

RADIO TEST REPORT

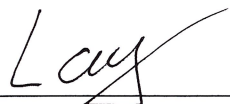
The device described below is tested by Dongguan Nore Testing Center Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results, data evaluation, test procedures, and equipment of configurations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

Applicant : Ningbo Tonwel Audio Co., Ltd
Address : No. 28, Xiyi Road, Jiangshan Town, Yinzhou, Ningbo, China
Manufacturer/ Factory : Ningbo Tonwel Audio Co., Ltd
Address : 500, Qihang North Road, Zhanqi Town, Ningbo, China
E.U.T. : Active Speaker
Brand Name : HARBINGER
Model No. : M100-BT
FCC ID : 2AIQW-MBT
Measurement Standard : FCC PART 15.247
Date of Receiver : March 19, 2019
Date of Test : March 19, 2019 to July 24, 2019
Date of Report : July 24, 2019

This Test Report is Issued Under the Authority of :

Prepared by

Approved & Authorized Signer


Lay Lei / Engineer
Ioli 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
NTC1903205FV00	Initial Issue	2019-06-22
NTC1903205FV01	C2PC	2019-07-24

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test

E.U.T. : Active Speaker

Main model number : M100-BT

Additional Model number : N/A

Brand Name : HARBINGER

Rating : AC 110-120V, 60Hz

Adapter : N/A

Test Voltage : AC 120V/60Hz

HW : V1.0

SW : V1.0

Note : N/A

Technical Specification:

Bluetooth Version : V4.1+EDR

Frequency : 2402-2480MHz

Modulation : GFSK, $\pi/4$ -DQPSK, 8DPSK

Number of Channel : 79

Channel space : 1MHz

Antenna Type : PCB

Antenna Gain : 0dBi (Declaration by manufacturer)

BT 4.1 Channel List

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	ASTTestTool.exe
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1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for C2PC of FCC ID: 2AIQW-MBT, The test items are AC Power Conducted Emission test, Radiated Emission and Band edge test, which are from FCC 15.247 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	: Manufacturer: IBM Corporation M/N: 08K8210 Input: AC100-240V 50/60Hz 0.5-1.0A Output: DC 16V 4.5A

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(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

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

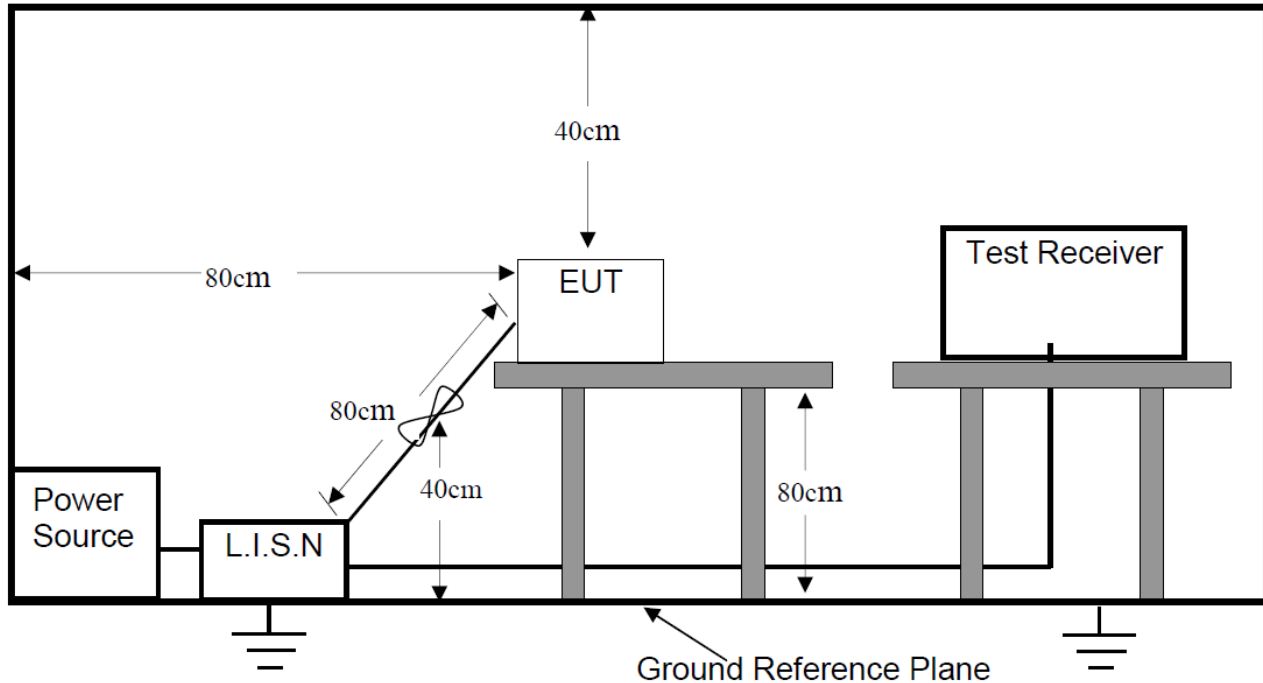
The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and normal mode is programmed. The Lowest, middle and highest channel were chosen for testing, and all packets DH1, DH3 and DH5 mode in all modulation type GFSK, $\pi/4$ -DQPSK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

3.3 Measurement Results

Please refer to following plots of the worst case: 8DPSK High Channel



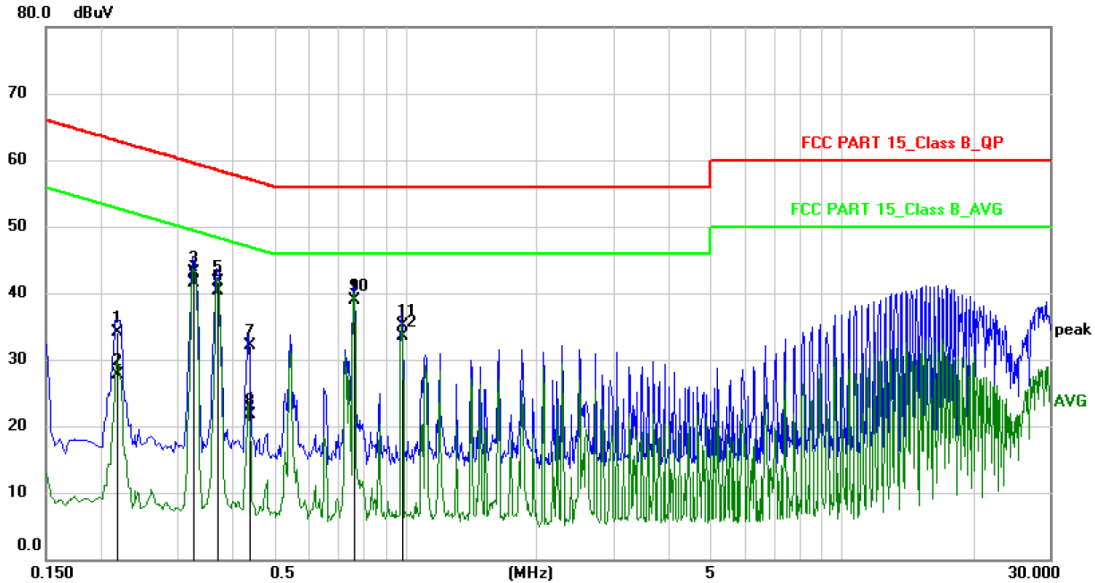
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Web: <http://www.ntc-c.com>

Conducted Emission Measurement

Data: #1

Date: 2019/6/20

Time: 15:07:55



Site

Phase: **L1**

Temperature: 26

Limit: FCC PART 15_Class B_QP

Power: AC120V/60Hz

Humidity: 50 %

EUT: Active Speaker

M/N: M100-BT

Mode: TX

Note: 8DPSK High Channel

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.2179	23.49	10.61	34.10	62.90	-28.80	QP	
2		0.2179	17.19	10.61	27.80	52.90	-25.10	AVG	
3		0.3260	32.59	10.61	43.20	59.55	-16.35	QP	
4		0.3260	30.99	10.61	41.60	49.55	-7.95	AVG	
5		0.3700	31.19	10.61	41.80	58.50	-16.70	QP	
6		0.3700	29.69	10.61	40.30	48.50	-8.20	AVG	
7		0.4380	21.58	10.62	32.20	57.10	-24.90	QP	
8		0.4380	11.18	10.62	21.80	47.10	-25.30	AVG	
9		0.7620	28.26	10.64	38.90	56.00	-17.10	QP	
10	*	0.7620	28.26	10.64	38.90	46.00	-7.10	AVG	
11		0.9818	24.45	10.65	35.10	56.00	-20.90	QP	
12		0.9818	22.95	10.65	33.60	46.00	-12.40	AVG	



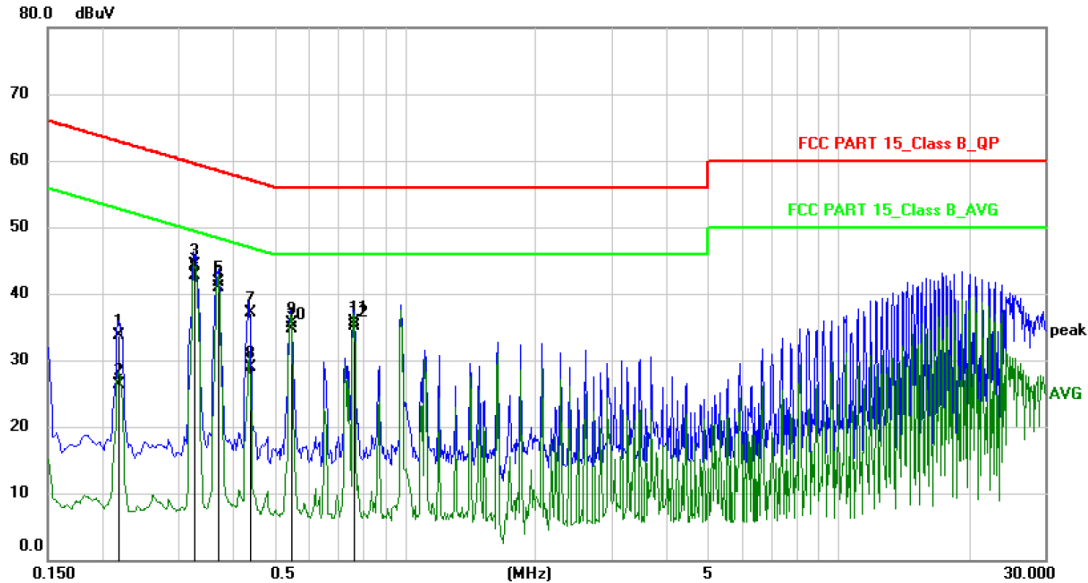
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Conducted Emission Measurement

Data :#2

Date: 2019/6/20

Time: 15:14:29



Site

Phase: **N**

Temperature: 26

Limit: FCC PART 15_Class B_QP

Power: AC120V/60Hz

Humidity: 50 %

EUT: Active Speaker

M/N: M100-BT

Mode: TX

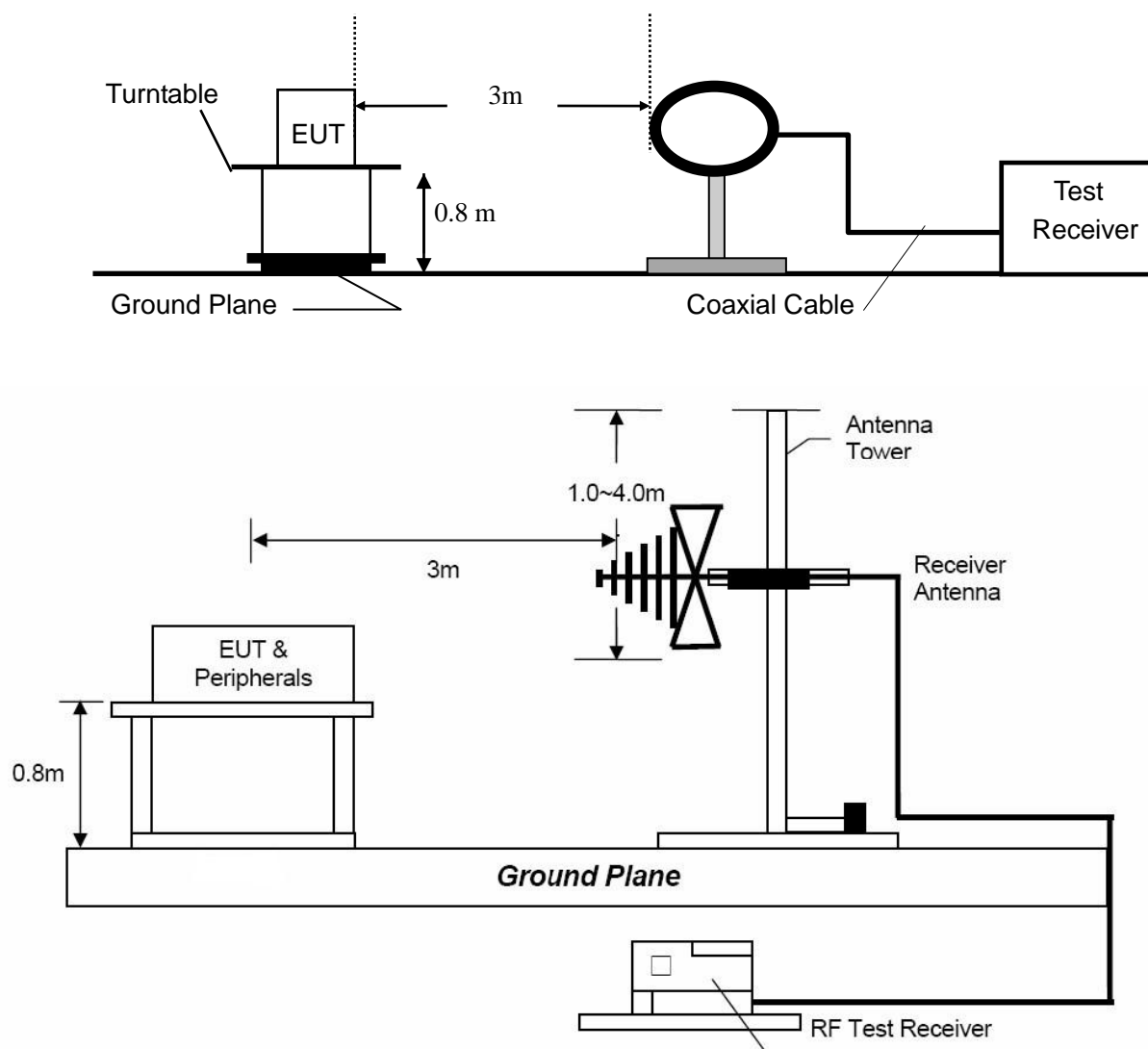
Note: 8DPSK High Channel

No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	0.2184	23.19	10.61	33.80	62.88	-29.08	QP	
2	0.2184	15.69	10.61	26.30	52.88	-26.58	AVG	
3	0.3260	33.69	10.61	44.30	59.55	-15.25	QP	
4 *	0.3260	32.09	10.61	42.70	49.55	-6.85	AVG	
5	0.3709	31.19	10.61	41.80	58.48	-16.68	QP	
6	0.3709	30.29	10.61	40.90	48.48	-7.58	AVG	
7	0.4380	26.58	10.62	37.20	57.10	-19.90	QP	
8	0.4380	18.38	10.62	29.00	47.10	-18.10	AVG	
9	0.5460	24.88	10.62	35.50	56.00	-20.50	QP	
10	0.5460	24.18	10.62	34.80	46.00	-11.20	AVG	
11	0.7620	25.06	10.64	35.70	56.00	-20.30	QP	
12	0.7620	24.56	10.64	35.20	46.00	-10.80	AVG	

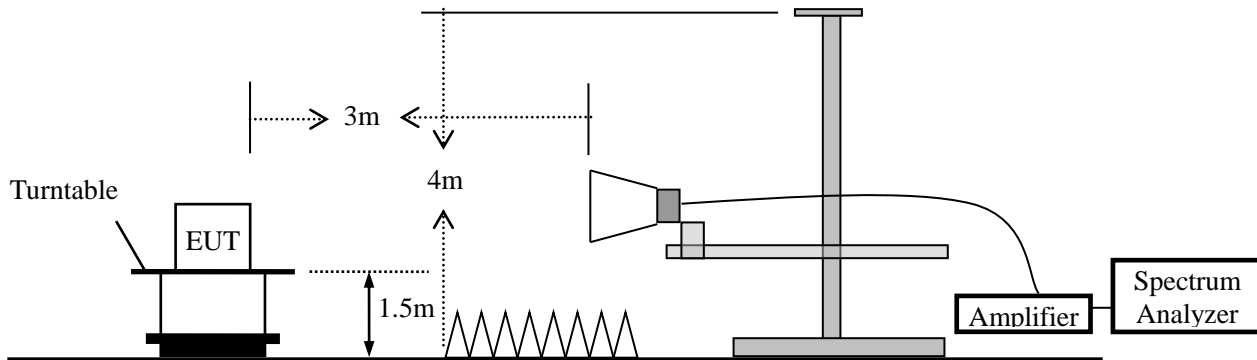
4. Radiated Emission Test

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

- 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.
- 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.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- 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 $(\text{dB})\mu\text{V} = 20 \log \text{Emission level } \mu\text{V/m}$
 - (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: 8DPSK High Channel



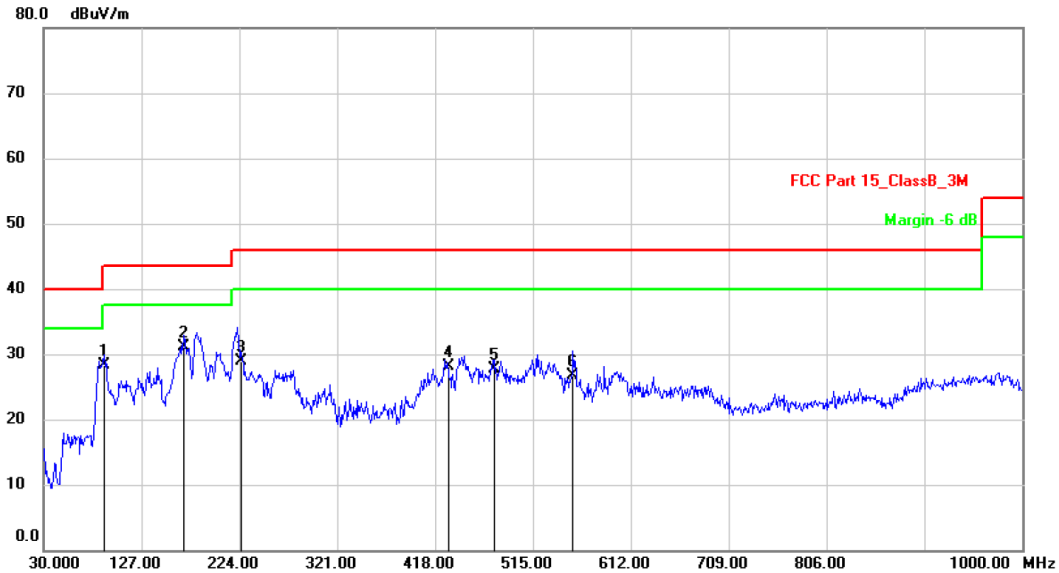
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Radiated Emission Measurement

Data :#5

Date: 2019/6/20

Time: 9:42:23



Site
Limit: FCC Part 15_ClassB_3M
EUT: Active Speaker
M/N: M100-BT
Mode: TX
Note: 8DPSK High Channel

Polarization: **Horizontal** Temperature: 26
Power: AC120V/60Hz Humidity: 47 %
Distance: 3m

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		90.1400	42.30	-13.90	28.40	43.50	-15.10	QP		
2	*	168.7100	45.95	-14.85	31.10	43.50	-12.40	QP		
3		225.9400	41.57	-12.67	28.90	46.00	-17.10	QP		
4		431.5800	36.49	-8.39	28.10	46.00	-17.90	QP		
5		476.2000	35.11	-7.31	27.80	46.00	-18.20	QP		
6		554.7700	33.09	-6.39	26.70	46.00	-19.30	QP		

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



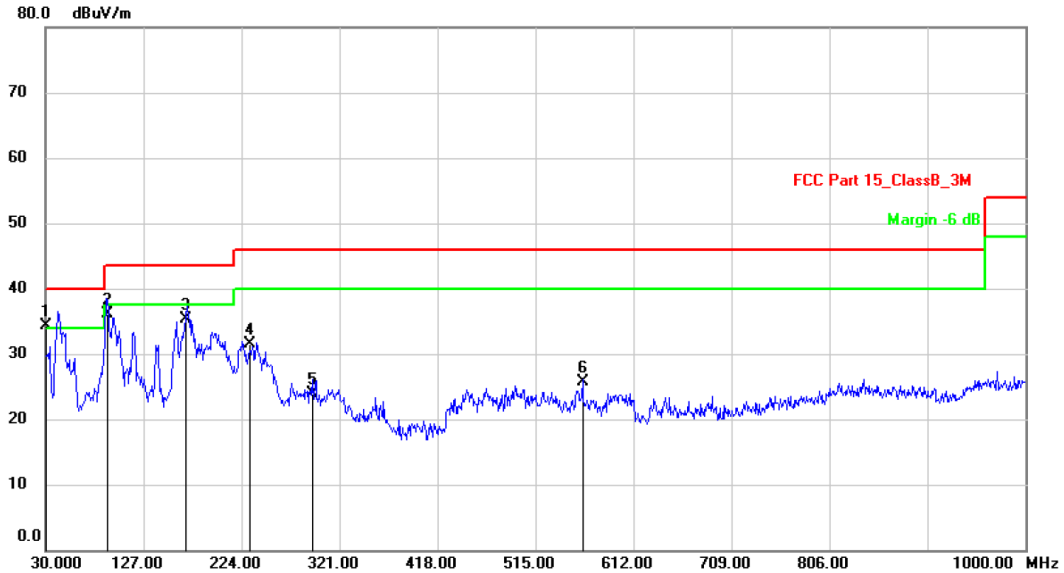
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Radiated Emission Measurement

Data :#6

Date: 2019/6/20

Time: 9:49:32



Site

Polarization: **Vertical**

Temperature: 26

Limit: FCC Part 15_ClassB_3M

Power: AC120V/60Hz

Humidity: 47 %

EUT: Active Speaker

Distance: 3m

M/N: M100-BT

Mode: TX

Note: 8DPSK High Channel

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1	*	30.0000	50.20	-15.90	34.30	40.00	-5.70	QP		
2		91.1100	52.86	-16.66	36.20	43.50	-7.30	QP		
3		168.7100	53.25	-17.85	35.40	43.50	-8.10	QP		
4		232.7300	46.93	-15.33	31.60	46.00	-14.40	QP		
5		293.8400	36.64	-12.64	24.00	46.00	-22.00	QP		
6		561.5600	33.96	-8.16	25.80	46.00	-20.20	QP		

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

Modulation: 8DPSK (the worst case)
Frequency Range: 1-25GHz Test Date : June 20, 2019
Test Result: PASS Temperature : 23 °C
Measured Distance: 3m Humidity : 51 %
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	46.85	30.61	6.30	53.15	36.91	74.00	54.00	-20.85	-17.09
7206	V	46.85	30.61	10.44	56.17	40.36	74.00	54.00	-17.83	-13.64

4804	H	46.94	33.80	6.30	53.24	40.10	74.00	54.00	-20.76	-13.90
7206	H	44.92	29.70	10.44	55.36	40.14	74.00	54.00	-18.64	-13.86

Operation Mode: TX Mode (Mid)										
4882	V	48.61	32.54	6.60	55.21	39.14	74.00	54.00	-18.79	-14.86
7323	V	44.06	29.78	10.55	54.61	40.33	74.00	54.00	-19.39	-13.67

4882	H	46.96	33.73	6.60	53.56	40.33	74.00	54.00	-20.44	-13.67
7323	H	47.11	30.72	10.55	57.66	41.27	74.00	54.00	-16.34	-12.73

Operation Mode: TX Mode (High)										
4960	V	45.58	33.34	6.89	52.47	40.23	74.00	54.00	-21.53	-13.77
7440	V	45.53	29.65	10.60	56.13	40.25	74.00	54.00	-17.87	-13.75

4960	H	45.80	30.74	6.89	52.69	37.63	74.00	54.00	-21.31	-16.37
7440	H	44.57	29.91	10.60	55.17	40.51	74.00	54.00	-18.83	-13.49

- 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 : $\pm 3.7\text{dB}$.
 - (6) Horn antenna used for the emission over 1000MHz.

5. Band Edge

5.1 Measurement Procedure

For radiated measurement Refer to section 4.1.2 for Set-up

5.2 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.

5.3 Measurement Results

Please see below test table and plots.
 For Radiated Emission
 The worst case: 8DPSK

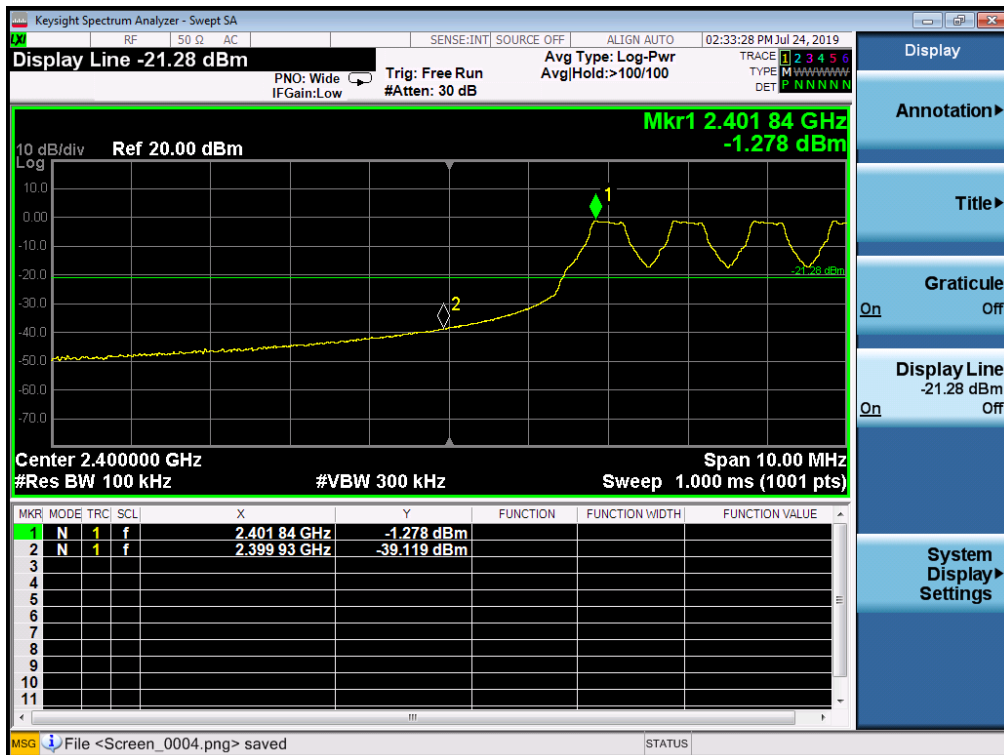
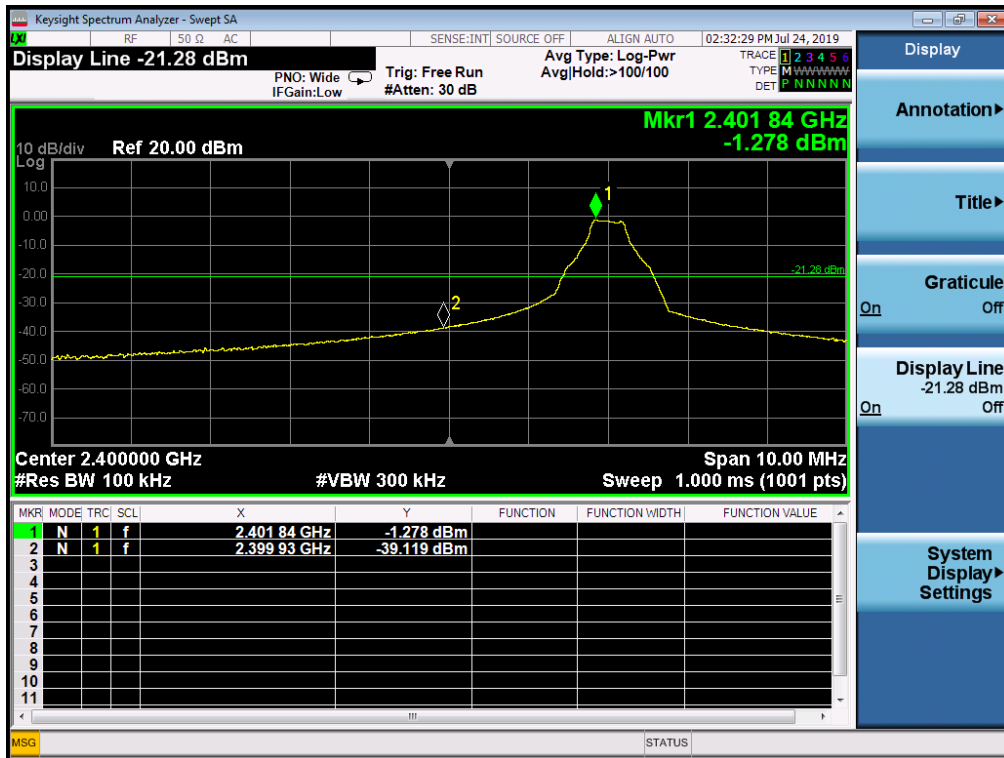
Hopping-on mode

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
2399.000	H	70.10	44.11	0.13	70.23	44.24	74.00	54.00	-3.77	-9.76
2399.000	V	63.11	37.88	0.13	63.24	38.01	74.00	54.00	-10.76	-15.99
2483.560	H	65.13	42.20	0.34	65.47	42.54	74.00	54.00	-8.53	-11.46
2483.560	V	61.07	37.17	0.34	61.41	37.51	74.00	54.00	-12.59	-16.49

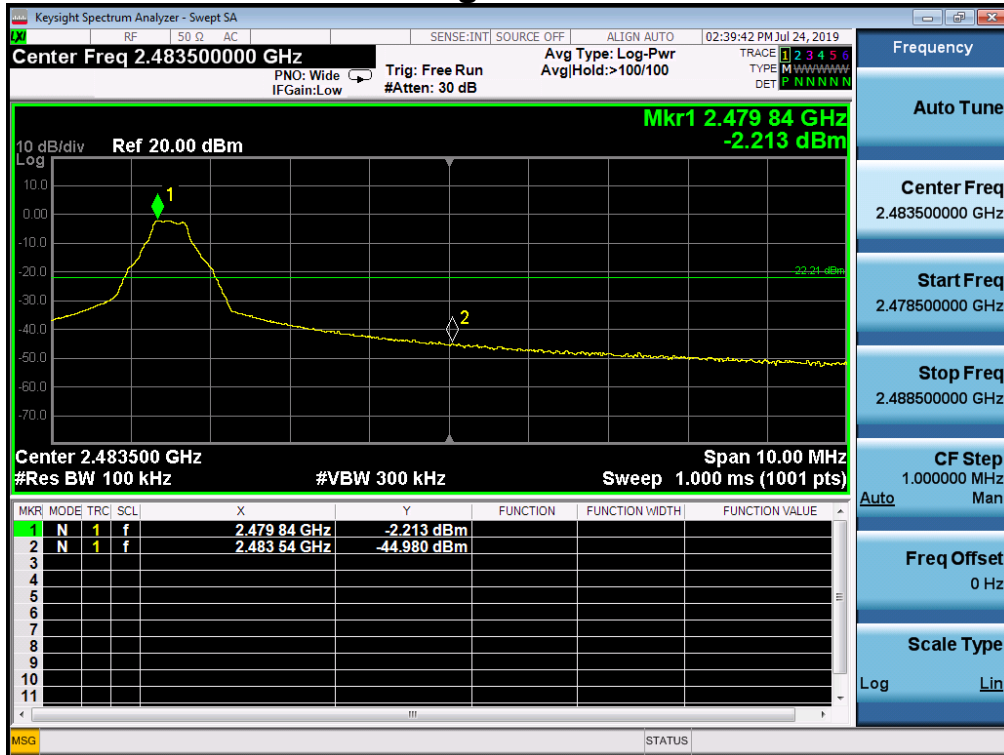
- Note:**
- (1) Emission Level= Reading Level + Factor
 - (2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
 - (3) Horn antenna used for the emission over 1000MHz.

For RF Conducted

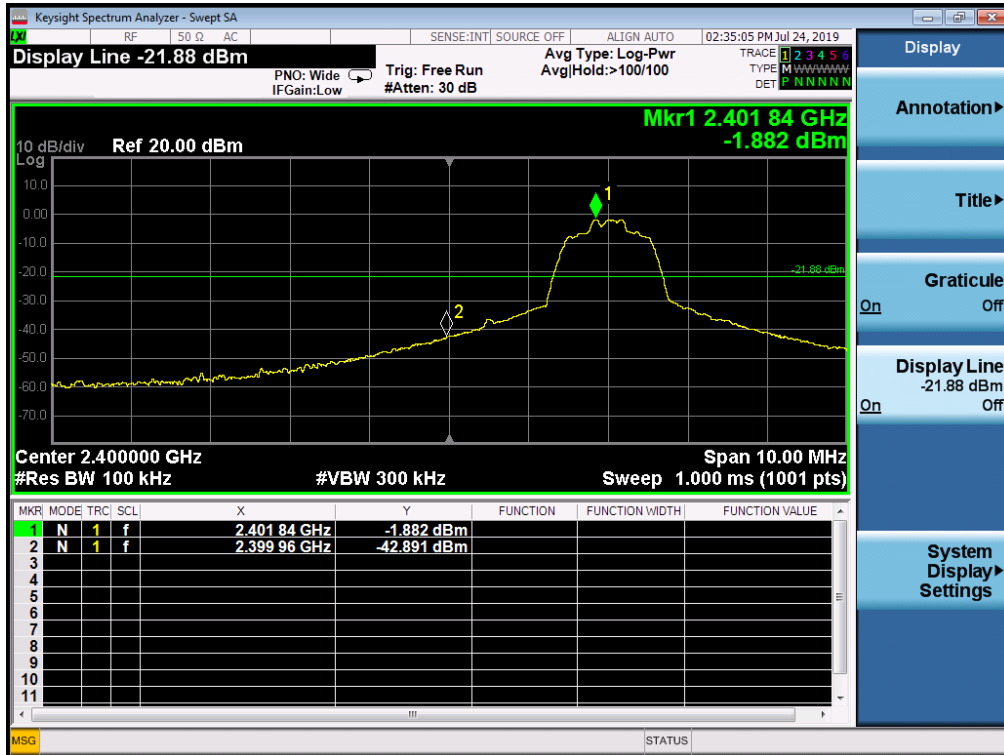
GFSK Lowest Channel



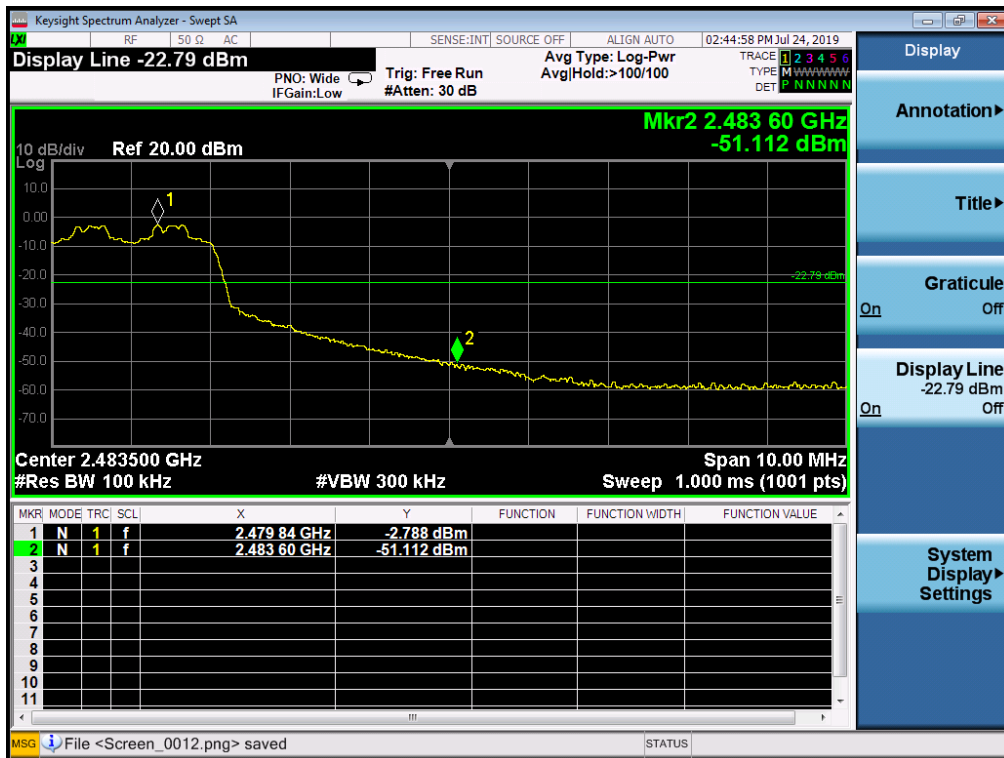
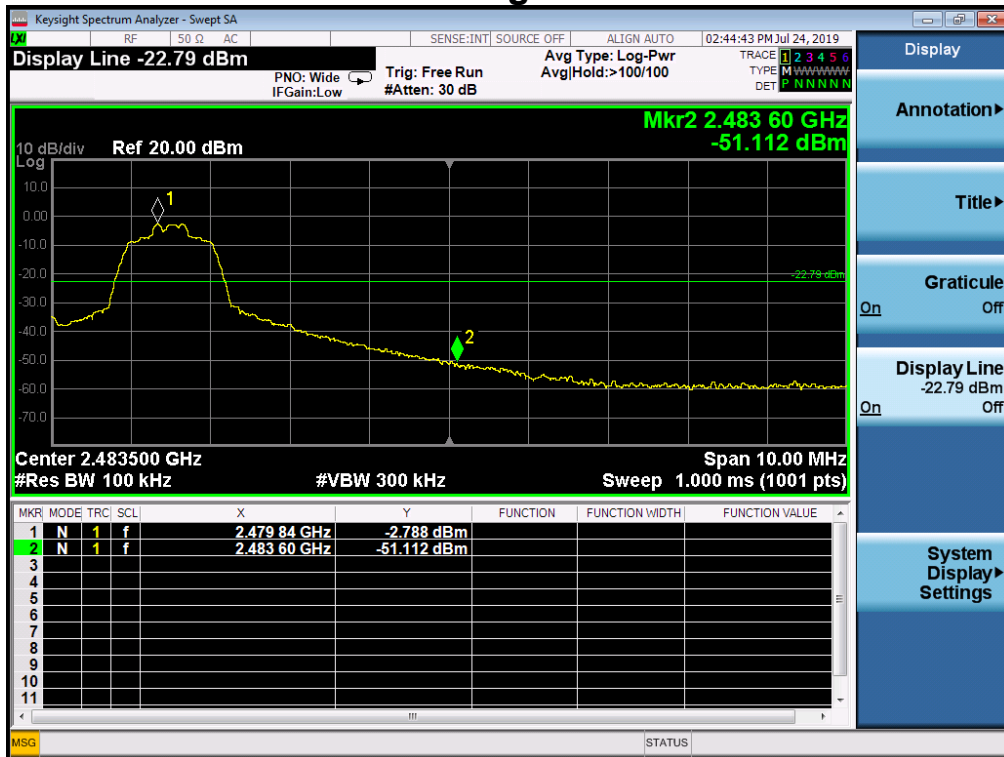
GFSK Highest Channel



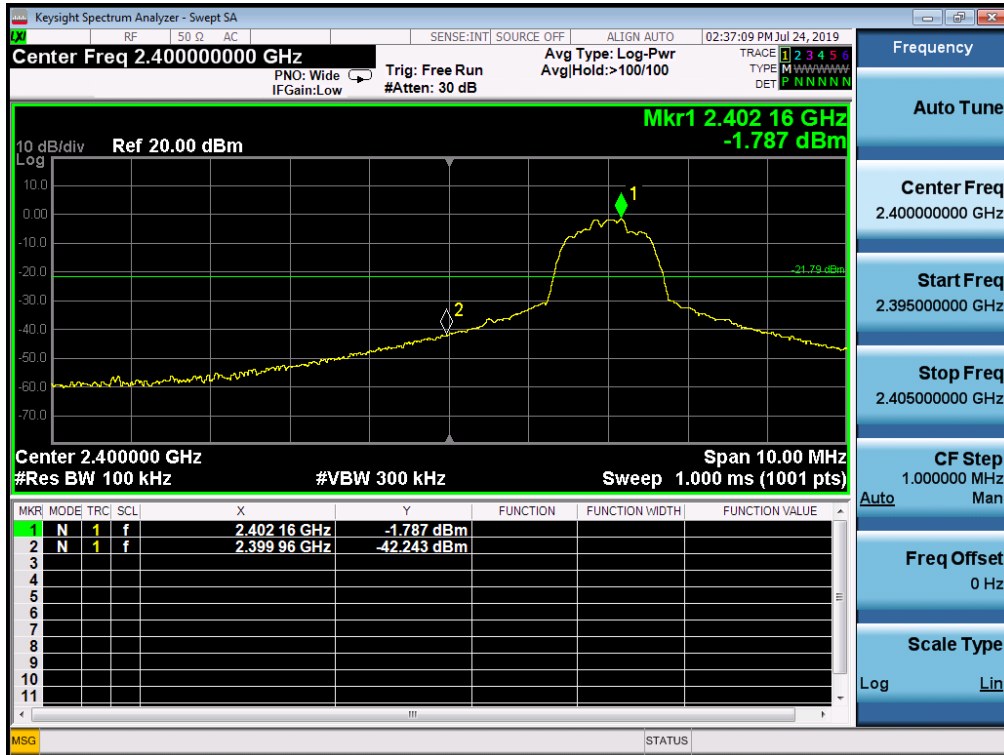
$\pi/4$ -DQPSK Lowest Channel



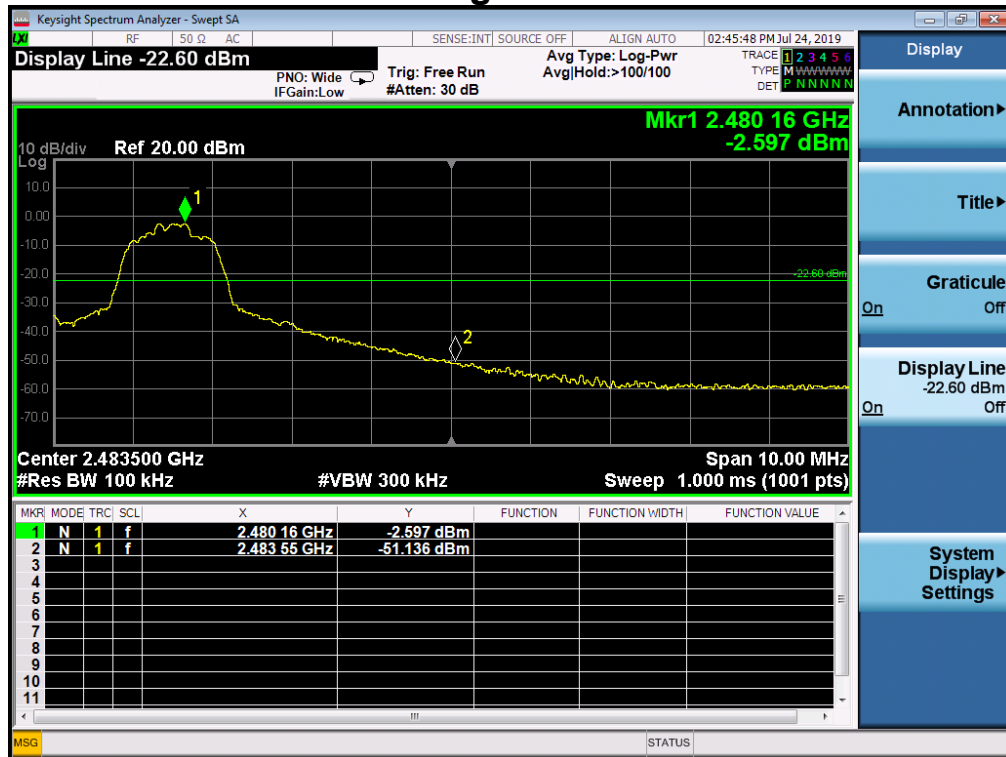
$\pi/4$ -DQPSK Highest Channel



8DPSK Lowest Channel



8DPSK Highest Channel



6. 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, 2018	Apr. 25, 2019
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, 2018	Apr. 25, 2019
Loop antenna	Daze	ZA30900A	0708	9KHz~30MHz	Apr. 25, 2018	Apr. 25, 2019
Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	20Hz~26.5GHz	Apr. 25, 2018	Apr. 25, 2019
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, 2018	Apr. 25, 2019
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.

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