

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 : Shenzhen Ground Enterprises Co., Ltd
Address : Room607, Building F, MingYueHuaDu, Gonghe, Industrial Rd, Xixiang, Bao An District, Shenzhen, China.
Manufacturer/ Factory : Shenzhen Ground Enterprises Co., Ltd
Address : Room607, Building F, MingYueHuaDu, Gonghe, Industrial Rd, Xixiang, Bao An District, Shenzhen, China.
E.U.T. : BLUETOOTH SPEAKER
Brand Name : N/A
Model No. : SP-001, SP3345-BKA
(For model difference refer to section 1)
FCC ID : 2AMD8SP-3345
Measurement Standard : FCC PART 15.247
Date of Receiver : May 08, 2019
Date of Test : May 09, 2019 to May 27, 2019
Date of Report : May 28, 2019

This Test Report is Issued Under the Authority of :

Prepared by


Lay Lei / Engineer

Approved by Authorized Signer


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.



Table of Contents

1. GENERAL INFORMATION	5
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST	5
1.2 RELATED SUBMITTAL(S) / GRANT (S).....	8
1.3 TEST METHODOLOGY.....	8
1.4 EQUIPMENT MODIFICATIONS	8
1.5 SUPPORT DEVICE	8
1.6 TEST FACILITY AND LOCATION	9
1.7 SUMMARY OF TEST RESULTS.....	10
2. SYSTEM TEST CONFIGURATION.....	11
2.1 EUT CONFIGURATION.....	11
2.2 SPECIAL ACCESSORIES.....	11
2.3 DESCRIPTION OF TEST MODES	11
2.4 EUT EXERCISE.....	11
3. CONDUCTED EMISSIONS TEST	12
3.1 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	12
3.2 TEST CONDITION	12
3.3 MEASUREMENT RESULTS.....	12
4. RADIATED EMISSION TEST.....	15
4.1 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	15
4.2 MEASUREMENT PROCEDURE	16
4.3 LIMIT.....	17
4.4 MEASUREMENT RESULTS.....	17
5. CHANNEL SEPARATION TEST.....	21
5.1 MEASUREMENT PROCEDURE	21
5.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	21
5.3 MEASUREMENT RESULTS.....	21
6. 20DB BANDWIDTH.....	25
6.1 MEASUREMENT PROCEDURE	25
6.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	25
6.3 MEASUREMENT RESULTS.....	25
7. HOPPING CHANNEL NUMBER	29
7.1 MEASUREMENT PROCEDURE	29
7.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	29
7.3 MEASUREMENT RESULTS.....	29



8. TIME OF OCCUPANCY (DWELL TIME)	31
8.1 MEASUREMENT PROCEDURE	31
8.2 MEASUREMENT RESULTS.....	31
9. MAXIMUM PEAK OUTPUT POWER	35
9.1 MEASUREMENT PROCEDURE	35
9.2 MEASUREMENT RESULTS.....	35
10. BAND EDGE	39
10.1 MEASUREMENT PROCEDURE	39
10.2 LIMIT.....	39
10.3 MEASUREMENT RESULTS.....	39
11. ANTENNA APPLICATION	44
11.1 ANTENNA REQUIREMENT	44
11.2 MEASUREMENT RESULTS.....	44
12. CONDUCTED SPURIOUS EMISSIONS	45
12.1 MEASUREMENT PROCEDURE	45
12.2 MEASUREMENT RESULTS.....	45
12. TEST EQUIPMENT LIST	49

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test

E.U.T.	:	BLUETOOTH SPEAKER
Main model number	:	SP-001
Additional Model number	:	SP3345-BKA
Brand Name	:	N/A
Rating	:	DC 5V(From Micro USB port) DC 3.7V(From internal battery)
Adapter	:	N/A
Test Voltage	:	AC 120V/60Hz(From adapter) DC 3.7V(From internal battery)
Model Difference Description	:	Both of models have the same circuit schematic, construction, PCB Layout and critical components. Their difference in model number for due to trading purpose.
Remark	:	According to the model difference, all tests were performed on model SP-001.
HW	:	V1.0
SW	:	V1.0
Note	:	N/A

Technical Specification:

Bluetooth Version : V4.2+EDR
Frequency : 2402-2480MHz
Modulation : GFSK, $\pi/4$ -DQPSK
Number of Channel : 79
Channel space : 1MHz
Antenna Type : PCB
Antenna Gain : 0dBi (Declaration by manufacturer)
Data Rate : 1Mbps for GFSK, 2Mbps for $\pi/4$ -DQPSK

BT 4.2 Channel List

Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	39	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	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
0	2402
39	2441
78	2480

Test SW version	FCCAssist_2.4
------------------------	----------------------

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **2AMD8SP-3345** filing to comply with Section 15.247 of the FCC Part 15 (2017), 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

Notebook PC	: Manufacturer: IBM Corporation M/N: R50e S/N: L3-HZNGO P/N: 1834KDC
Adapter (From Notebook)	: Manufacturer: IBM Corporation M/N: 08K8210 Input: AC100-240V 50/60Hz 0.5-1.0A Output: DC 16V 4.5A
Adapter	: Manufacturer: HUWEI Model No.: HW-050200C01 Input: AC100-240V 50/60Hz, 0.5A Output: DC5V 2A



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	$\pm 1.42 \times 10^{-4}\%$	Compliant
§15.247(a)(1)	20dB Bandwidth	$\pm 1.42 \times 10^{-4}\%$	Compliant
§15.247(a)(1)(iii)	Hopping Channel Number	$\pm 1.42 \times 10^{-4}\%$	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	$\pm 5\%$	Compliant
§15.247(b)	Max Peak output Power test	$\pm 1.06\text{dB}$	Compliant
§15.247(d)	Band edge test	$\pm 1.70\text{dB}$	Compliant
§15.207 (a)	AC Power Conducted Emission	$\pm 1.06\text{dB}$	Compliant
§15.247(d), §15.209, §15.205	Radiated Emission	$\pm 3.70\text{dB}$	Compliant
§15.203	Antenna Requirement	---	Compliant
§15.247(d)	Conducted Spurious Emission	$\pm 2.51\text{dB}$	Compliant

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

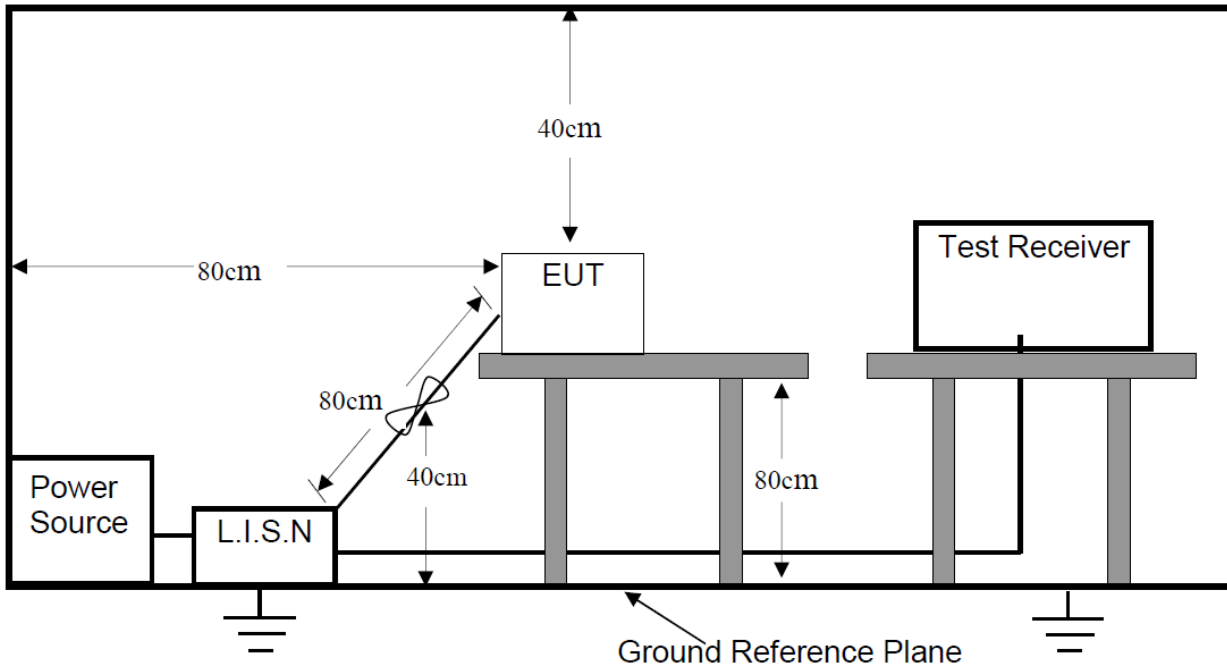
The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and normal mode is programmed. The Lowest, middle and highest channel were chosen for testing, and all packets DH1, DH3, DH5, 2-DH1, 2-DH3, and 2-DH5 mode in all modulation type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

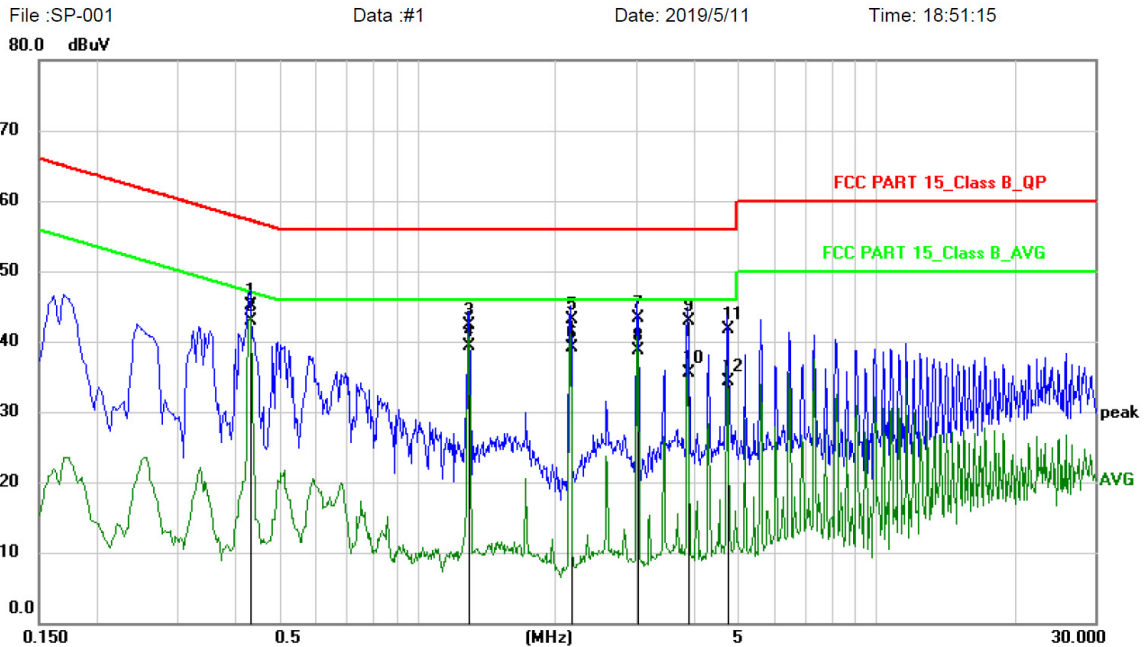
3.3 Measurement Results

Please refer to following plots of the worst case:
Charging+TX($\pi/4$ -DQPSK Low Channel)



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Conducted Emission Measurement



Site: Phase: **L1** Temperature: 26
 Limit: FCC PART 15_Class B_QP Power: AC120V/60Hz Humidity: 50 %
 EUT: BLUETOOTH SPEAKER
 M/N: SP-001
 Mode: Charging+TX
 Note: $\pi/4$ -DQPSK Low Channel

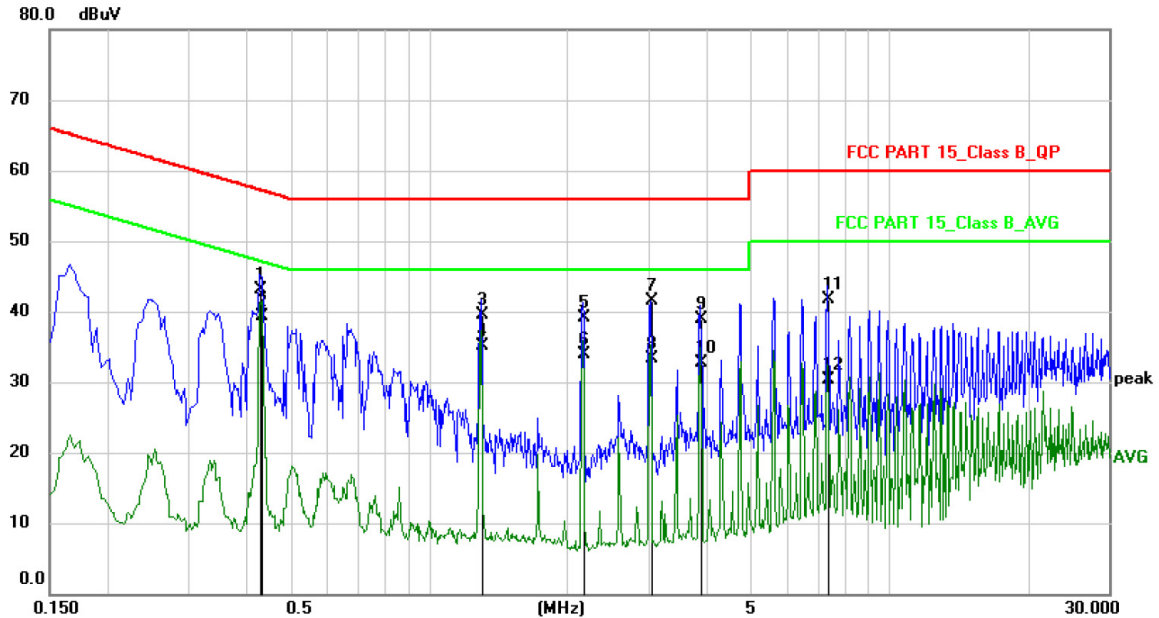
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.4340	34.48	10.62	45.10	57.18	-12.08	QP	
2	*	0.4340	32.38	10.62	43.00	47.18	-4.18	AVG	
3		1.2940	31.65	10.65	42.30	56.00	-13.70	QP	
4		1.2940	28.75	10.65	39.40	46.00	-6.60	AVG	
5		2.1580	32.45	10.65	43.10	56.00	-12.90	QP	
6		2.1580	28.45	10.65	39.10	46.00	-6.90	AVG	
7		3.0220	32.65	10.65	43.30	56.00	-12.70	QP	
8		3.0220	28.05	10.65	38.70	46.00	-7.30	AVG	
9		3.8860	32.24	10.66	42.90	56.00	-13.10	QP	
10		3.8860	24.84	10.66	35.50	46.00	-10.50	AVG	
11		4.7458	31.04	10.66	41.70	56.00	-14.30	QP	
12		4.7458	23.74	10.66	34.40	46.00	-11.60	AVG	



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Conducted Emission Measurement

File :SP-001 Data :#2 Date: 2019/5/11 Time: 18:59:25



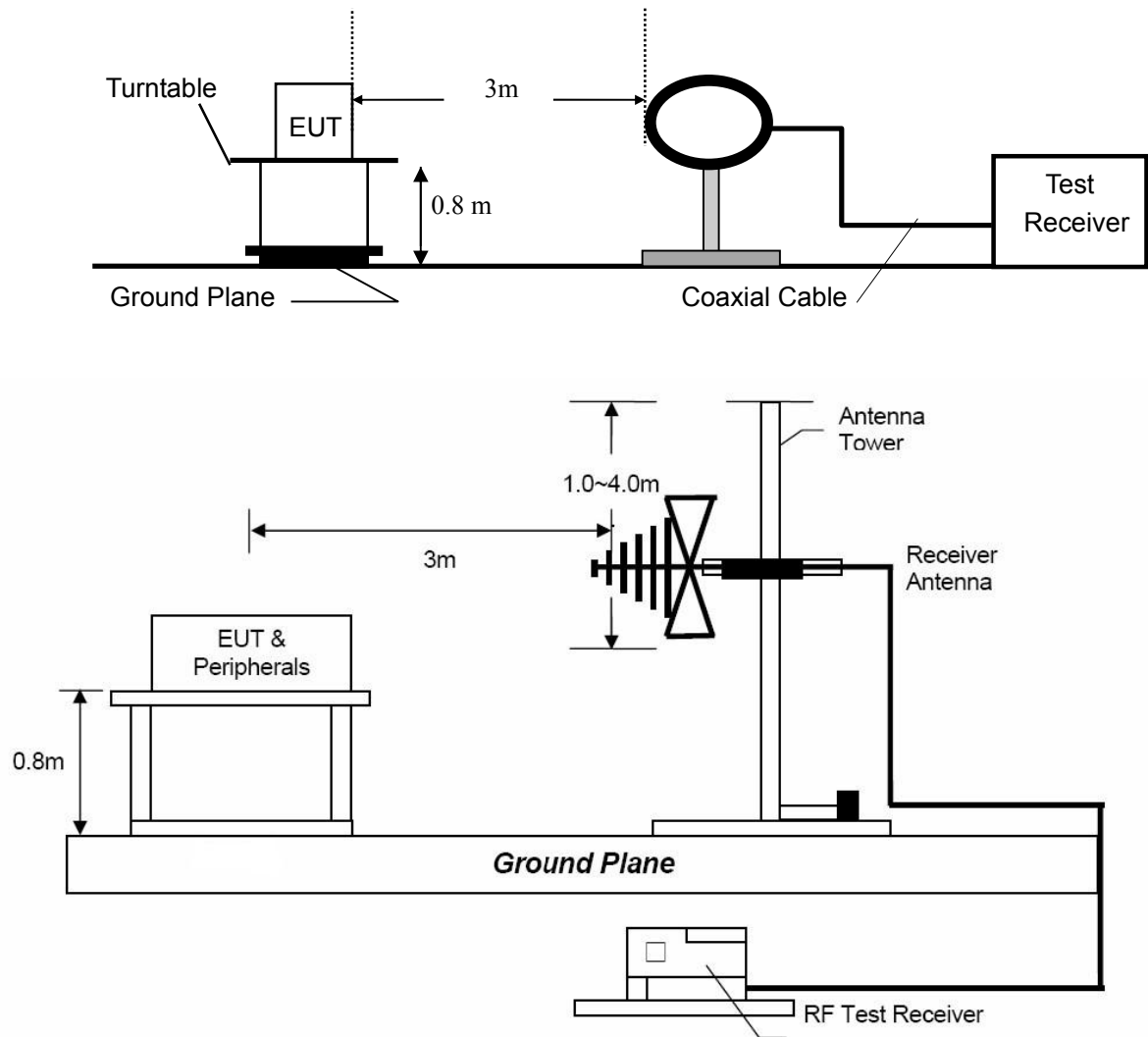
Site: Phase: **N** Temperature: 26
 Limit: FCC PART 15_Class B_QP Power: AC120V/60Hz Humidity: 50 %
 EUT: BLUETOOTH SPEAKER
 M/N: SP-001
 Mode: Charging+TX
 Note: $\pi/4$ -DQPSK Low Channel

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.4300	32.58	10.62	43.20	57.25	-14.05	QP	
2	*	0.4340	28.78	10.62	39.40	47.18	-7.78	AVG	
3		1.2980	28.95	10.65	39.60	56.00	-16.40	QP	
4		1.2980	24.55	10.65	35.20	46.00	-10.80	AVG	
5		2.1619	28.55	10.65	39.20	56.00	-16.80	QP	
6		2.1619	23.35	10.65	34.00	46.00	-12.00	AVG	
7		3.0260	30.83	10.65	41.48	56.00	-14.52	QP	
8		3.0260	22.75	10.65	33.40	46.00	-12.60	AVG	
9		3.8940	28.34	10.66	39.00	56.00	-17.00	QP	
10		3.8940	22.14	10.66	32.80	46.00	-13.20	AVG	
11		7.3539	31.14	10.66	41.80	60.00	-18.20	QP	
12		7.3539	19.74	10.66	30.40	50.00	-19.60	AVG	

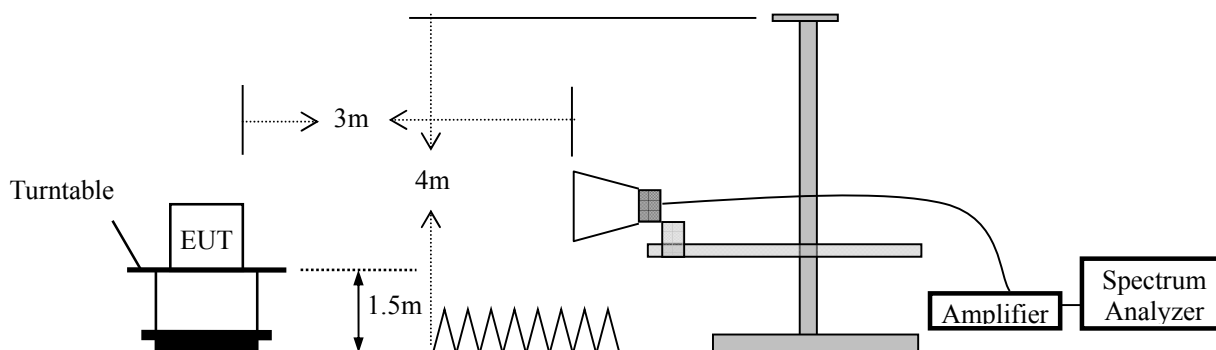
4. Radiated Emission Test

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)
		$\mu\text{V/m}$
0.009 ~ 0.490	300	$2400/F(\text{kHz})$
0.490 ~ 1.705	30	$24000/F(\text{kHz})$
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 $\mu\text{V/m}$
 - (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

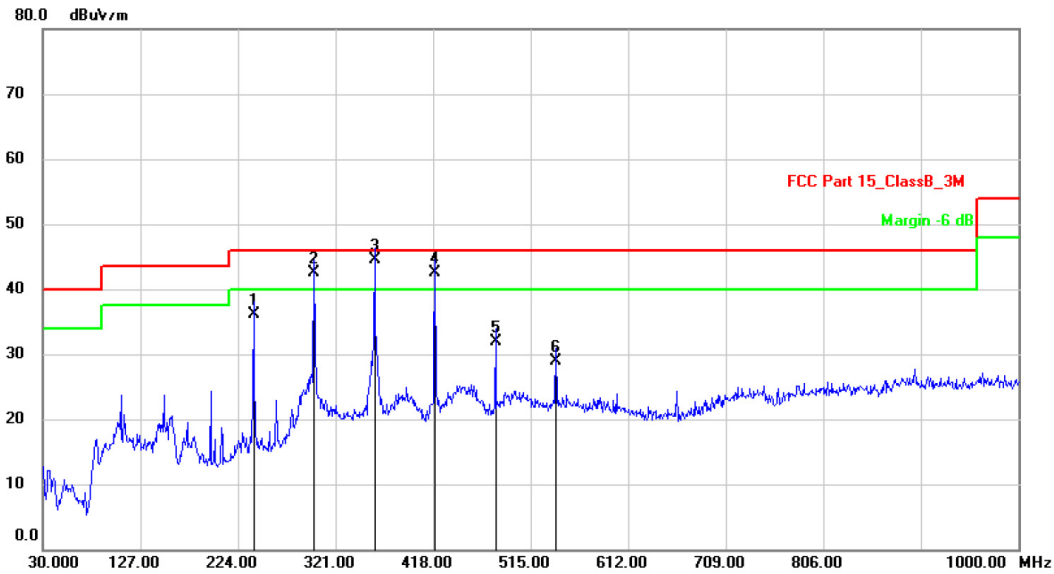
Please refer to following plots of the worst case:
 Charging+TX($\pi/4$ -DQPSK Low Channel)



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Radiated Emission Measurement

File :SP-001 Data :#13 Date: 2019/5/25 Time: 10:12:59



Site: 3m Chamber Polarization: **Horizontal** Temperature: 26
 Limit: FCC Part 15_ClassB_3M Power: AC120V/60Hz Humidity: 47 %
 EUT: BLUETOOTH-SPEAKER Distance: 3m
 M/N: SP-001
 Mode: Charging+TX
 Note: $\pi/4$ -DQPSK Low Channel

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	degree
1		239.5200	48.16	-12.06	36.10	46.00	-9.90	QP	
2	!	299.6600	53.07	-10.47	42.60	46.00	-3.40	QP	
3	*	359.8000	53.63	-9.13	44.50	46.00	-1.50	QP	
4	!	419.9400	51.24	-8.64	42.60	46.00	-3.40	QP	
5		480.0800	39.11	-7.21	31.90	46.00	-14.10	QP	
6		540.2199	35.65	-6.65	29.00	46.00	-17.00	QP	

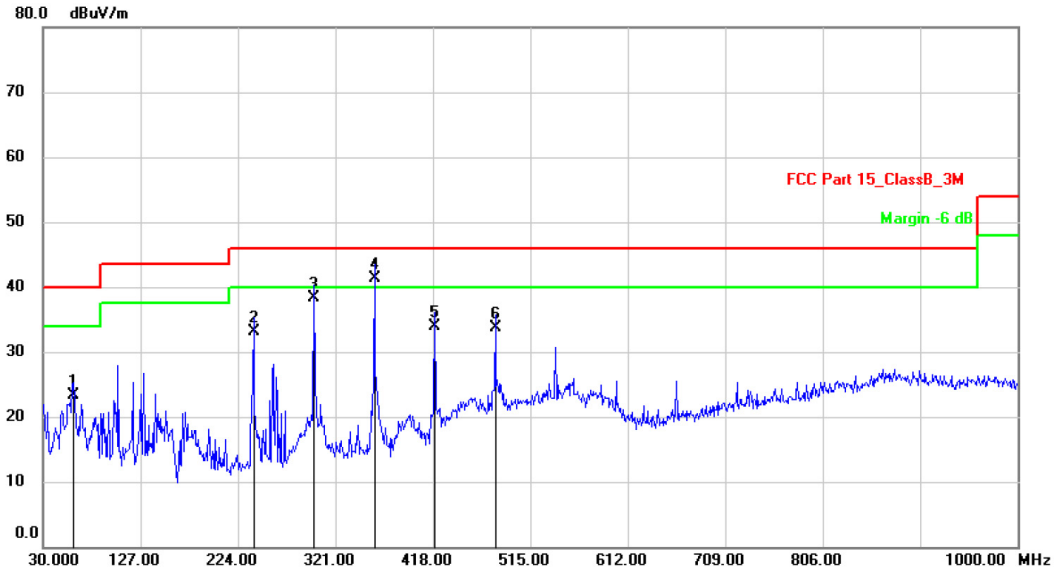
Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.



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Radiated Emission Measurement

File : SP-001 Data : #14 Date: 2019/5/25 Time: 10:19:14



Site: 3m Chamber Polarization: **Vertical** Temperature: 26
 Limit: FCC Part 15_ClassB_3M Power: AC120V/60Hz Humidity: 47 %
 EUT: BLUETOOTH-SPEAKER Distance: 3m
 M/N: SP-001
 Mode: Charging+TX
 Note: $\pi/4$ -DQPSK Low Channel

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		60.0700	37.68	-14.38	23.30	40.00	-16.70	QP		
2		239.5200	48.26	-15.06	33.20	46.00	-12.80	QP		
3		299.6600	50.87	-12.47	38.40	46.00	-7.60	QP		
4	*	359.8000	52.53	-11.13	41.40	46.00	-4.60	QP		
5		419.9399	45.64	-11.64	34.00	46.00	-12.00	QP		
6		480.0799	42.91	-9.21	33.70	46.00	-12.30	QP		

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



Modulation: $\pi/4$ -DQPSK (the worst case)
 Frequency Range: 1-25GHz Test Date : May 14, 2019
 Test Result: PASS Temperature : 24°C
 Measured Distance: 3m Humidity : 56%
 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	47.89	33.78	6.30	54.19	40.08	74.00	54.00	-19.81	-13.92
7206	V	45.40	30.73	10.44	55.84	41.17	74.00	54.00	-18.16	-12.83

4804	H	50.32	40.62	6.30	56.62	46.92	74.00	54.00	-17.38	-7.08
7206	H	45.91	30.74	10.44	56.35	41.18	74.00	54.00	-17.65	-12.82

Operation Mode: TX Mode (Mid)										
4882	V	47.16	32.41	6.60	53.76	39.01	74.00	54.00	-20.24	-14.99
7323	V	45.14	31.25	10.55	55.69	41.80	74.00	54.00	-18.31	-12.20

4882	H	50.51	40.62	6.60	57.11	47.22	74.00	54.00	-16.89	-6.78
7323	H	45.59	31.28	10.55	56.14	41.83	74.00	54.00	-17.86	-12.17

Operation Mode: TX Mode (High)										
4960	V	46.44	32.01	6.89	53.33	38.90	74.00	54.00	-20.67	-15.10
7440	V	46.07	31.38	10.60	56.67	41.98	74.00	54.00	-17.33	-12.02

4960	H	48.44	33.41	6.89	55.33	40.30	74.00	54.00	-18.67	-13.70
7440	H	46.51	31.32	10.60	57.11	41.92	74.00	54.00	-16.89	-12.08

- 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 : ± 3.7 dB.
 - (6) Horn antenna used for the emission over 1000MHz.

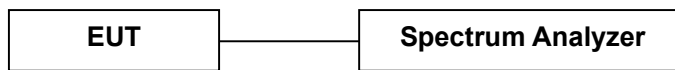
5. Channel Separation test

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)

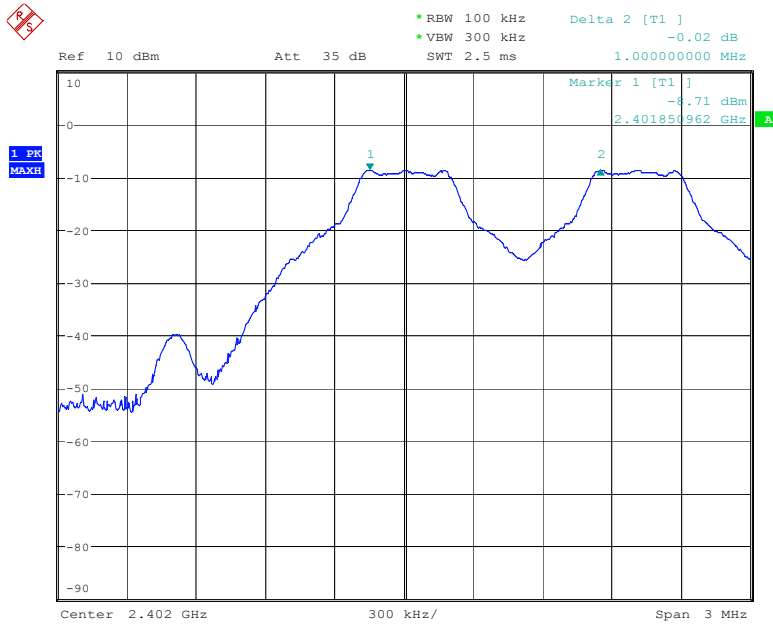


5.3 Measurement Results

Modulation:	GFSK, $\pi/4$ -DQPSK	VBW:	300KHz
RBW:	100KHz	Spectrum Detector:	PK
Packet:	DH5, 2DH5	Test Date :	May 11, 2019
Test By:	Lee	Humidity :	50 %
Temperature :	25°C		
Test Result:	PASS		

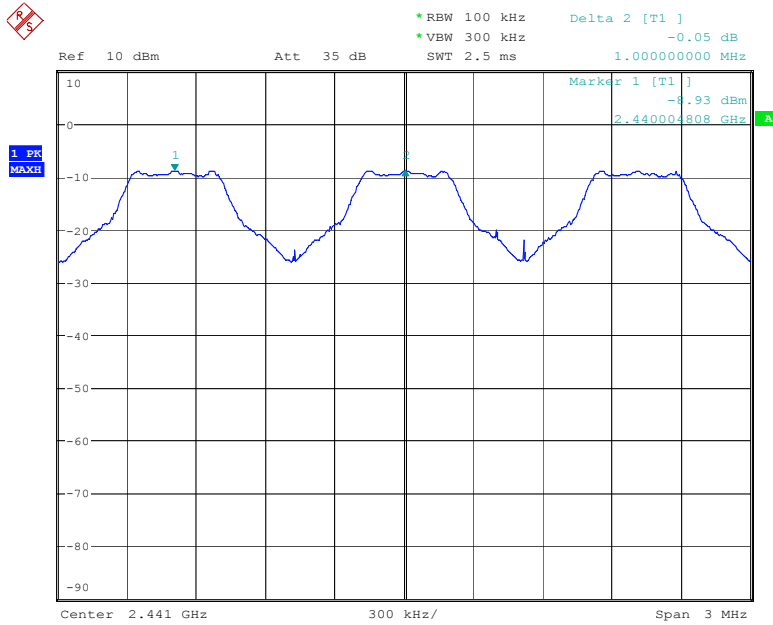
Channel number	Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit 2/3 20dB Bandwidth (KHz)
GFSK			
Lowest	2402	1000	>637.82
Middle	2441	1000	>634.61
Highest	2480	1000	>637.82
$\pi/4$ -DQPSK			
Lowest	2402	1000	>862.18
Middle	2441	1000	>862.18
Highest	2480	1000	>862.18

GFSK Lowest Channel



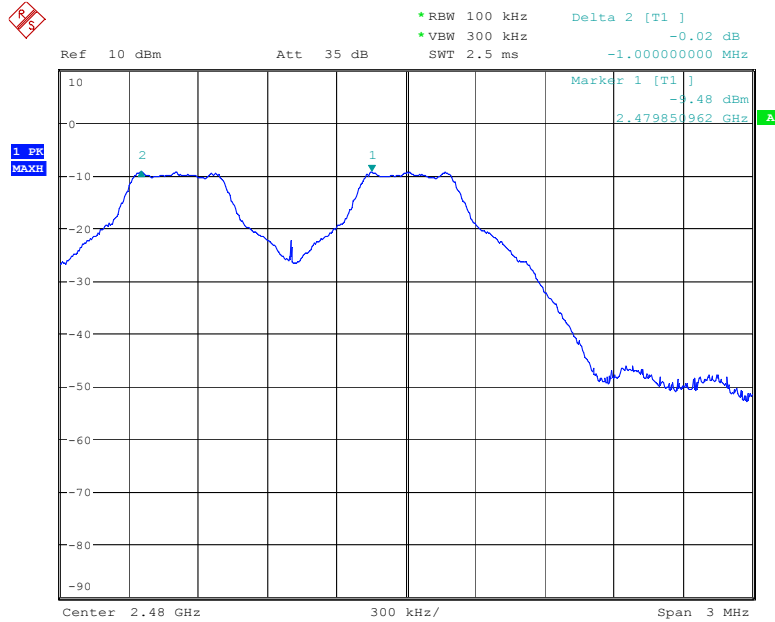
Date: 11.MAY.2019 17:42:19

GFSK Middle Channel



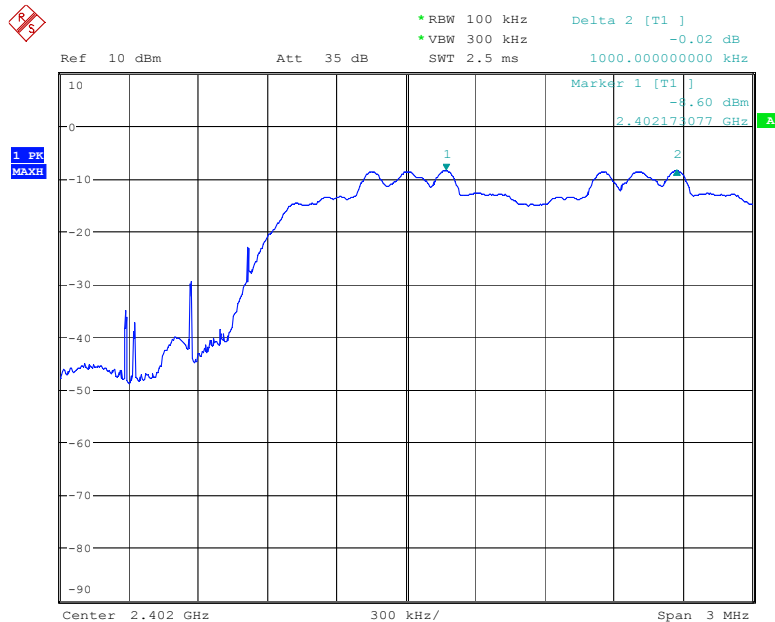
Date: 11.MAY.2019 17:43:25

GFSK Highest Channel



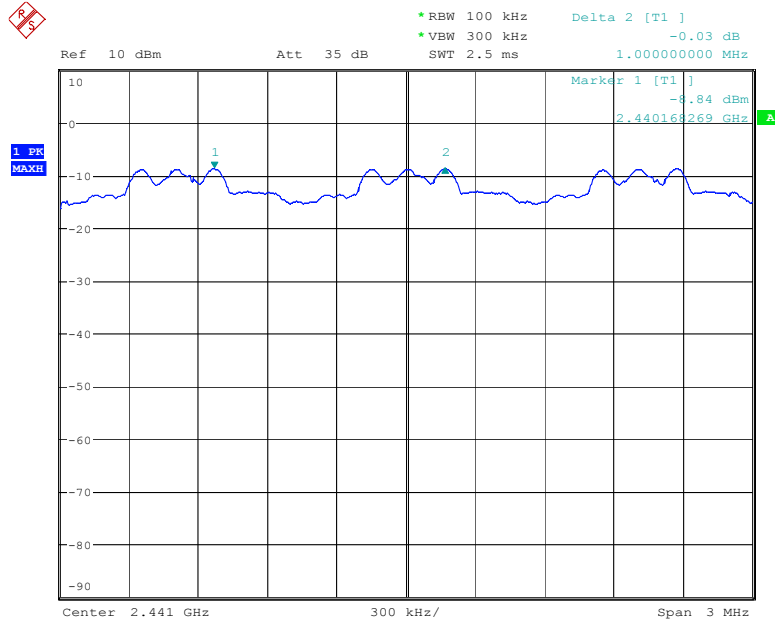
Date: 11.MAY.2019 17:44:12

$\pi/4$ -DQPSK Lowest Channel



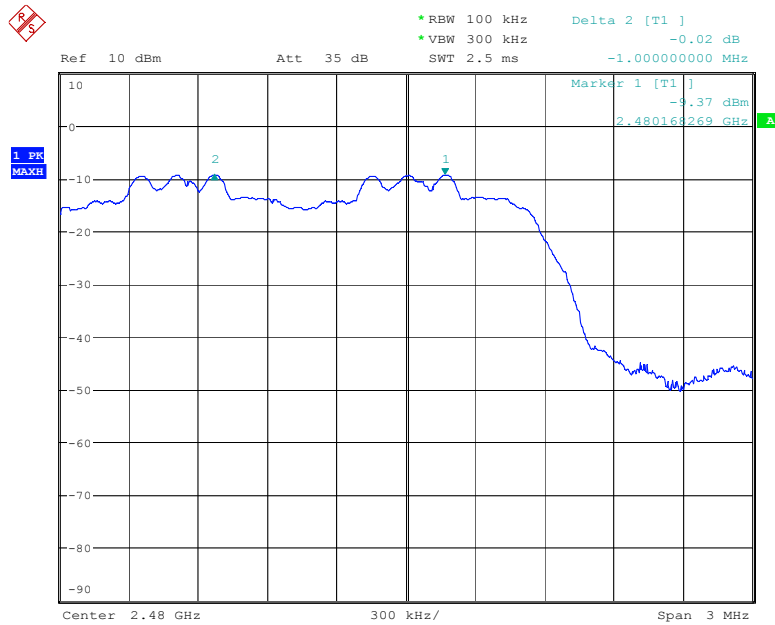
Date: 11.MAY.2019 17:46:40

$\pi/4$ -DQPSK Middle Channel



Date: 11.MAY.2019 17:48:39

$\pi/4$ -DQPSK Highest Channel



Date: 11.MAY.2019 17:50:07

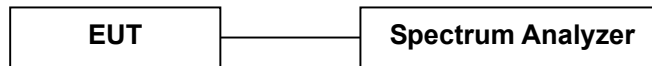
6. 20dB Bandwidth

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)



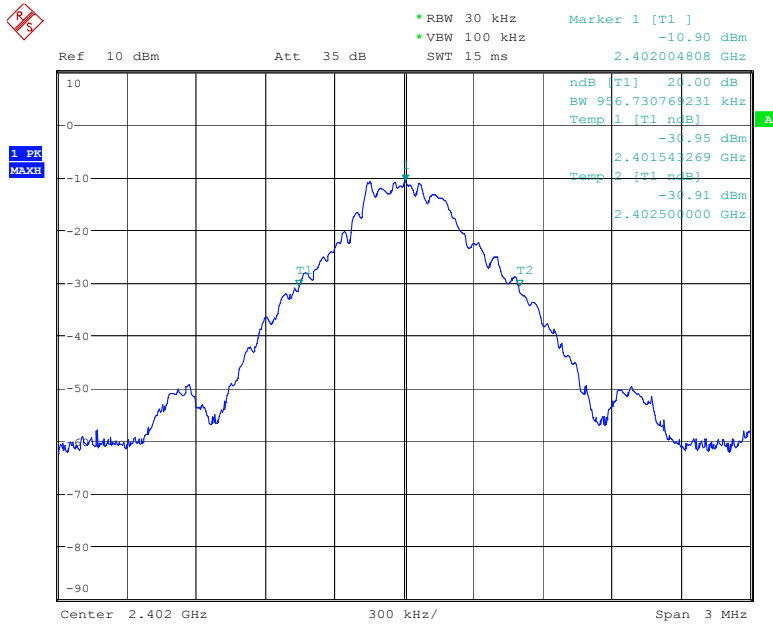
6.3 Measurement Results

Refer to attached data chart.

Modulation:	GFSK, $\pi/4$ -DQPSK		
RBW:	30KHz	VBW:	100KHz
Packet:	DH5, 2DH5	Spectrum Detector:	PK
Test By:	Lee	Test Date :	May 11, 2019
Temperature :	25°C	Humidity :	50 %
Test Result:	PASS		

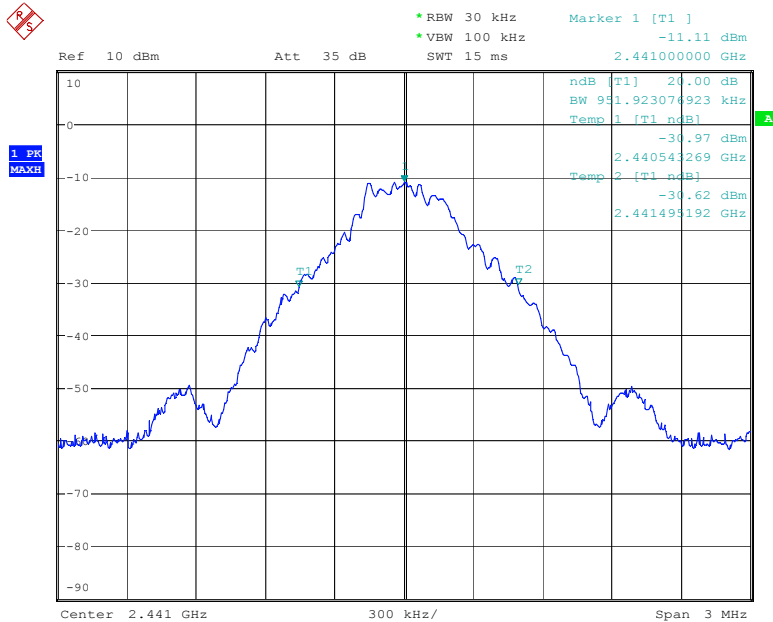
Channel frequency (MHz)	20dB Down BW(kHz)
GFSK	
2402	956.73
2441	951.92
2480	956.73
$\pi/4$-DQPSK	
2402	1293.27
2441	1293.27
2480	1293.27

GFSK Lowest Channel



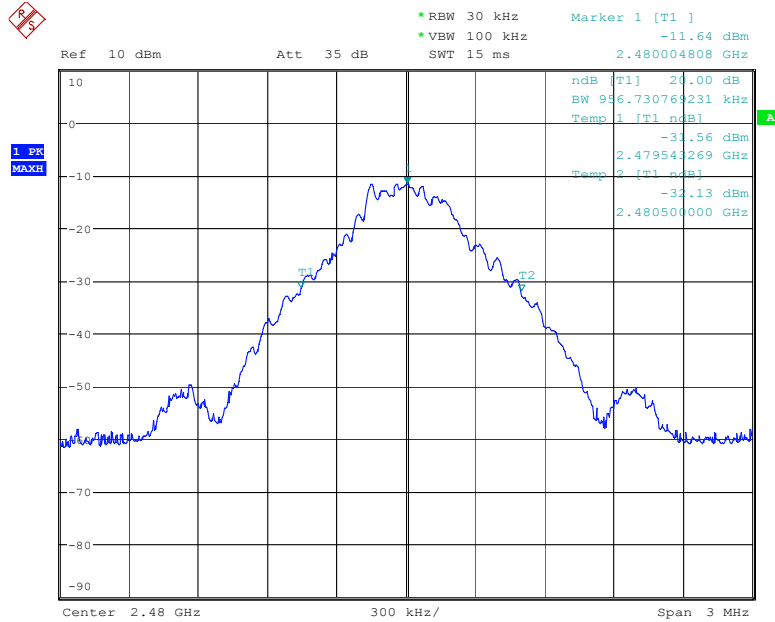
Date: 11.MAY.2019 17:38:01

GFSK Middle Channel



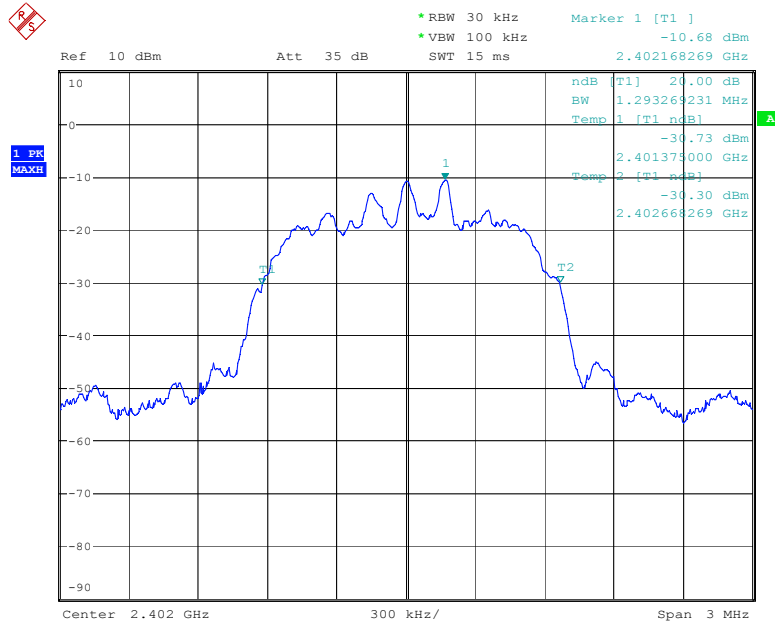
Date: 11.MAY.2019 17:38:38

GFSK Highest Channel



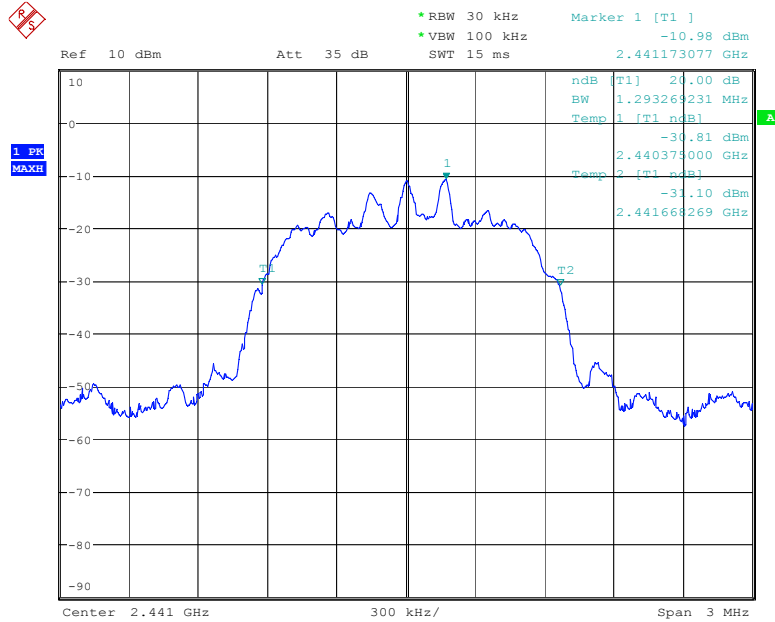
Date: 11.MAY.2019 17:39:15

$\pi/4$ -DQPSK Lowest Channel



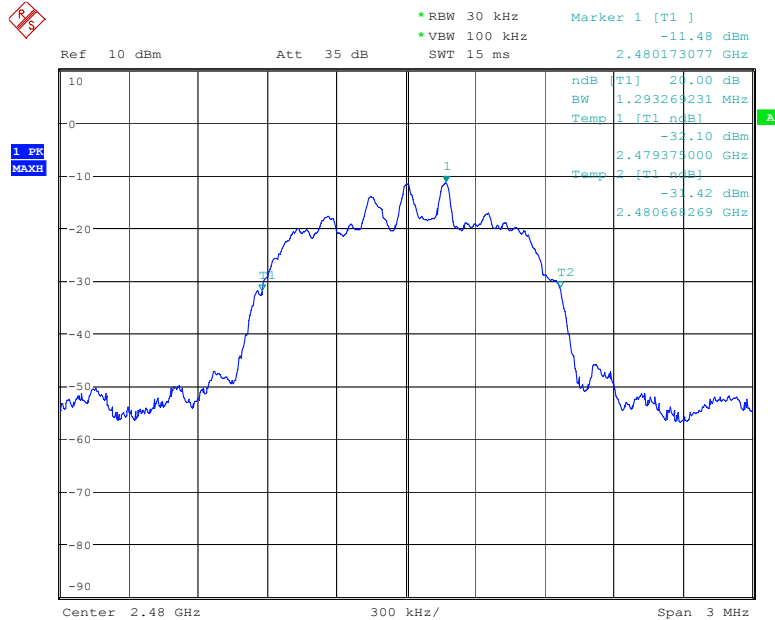
Date: 11.MAY.2019 17:40:13

$\pi/4$ -DQPSK Middle Channel



Date: 11.MAY.2019 17:40:41

$\pi/4$ -DQPSK Highest Channel



Date: 11.MAY.2019 17:41:14

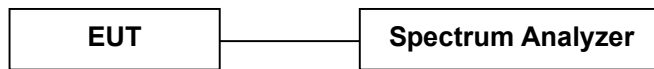
7. Hopping Channel Number

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)



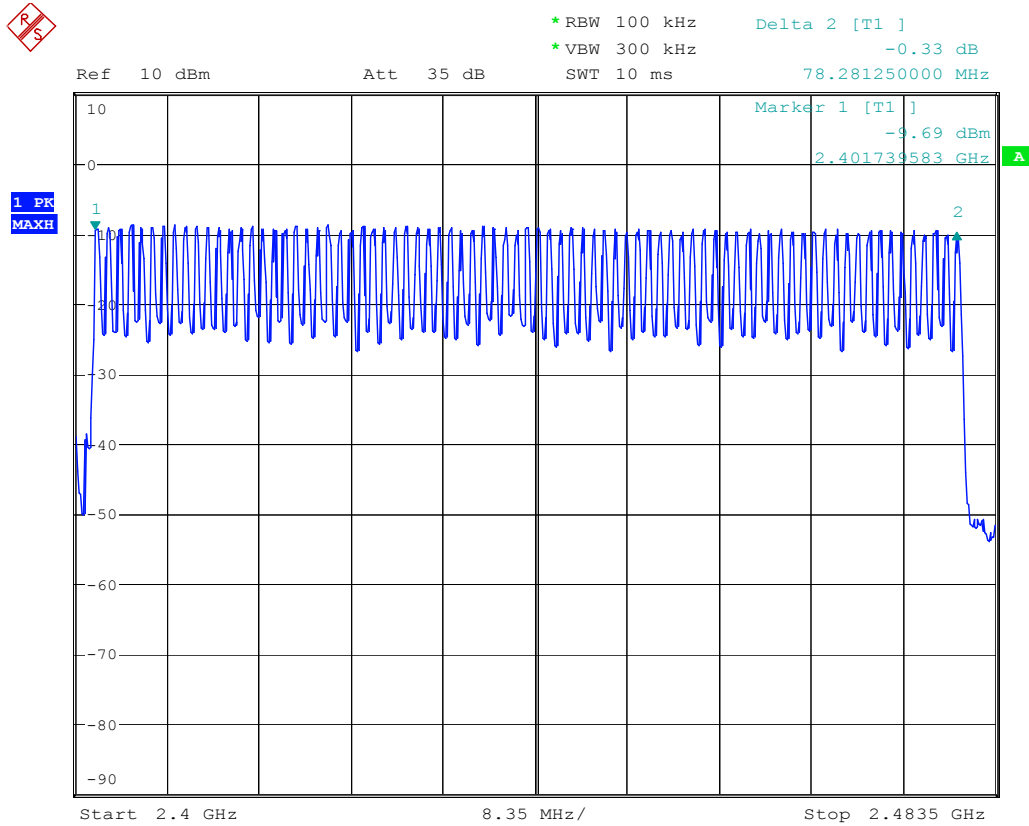
7.3 Measurement Results

Modulation	GFSK, $\pi/4$ -DQPSK	VBW:	300KHz
RBW:	100KHz	Spectrum Detector:	PK
Packet:	DH5, 2-DH5	Test Date :	May 11, 2019
Test By:	Lee	Humidity :	50 %
Temperature :	25°C		
Test Result:	PASS		

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

Please refer to following plots of the worst case: $\pi/4$ -DQPSK

$\pi/4$ -DQPSK



Date: 11.MAY.2019 17:57:28

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

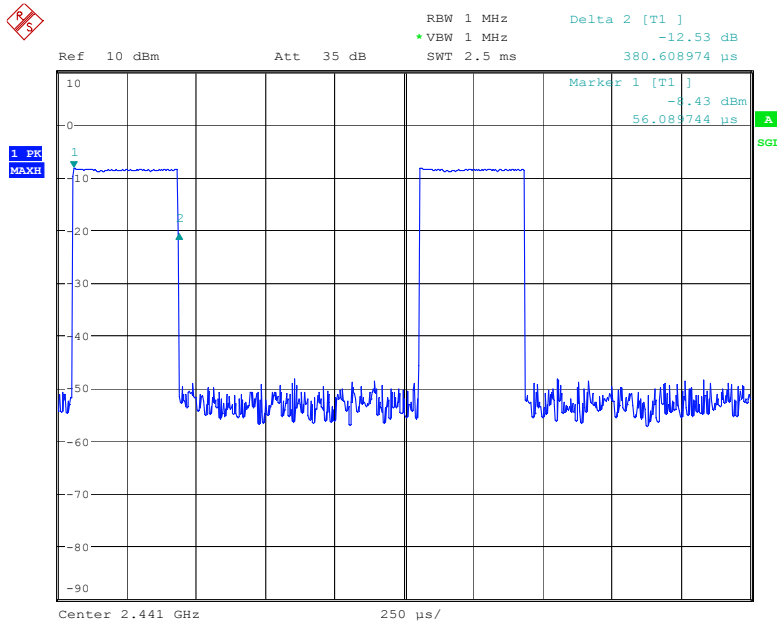
The maximum number of hopping channels in 31.6s (0.4s/Channel x 79 Channel)

Refer to attached data chart.

Modulation :	GFSK, $\pi/4$ -DQPSK	VBW :	1MHz
RBW :	1MHz	Test By:	Lee
Spectrum Detector:	PK	Temperature :	25°C
Test Date :	May 11, 2019	Humidity :	50 %
Test Result:	PASS		

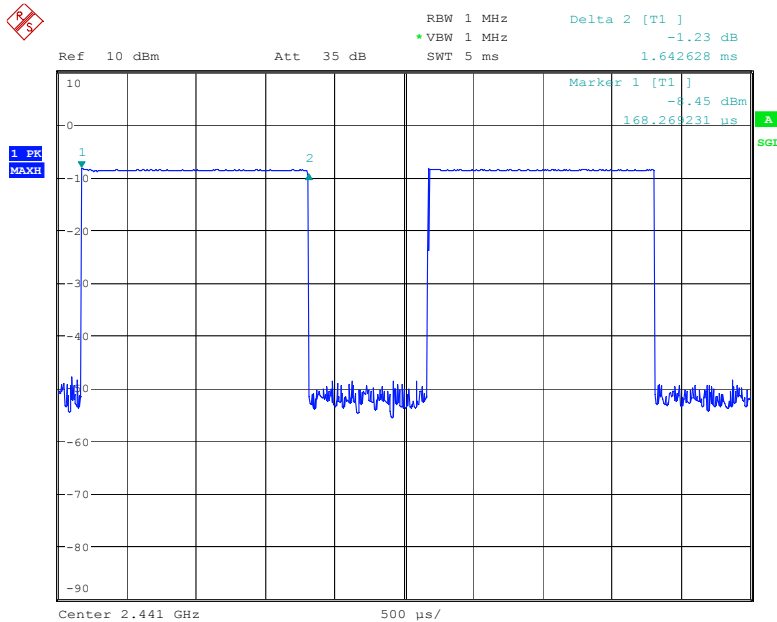
Packet	Frequency (MHz)	Result (msec)	Limit (msec)
GFSK			
DH1	2441	$0.3806 \text{ (ms)} \times (1600 / (2 \times 79)) \times 31.6 = 121.79$	400
DH3	2441	$1.6426 \text{ (ms)} \times (1600 / (4 \times 79)) \times 31.6 = 262.82$	400
DH5	2441	$2.8846 \text{ (ms)} \times (1600 / (6 \times 79)) \times 31.6 = 307.69$	400
$\pi/4$-DQPSK			
2-DH1	2441	$0.3966 \text{ (ms)} \times (1600 / (2 \times 79)) \times 31.6 = 126.91$	400
2-DH3	2441	$1.6426 \text{ (ms)} \times (1600 / (4 \times 79)) \times 31.6 = 262.82$	400
2-DH5	2441	$2.8966 \text{ (ms)} \times (1600 / (6 \times 79)) \times 31.6 = 308.97$	400

GFSK DH1



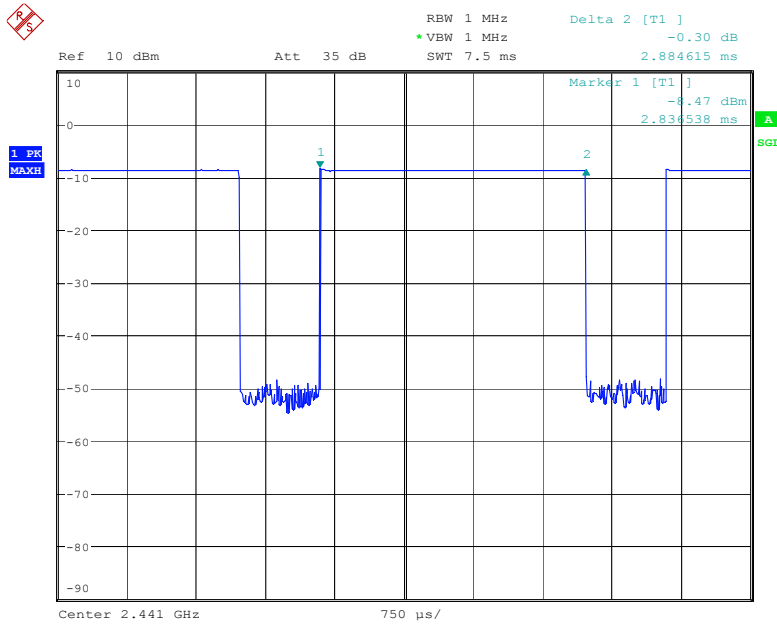
Date: 11.MAY.2019 18:03:33

GFSK DH3



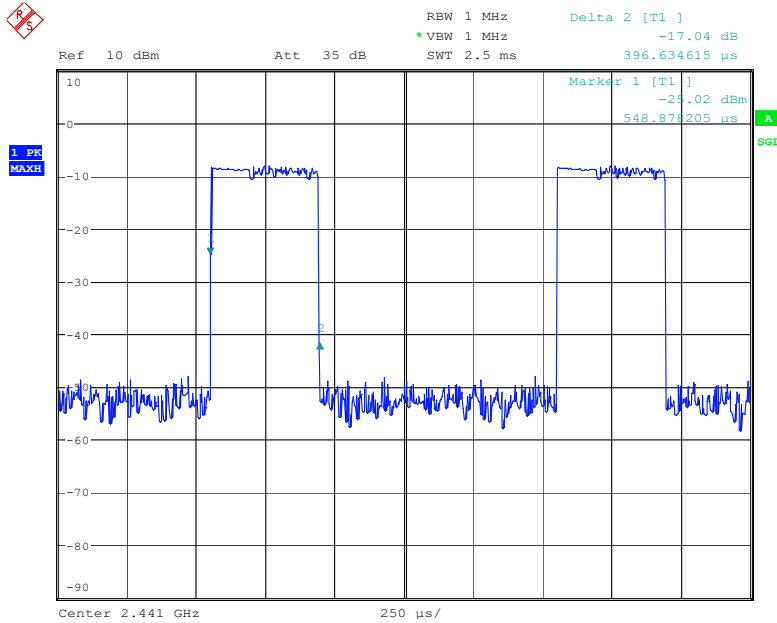
Date: 11.MAY.2019 18:04:03

GFSK DH5



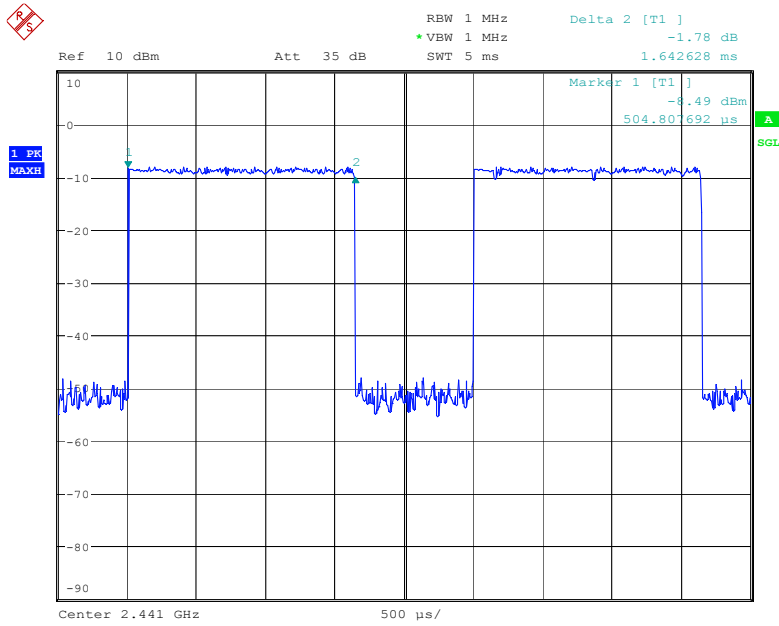
Date: 11.MAY.2019 18:04:29

$\pi/4$ -DQPSK 2-DH1



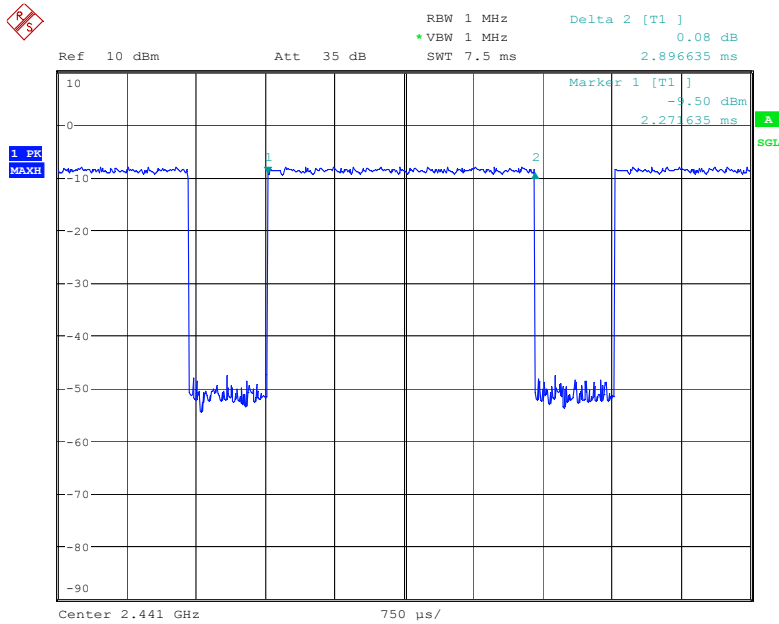
Date: 11.MAY.2019 18:05:01

$\pi/4$ -DQPSK 2-DH3



Date: 11.MAY.2019 18:05:33

$\pi/4$ -DQPSK 2-DH5



Date: 11.MAY.2019 18:05:57

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.

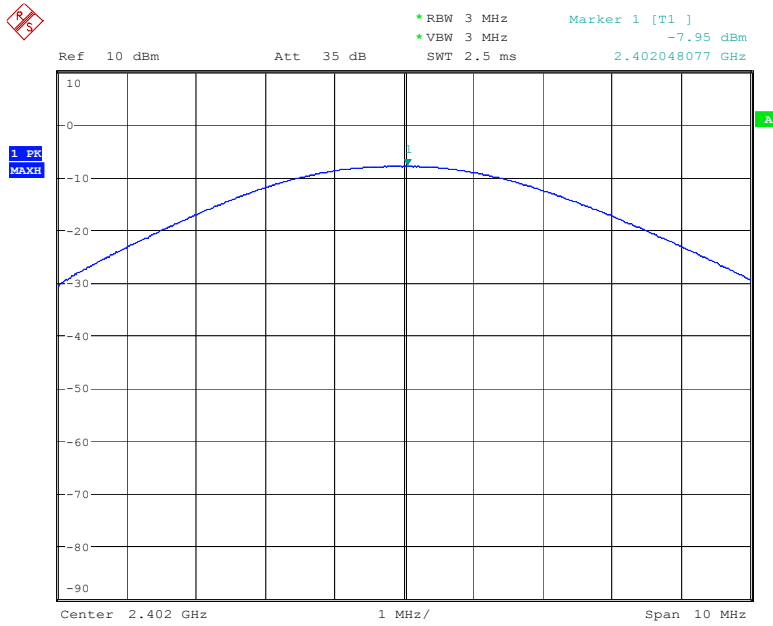
9.2 Measurement Results

Refer to attached data chart.

Modulation :	GFSK, $\pi/4$ -DQPSK		
RBW :	3MHz	VBW :	3MHz
Spectrum Detector:	PK	Test Date :	May 11, 2018
Test By:	Lee	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %

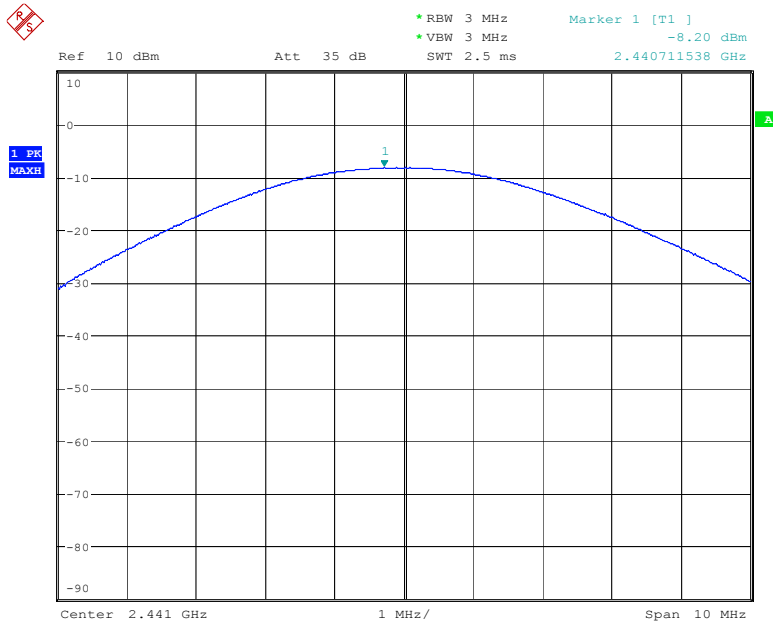
Channel Frequency (MHz)	Cable Loss dB	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(dBm)	Pass/Fail
GFSK					
2402.00	1.5	-7.95	0.16	21	PASS
2441.00	1.5	-8.20	0.15	21	PASS
2480.00	1.5	-8.79	0.13	21	PASS
$\pi/4$ -DQPSK					
2402.00	1.5	-7.03	0.20	21	PASS
2441.00	1.5	-7.32	0.19	21	PASS
2480.00	1.5	-7.84	0.16	21	PASS

GFSK Lowest Channel



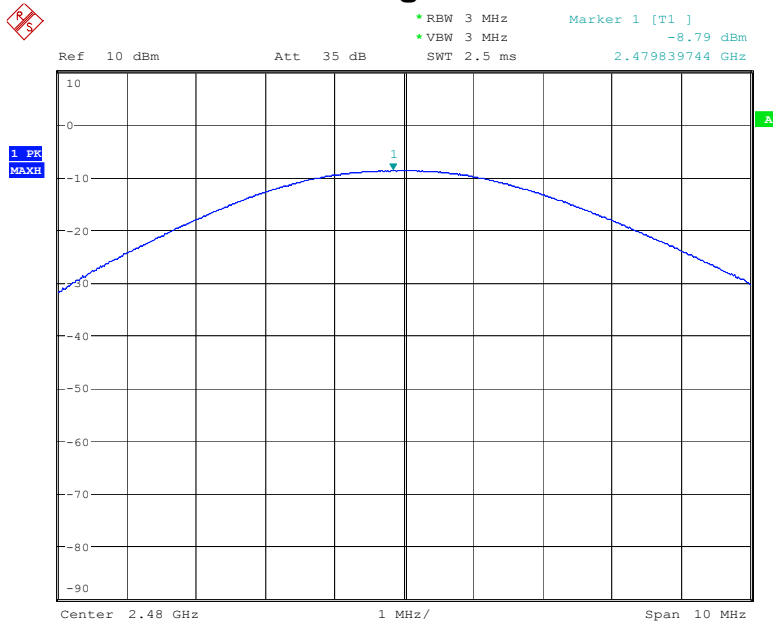
Date: 11.MAY.2019 17:35:48

GFSK Middle Channel



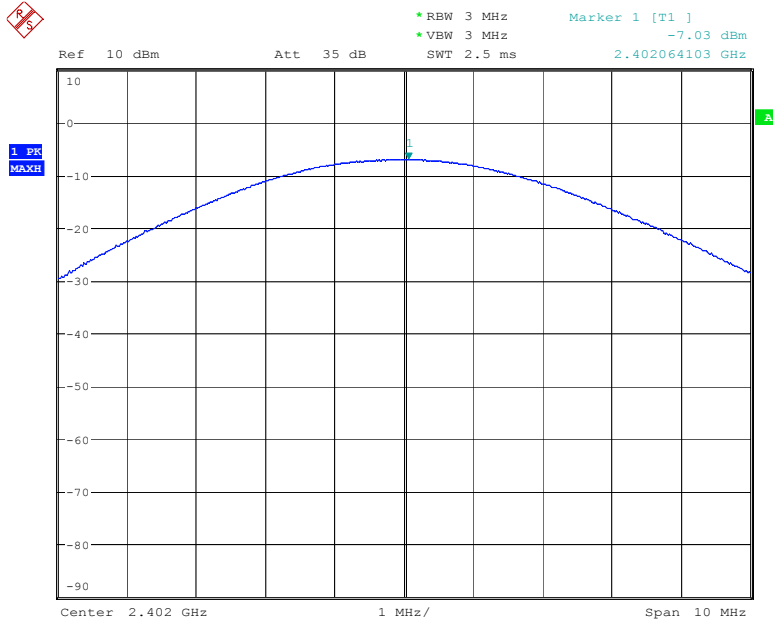
Date: 11.MAY.2019 17:36:08

GFSK Highest Channel



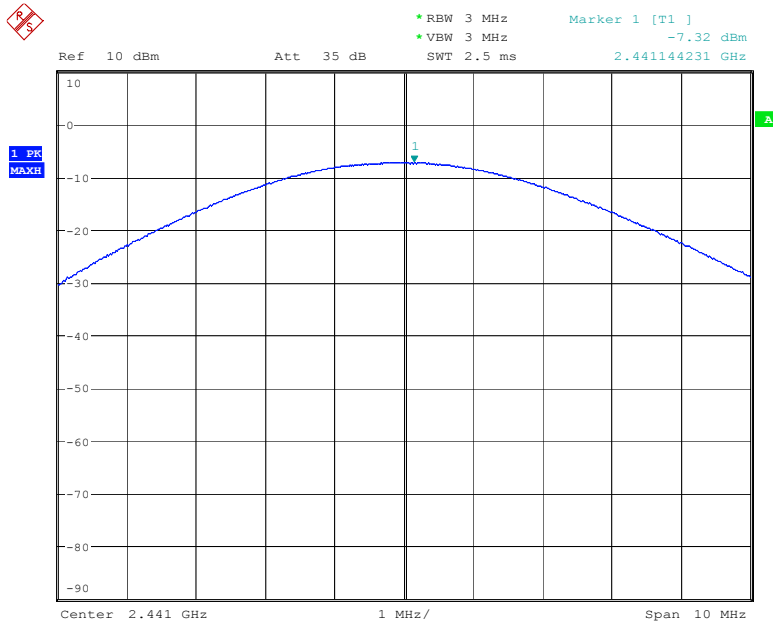
Date: 11.MAY.2019 17:36:23

$\pi/4$ -DQPSK Lowest Channel



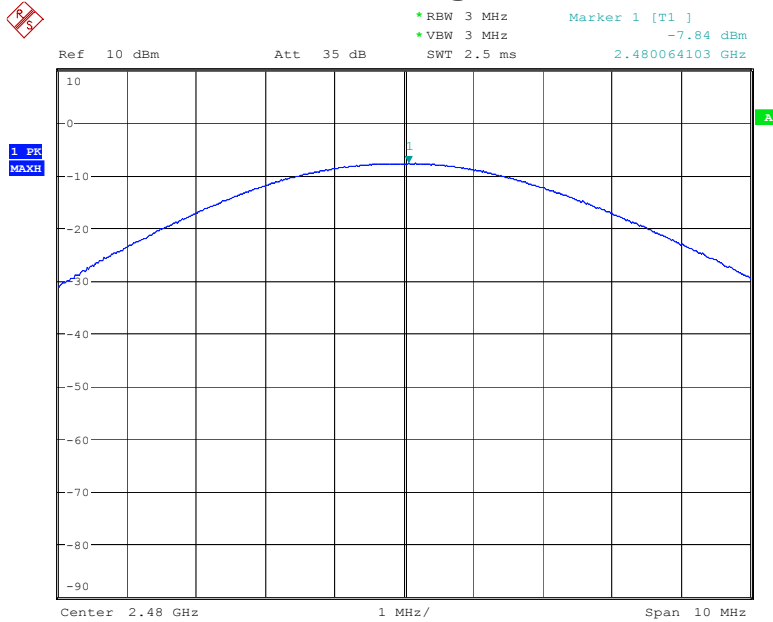
Date: 11.MAY.2019 17:36:43

$\pi/4$ -DQPSK Middle Channel



Date: 11.MAY.2019 17:37:00

$\pi/4$ -DQPSK Highest Channel



Date: 11.MAY.2019 17:37:17

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 to 100KHz, 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: $\pi/4$ -DQPSK

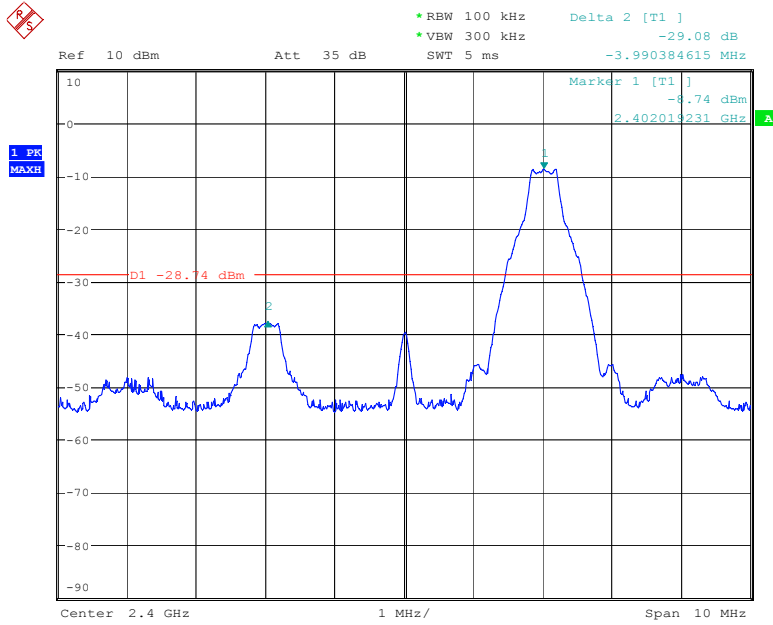
Hopping-on mode

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	46.59	33.37	0.09	46.68	33.46	74.00	54.00	-27.32	-20.54
2390.000	V	47.36	32.77	0.09	47.45	32.86	74.00	54.00	-26.55	-21.14
2483.500	H	46.15	33.32	0.35	46.50	33.67	74.00	54.00	-27.50	-20.33
2483.500	V	46.68	32.27	0.35	47.03	32.62	74.00	54.00	-26.97	-21.38

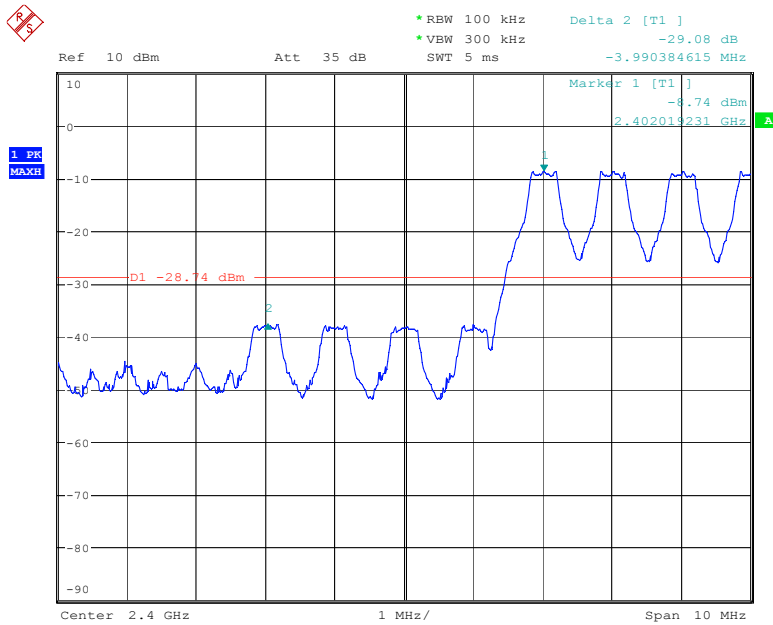
- Note:**
- (1) Emission Level= Reading Level + Factor
 - (2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
 - (3) Horn antenna used for the emission over 1000MHz.

For RF Conducted

GFSK Lowest Channel

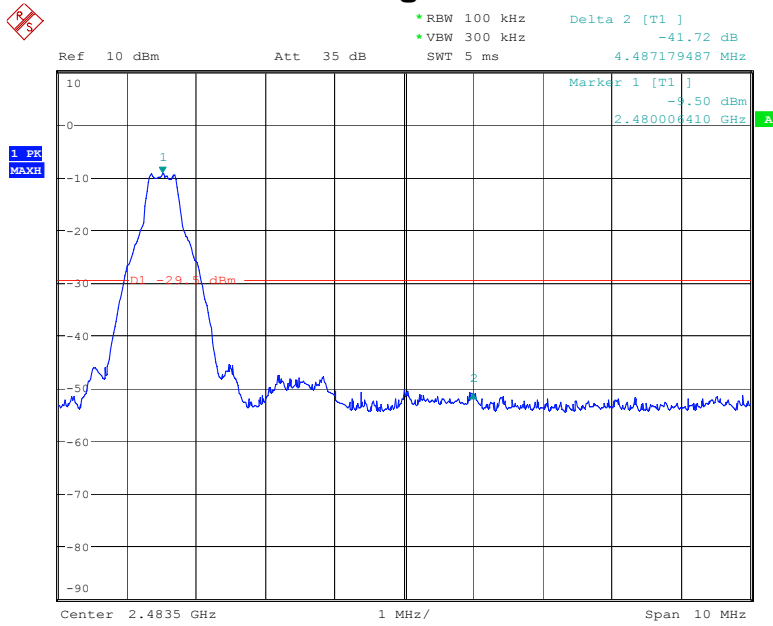


Date: 11.MAY.2019 17:51:24

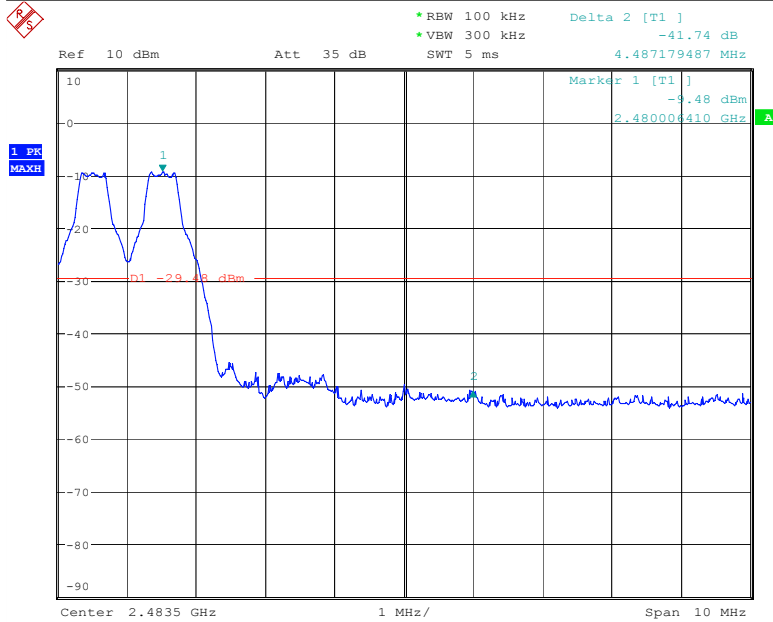


Date: 11.MAY.2019 17:51:50

GFSK Highest Channel

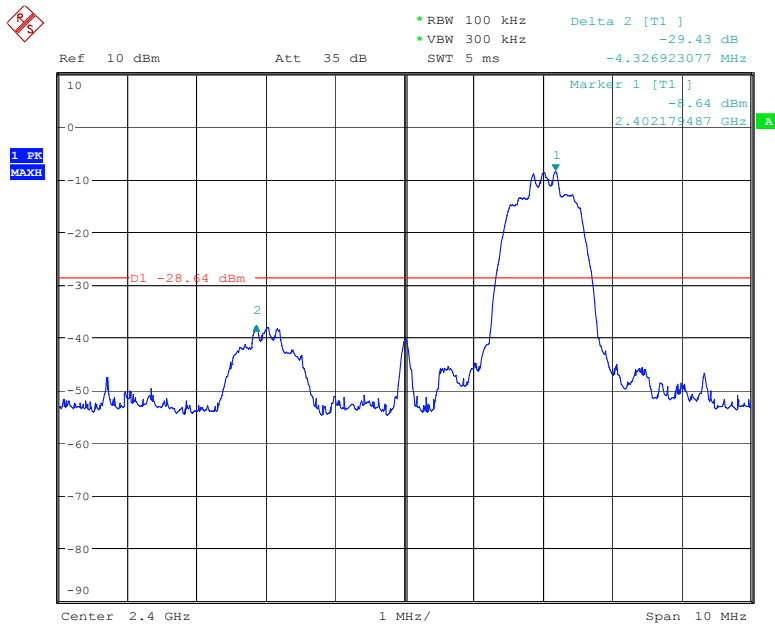


Date: 11.MAY.2019 17:52:48

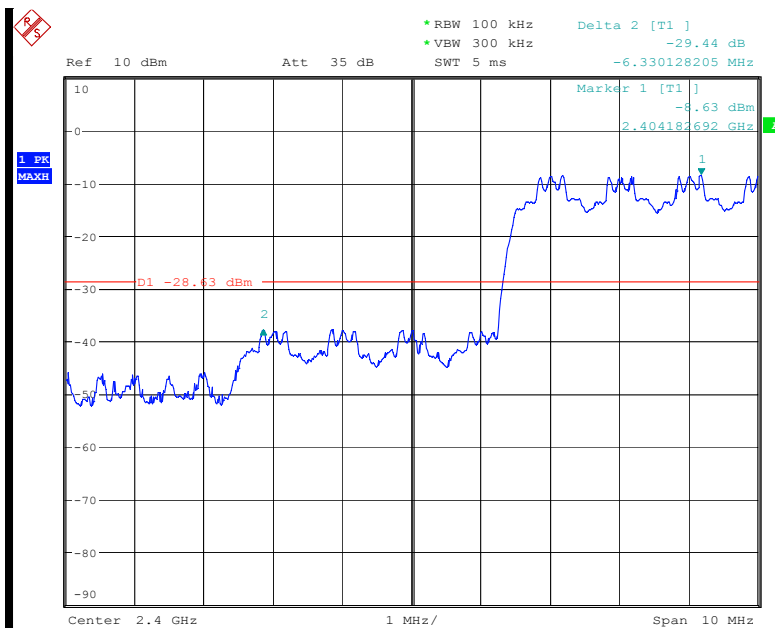


Date: 11.MAY.2019 17:53:11

$\pi/4$ -DQPSK Lowest Channel

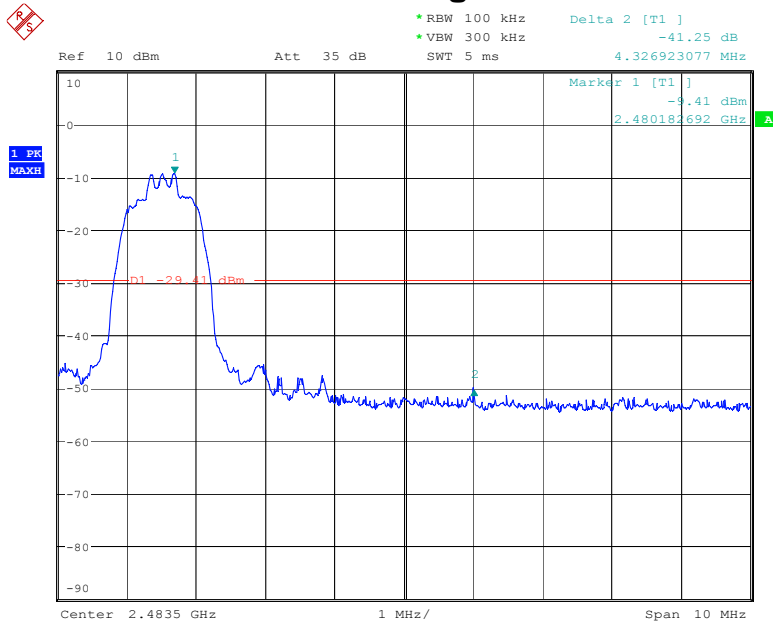


Date: 11.MAY.2019 17:53:47

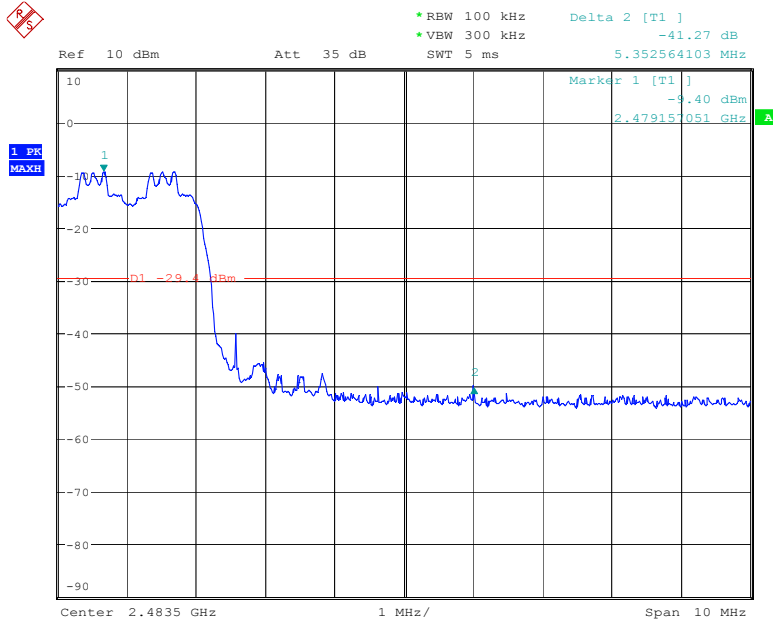


Date: 11.MAY.2019 17:54:30

$\pi/4$ -DQPSK Highest Channel



Date: 11.MAY.2019 17:55:29



Date: 11.MAY.2019 17:55:55

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 PCB antenna and no consideration of replacement, and the best case gain of the antenna is 0 dBi. So, the antenna is consider meet the requirement.

12. Conducted Spurious Emissions

12.1 Measurement Procedure

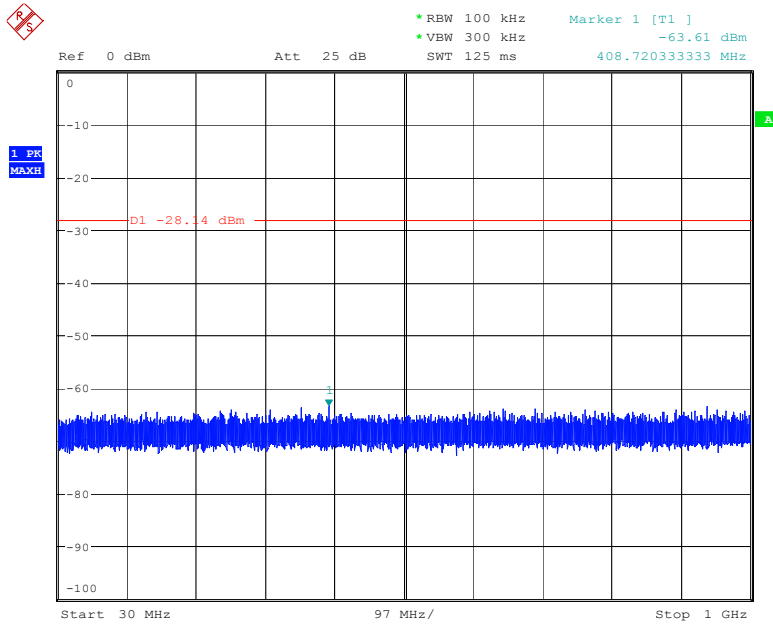
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

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

12.2 Measurement Results

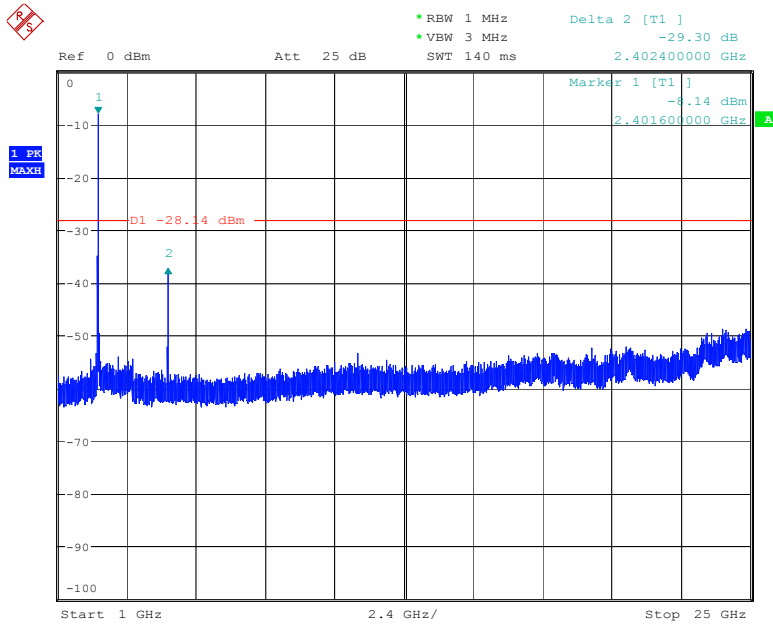
Please refer to following plots, the worst case ($\pi/4$ -DQPSK) was shown.

Lowest Channel Band 1



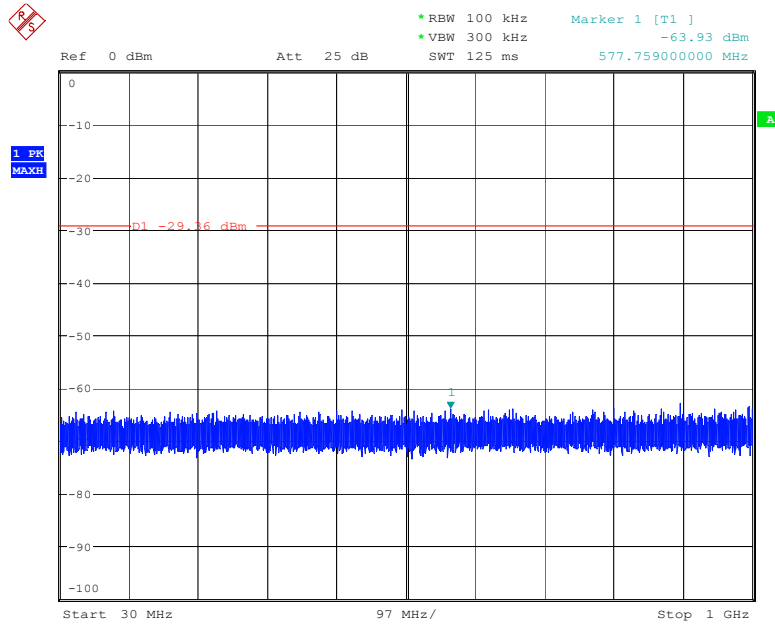
Date: 11.MAY.2019 18:08:07

Lowest Channel Band 2



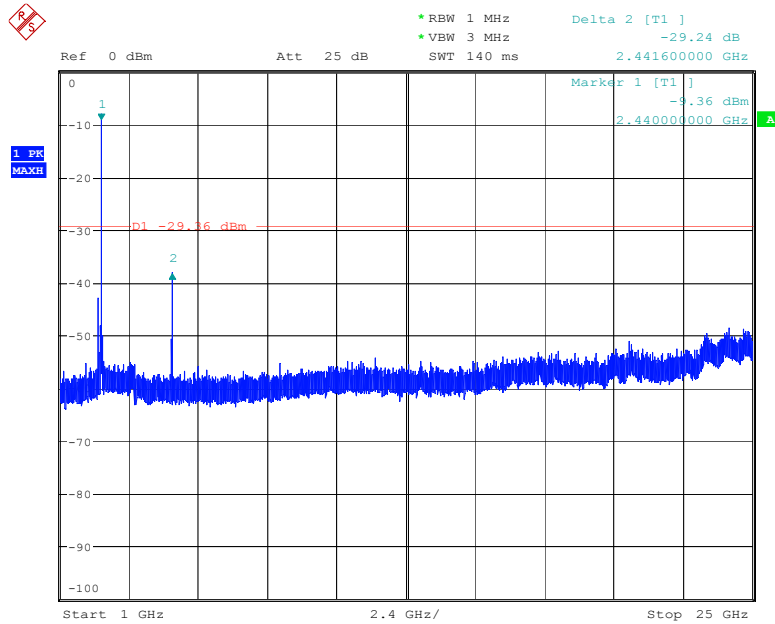
Date: 11.MAY.2019 18:07:37

Middle Channel Band 1



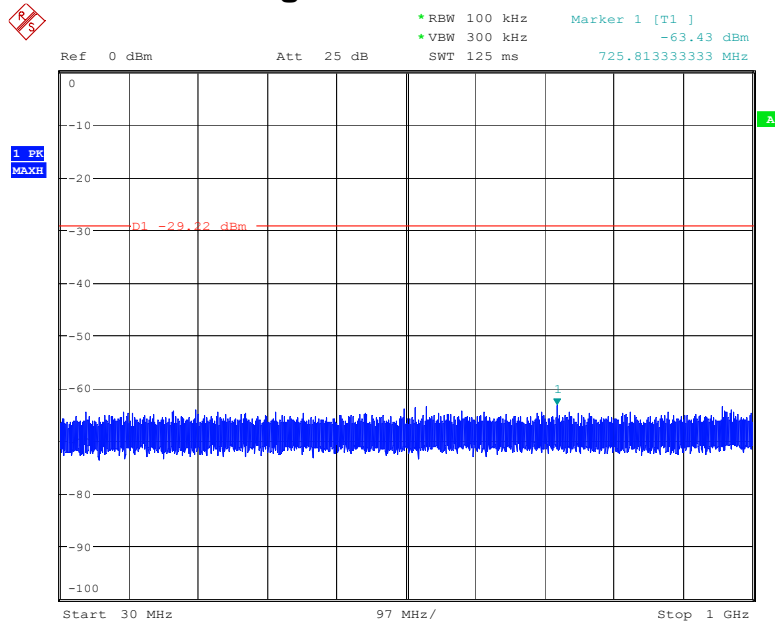
Date: 11.MAY.2019 18:11:27

Middle Channel Band 2



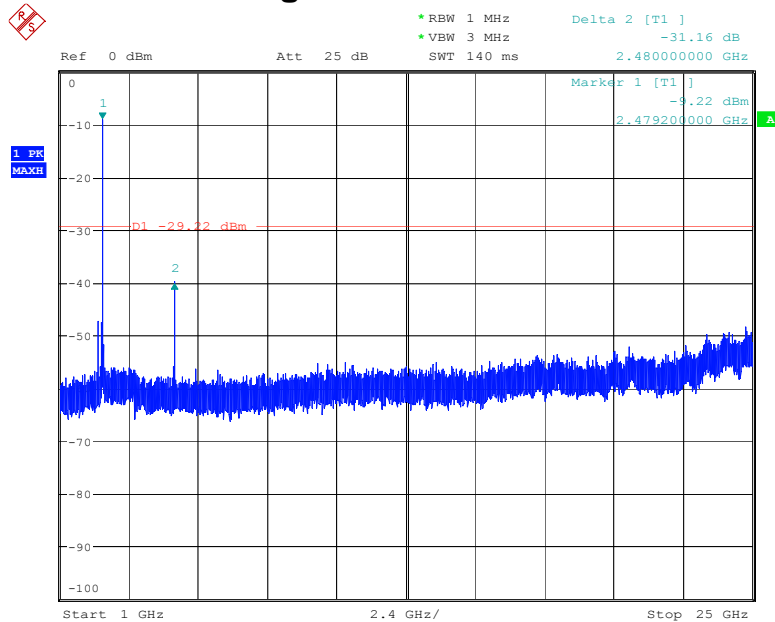
Date: 11.MAY.2019 18:09:45

Highest Channel Band 1



Date: 11.MAY.2019 18:12:29

Highest Channel Band 2



Date: 11.MAY.2019 18:12:03

Note: Sweep points=30001pts

12. Test Equipment List

Description	Manufacturer	Model Number	Serial Number	Characteristics	Calibration Date	Calibration Due Date
Test Receiver	Rohde & Schwarz	ESCI7	100837	9KHz~7GHz	Mar. 13, 2019	Mar. 12, 2020
Antenna	Schwarzbeck	VULB9162	9162-010	30MHz~7GHz	Mar. 14, 2019	Mar. 13, 2020
Cable	Huber+Suhner	CBL2-NN-1M	22390001	9KHz~7GHz	Mar. 13, 2019	Mar. 12, 2020
Cable	Huber+Suhner	CIL02	N/A	9KHz~7GHz	Mar. 13, 2019	Mar. 12, 2020
RF Cable	Huber+Suhner	SF-104	MY16559/4	9KHz~25GHz	Apr. 25, 2019	Apr. 25, 2020
Power Amplifier	HP	HP 8447D	1145A00203	100KHz~1.3GHz	Mar. 13, 2019	Mar. 12, 2020
Horn Antenna	Schwarzbeck	BBHA9170	9170-242	15GHz~40GHz	Mar. 13, 2019	Mar. 12, 2020
Horn Antenna	Com-Power	AH-118	071078	1GHz~18GHz	Mar. 14, 2019	Mar. 13, 2020
RF Cable	Huber+Suhner	SF-104	N/A	9KHz~40GHz	Apr. 25, 2019	Apr. 25, 2020
Loop antenna	Daze	ZA30900A	0708	9KHz~30MHz	Apr. 25, 2019	Apr. 25, 2020
Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	20Hz~26.5GHz	Apr. 25, 2019	Apr. 25, 2020
Spectrum Analyzer	Rohde & Schwarz	FSV40	101003	10Hz~40GHz	Apr. 06, 2019	Apr. 05, 2020
Pre-Amplifier	EMCI	EMC 184045	980102	18GHz~40GHz	Nov. 03, 2018	Nov. 02, 2019
Pre-Amplifier	Agilent	8449B	3008A02964	1GHz~26.5GHz	Apr. 25, 2019	Apr. 25, 2020
L.I.S.N.	Rohde & Schwarz	ENV 216	101317	9KHz~30MHz	Mar. 13, 2019	Mar. 12, 2020
Temporary antenna connector	TESCOM	SS402	N/A	9KHz-25GHz	N/A	N/A
Power Meter	Anritsu	ML2495A	1139001	100k-65GHz	Nov. 03, 2018	Nov. 02, 2019
Power Sensor	Anritsu	MA2411B	100345	300M-40GHz	Nov. 03, 2018	Nov. 02, 2019

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---