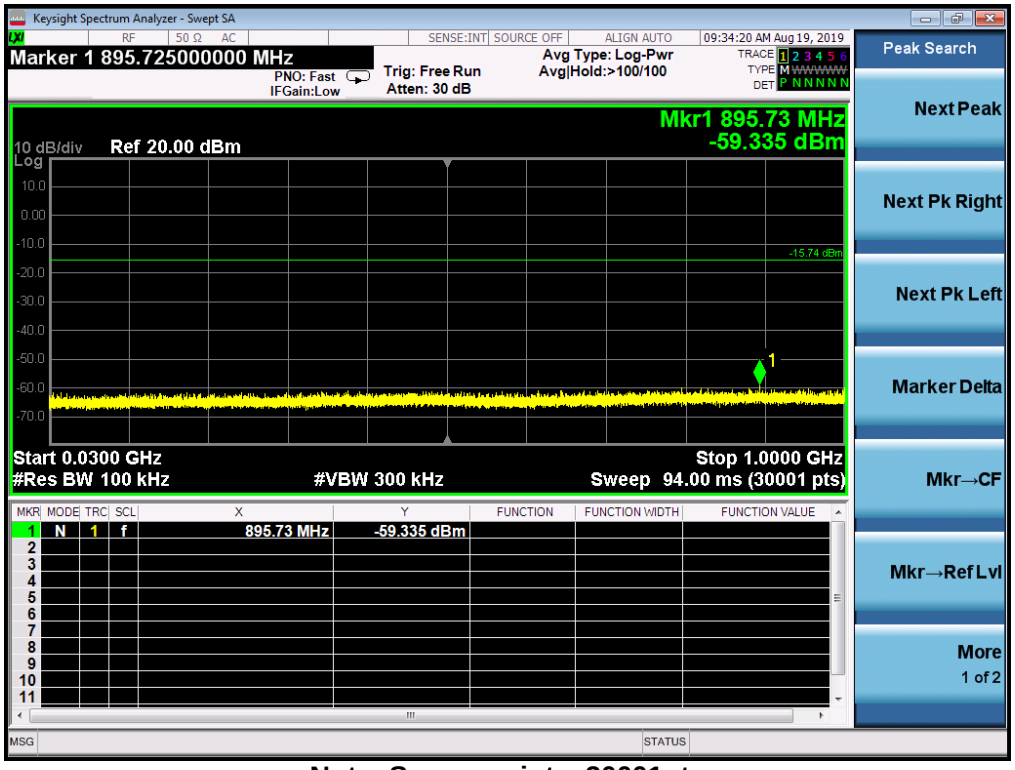
Middle Channel





Highest Channel





Note: Sweep points=30001pts

13. Test Equipment List

Description	Manufacturer	Model Number	Serial Number	Characteristics	Calibration Date	Calibration Due Date
Test Receiver	Rohde & Schwarz	ESCI7	100837	9KHz~7GHz	Mar. 14, 2019	1 year
Antenna	Schwarzbeck	VULB9162	9162-010	30MHz~7GHz	Mar. 23, 2019	1 year
Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	20Hz~26.5GHz	Mar. 14, 2019	1 year
Spectrum Analyzer	Keysight	N9020A	MY54200831	20Hz~26.5GHz	Apr. 24, 2019	1 year
Spectrum Analyzer	Rohde & Schwarz	FSV40	101003	10Hz~40GHz	Apr. 24, 2019	1 year
Horn Antenna	Schwarzbeck	BBHA9170	9170-372	15GHz~40GHz	Mar. 23, 2019	1 year
Pre-Amplifier	EMCI	EMC 184045	980102	18GHz~40GHz	Apr. 24, 2019	1 year
Power Sensor	DARE	RPR3006W	15I00041SNO64	100MHz~6GHz	Mar. 14, 2019	1 year
Communication Tester	Rohde & Schwarz	CMW500	149004	70MHz~6GHz	Mar. 14, 2019	1 year
Horn Antenna	COM-Power	AH-118	071078	500MHz~18GHz	Mar. 23, 2019	1 year
Pre-Amplifier	HP	HP 8449B	3008A00964	1GHz~26.5GHz	Mar. 14, 2019	1 year
Pre-Amplifier	HP	HP 8447D	1145A00203	100KHz~1.3GHz	Mar. 14, 2019	1 year
Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	9KHz~30MHz	Apr. 24, 2019	1 year
Temperature & Humidity Chamber	REMAFEE	SYHR225L	N/A	-40~150℃	Apr. 24, 2019	1 year
DC Source	MY	MY8811	N/A	0~30V	N/A	N/A
Temporary antenna connector	TESCOM	SS402	N/A	9KHz~25GHz	N/A	N/A
Power Meter	Anritsu	ML2495A	1139001	100k-65GHz	Apr. 24, 2019	1 year
Power Sensor	Anritsu	MA2411B	100345	300M-40GHz	Apr. 24, 2019	1 year
Test Software	EZ	EZ_EMC	N/A	N/A	N/A	N/A

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

---End---