



Test Report

Date : 2020-09-28
No. : HM20080050

Page 1 of 85

Applicant: inMusic Brands Inc
200 Scenic View Drive Cumberland,
RI 02864 USA

Manufacturer: inMusic Brands Inc
200 Scenic View Drive Cumberland,
RI 02864 USA

Description of Sample(s): Submitted sample(s) said to be
Product: Bluetooth Receiver with XLR outputs
Brand Name: 
ALTO PROFESSIONAL
Model No.: BLUETOOTH® ULTIMATE
FCC ID: Y4O-TBT2

Date Samples Received: 2020-08-24

Date Tested: 2020-09-02 to 2020-09-12

Investigation Requested: Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2018 and ANSI C63.10:2013 for FCC Certification.

Conclusions: The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

Remarks: Bluetooth BR + EDR only



Dr. LEE Kam Chuen,
Authorized Signatory



Test Report

Date : 2020-09-28
No. : HM20080050

Page 2 of 85

CONTENT:

Cover	Page 1 of 85
Content	Page 2 of 85
<u>1.0</u> <u>General Details</u>	
1.1 Test Laboratory	Page 3 of 85
1.2 Equipment Under Test [EUT] Description of EUT operation	Page 3 of 85
1.3 Date of Order	Page 3 of 85
1.4 Submitted Sample(s)	Page 3 of 85
1.5 Test Duration	Page 4 of 85
1.6 Country of Origin	Page 4 of 85
1.7 RF Module Details	Page 4 of 85
1.8 Channel List	Page 4 of 85
<u>2.0</u> <u>Technical Details</u>	
2.1 Investigations Requested	Page 5 of 85
2.2 Test Standards and Results Summary	Page 5 of 85
2.3 Table for Test Modes	Page 6 of 85
<u>3.0</u> <u>Test Results</u>	
3.1 Emission	Page 7-63 of 85
<u>Appendix A</u>	
List of Measurement Equipment	Page 64 of 85
<u>Appendix B</u>	
Photograph(s) of Product	Page 65-85 of 85

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 3 of 85

1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
Head Office: 10 Dai Wang Street, Taipo Industrial Estate, Tai Po, N.T., Hong Kong
Telephone: 852 2666 1888
Fax: 852 2664 4353

FCC Test Firm Registration Number 723883
Designation Number HK0001

1.2 Equipment Under Test [EUT]

Description of Sample(s)

Product Name: Bluetooth Receiver with XLR outputs
Manufacturer: inMusic Brands Inc
200 Scenic View Drive Cumberland,
RI 02864 USA

Brand Name:



ALTO PROFESSIONAL
BLUETOOTH® ULTIMATE
TBT2
3.7Vd.c Li-ion Battery (500mAh)
5Vd.c of USB port of EUT

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a 2.4GHz Bluetooth Audio Receiver. The tests were conducted under RF Test mode to maintain continuous transmission during test. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC. The test mode was controlled by test software – “FCC_assist.exe “used during tests, which was provided by manufacturer.

1.3 Date of Order

2020-08-24

1.4 Submitted Sample(s):

2 Samples

1.5 Test Duration

2020-09-02 to 2020-09-12

1.6 Country of Origin

Not Provided

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 4 of 85

1.7 RF Module Details

Module Model Number: AC6925A
Module FCC ID: N/A
Module Transmission Type: Bluetooth BR +EDR
Modulation: GFSK, $\pi/4$ -DQPSK
Data Rates: 2Mbps (Max)
Frequency Range: 2400-2483.5MHz
Carrier Frequencies: 2402MHz – 2480MHz

Module Specification (specification provided by manufacturer)

1.8 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	42	2444
1	2403	43	2445
2	2404	44	2446
3	2405	45	2447
4	2406	46	2448
5	2407	47	2449
6	2408	48	2450
7	2409
8	2410	67	2469
9	2411	68	2470
...	...	69	2471
33	2435	70	2472
34	2436	71	2473
35	2437	72	2474
36	2438	73	2475
37	2439	74	2476
38	2440	75	2477
39	2441	76	2478
40	2442	77	2479
41	2443	78	2480

2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2018 Regulations. ANSI C63.10:2013 for FCC Certification. The device was realized by test software.

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 5 of 85

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Maximum Peak Output Power	FCC 47CFR 15.247(b)(1)	ANSI C63.10:2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Radiated Spurious Emissions	FCC 47CFR 15.209 FCC 47CFR 15.205	ANSI C63.10:2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conducted Spurious Emissions	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10:2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of Hopping Frequency	FCC 47CFR 15.247 (b)(1)	ANSI C63.10:2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hopping Channel Separation	FCC 47CFR 15.247(a)(1)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Band-edge Measurement	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pseudorandom Hopping Algorithm	FCC 47CFR 15.247(a)(1)	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time of Occupancy (Dwell Time)	FCC 47CFR 15.247(a)(1)(iii)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Antenna Requirement	FCC 47CFR 15.203	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RF Exposure	FCC 47CFR 15.247(i)	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: N/A - Not Applicable

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 6 of 85

0

2.3 Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate in the table below is the worst case rate with respect to the specific test item.

Investigation has been done on all the possible configurations for searching the worst cases.

The following table is a list of the test modes shown in this test report.

Test software	FCC_assist.exe	
Power level setting	10	
Channel	0	2402 MHz
	39	2441 MHz
	78	2480 MHz

Test Items	
Maximum Peak Conducted Output Power	GFSK (DH5) / $\pi/4$ -DQPSK (2DH5)
Hopping Channel Separation	GFSK (DH5) / $\pi/4$ -DQPSK (2DH5)
Number of Hopping Frequency	GFSK (DH5) / $\pi/4$ -DQPSK (2DH5)
Time of Occupancy(Dwell Time)	$\pi/4$ -DQPSK (2DH1 / 2DH3 / 2DH5)
Radiated Spurious Emissions	GFSK (DH5) / $\pi/4$ -DQPSK (2DH5)

Duty Cycle	
DH5	77%
2DH5	77%

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 7 of 85

3.0 Test Results

3.1 Emission

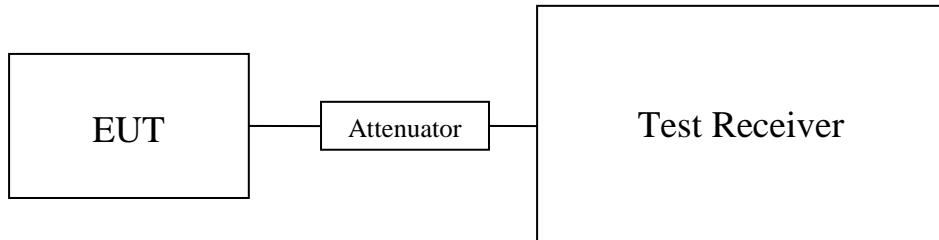
3.1.1 Maximum Peak Output Power

Test Requirement: FCC 47CFR 15.247(b)(3)
Test Method: ANSI C63.10: 2013
Test Date: 2020-09-09
Mode of Operation: Tx mode

Test Method:

The RF output of the EUT was connected to the Test Receiver. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

Test Setup:



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 8 of 85

Limits for Peak Output Power of Fundamental & Harmonics Emissions [FCC 47CFR 15.247]:

2400–2483.5 MHz band:
The maximum peak output power shall not exceed the following limits:
For frequency hopping systems employing at least 75 hopping channels: 1 Watt
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts
For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt

Results of Bluetooth Communication mode (GFSK) (Fundamental Power): Pass Maximum conducted peak power

Channel	Frequency(MHz)	Output Power(dBm)	Output Power(Watt)
0	2402	-3.18	0.00048
39	2441	-3.79	0.00042
78	2480	-3.89	0.00041

Results of Bluetooth Communication mode ($\pi/4$ -DQPSK) (Fundamental Power): Pass Maximum conducted peak power

Channel	Frequency(MHz)	Output Power(dBm)	Output Power(Watt)
0	2402	-2.54	0.00056
39	2441	-3.11	0.00049
78	2480	-3.16	0.00048

Calculated measurement uncertainty :
30MHz to 1GHz 1.7dB
1GHz to 18GHz 1.7dB

Remark:

1. All test data for each data rate were verified, but only the worst case was reported.
2. The EUT is programmed to transmit signals continuously for all testing.

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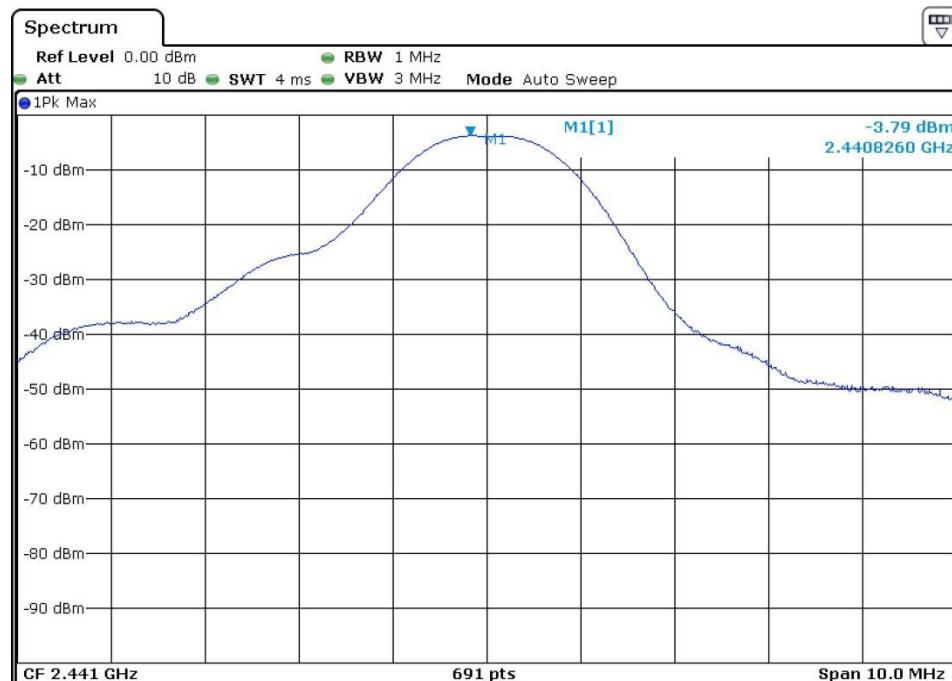
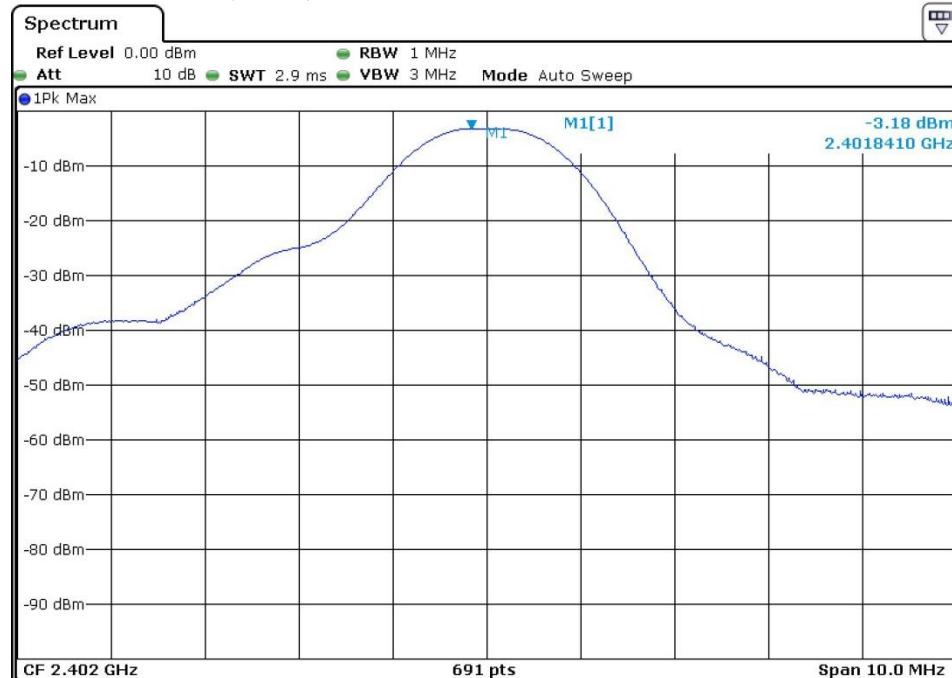
Test Report

Date : 2020-09-28

No. : HM20080050

Page 9 of 85

Result of Tx mode (GFSK)



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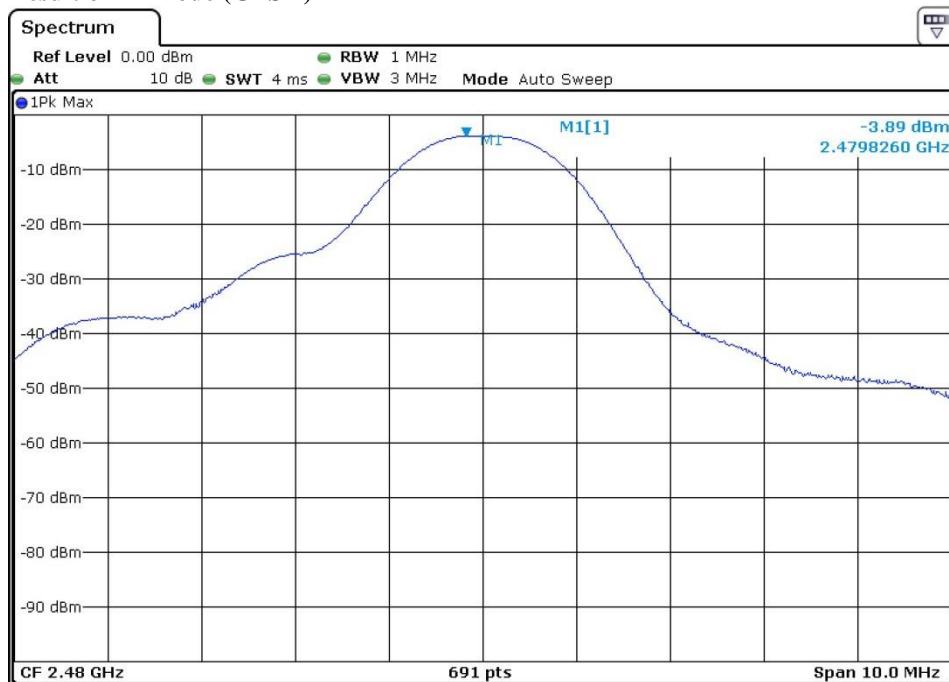


Test Report

Date : 2020-09-28
No. : HM20080050

Page 10 of 85

Result of Tx mode (GFSK)



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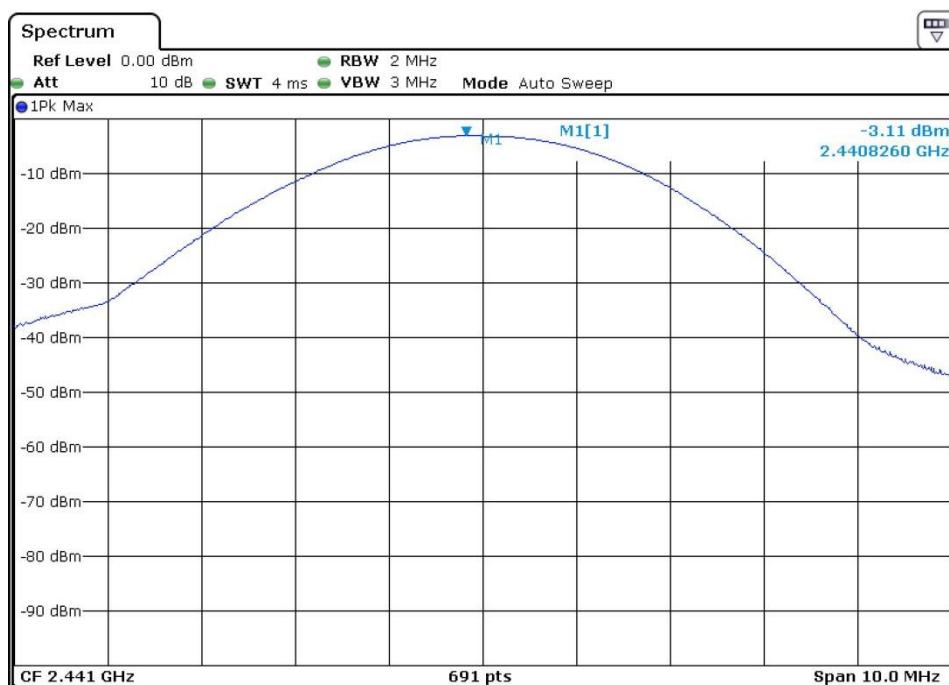
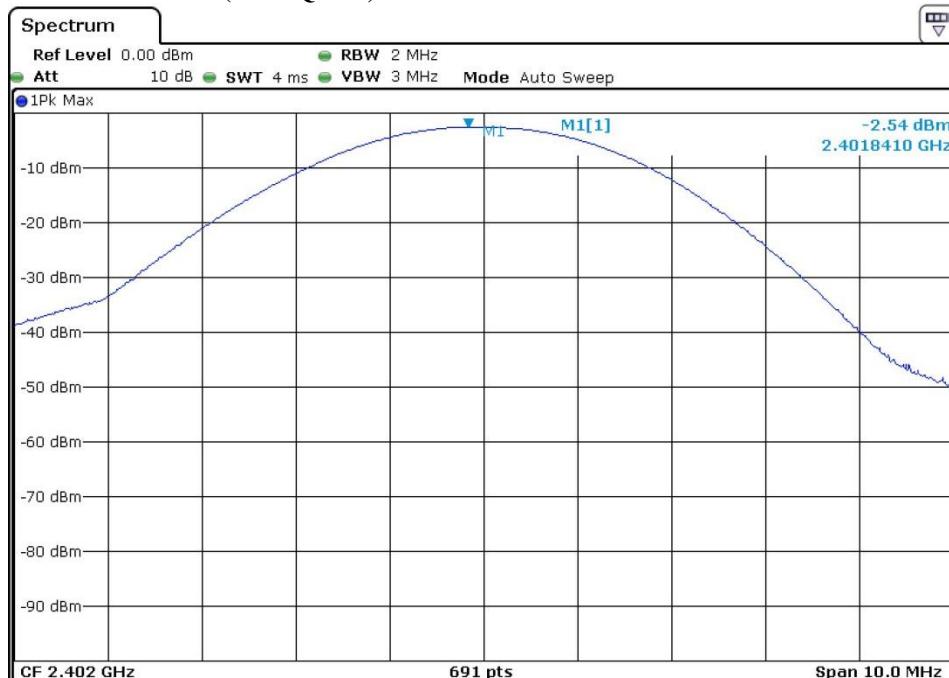
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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 11 of 85

Result of Tx mode ($\pi/4$ -DQPSK)

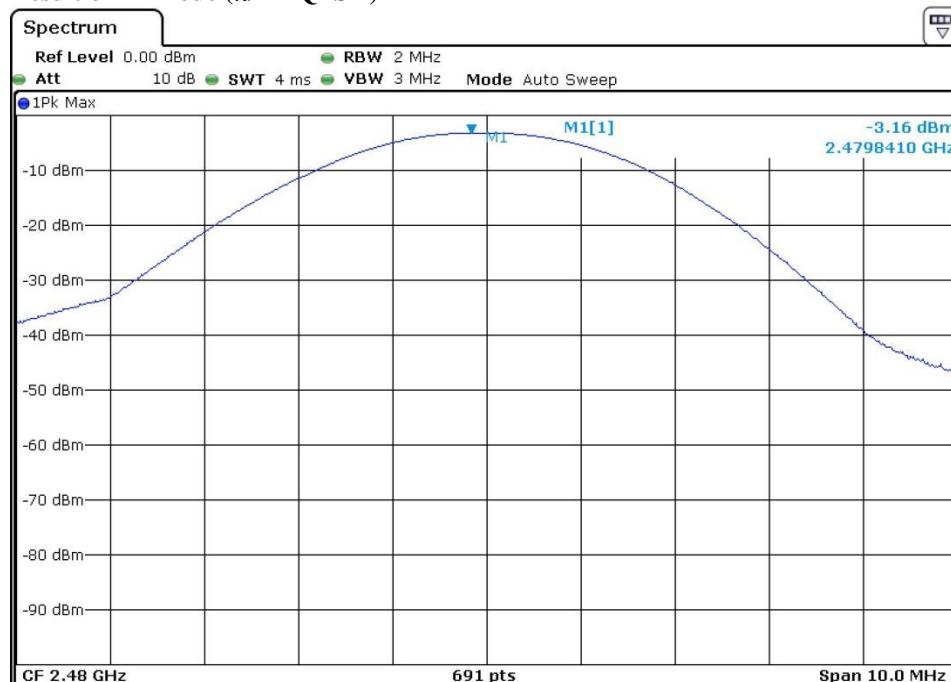


Test Report

Date : 2020-09-28
No. : HM20080050

Page 12 of 85

Result of Tx mode ($\pi/4$ -DQPSK)



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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 13 of 85

3.1.2 Radiated and Conducted Spurious Emissions

Test Requirement: FCC 47CFR 15.209

Test Method: ANSI C63.10:2013

Test Date: 2020-09-09

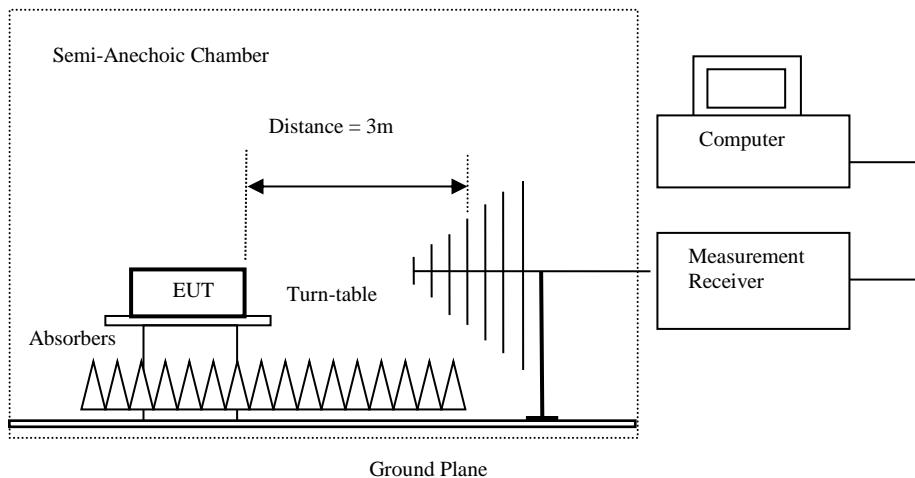
Mode of Operation: Tx mode

Radiated Spurious Emissions

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. The measured field strength would be calculated as EIRP.

Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.
- For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.



Test Report

Date : 2020-09-28
No. : HM20080050

Page 14 of 85

Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:

Frequency Range [MHz]	Quasi-Peak Limits [μ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above 960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Spectrum Analyzer and EMI Test Receiver setting parameters are referred to ANSI 63.10, KDB 558074 and CISPR 16-1-1

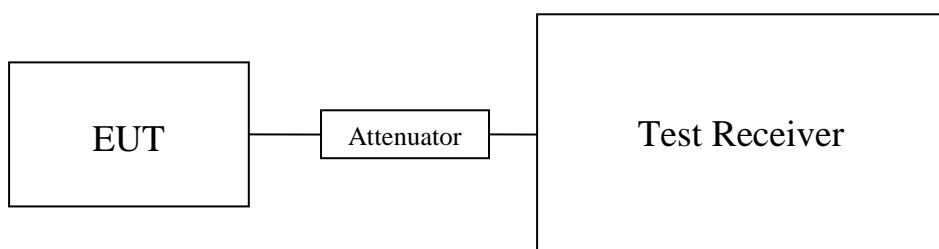
Frequency range	RBW	VBW
9 kHz to 150 kHz	200 Hz	3 x RBW
0.15 MHz to 30 MHz	9 kHz	
30 MHz to 1 000 MHz	120 kHz	
1 GHz to 40 GHz	1 MHz	

Conducted Spurious Emissions

Test Method:

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Test Setup:



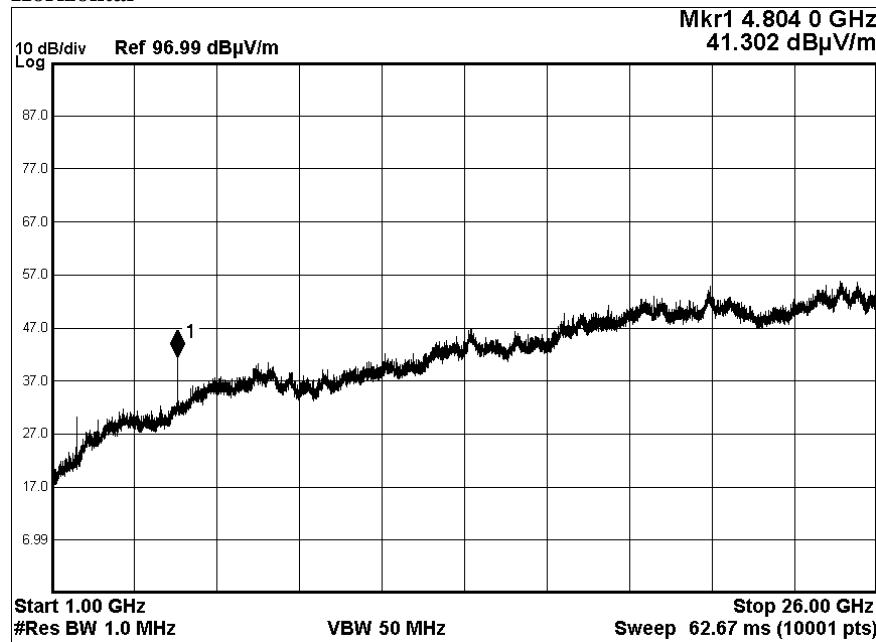


Test Report

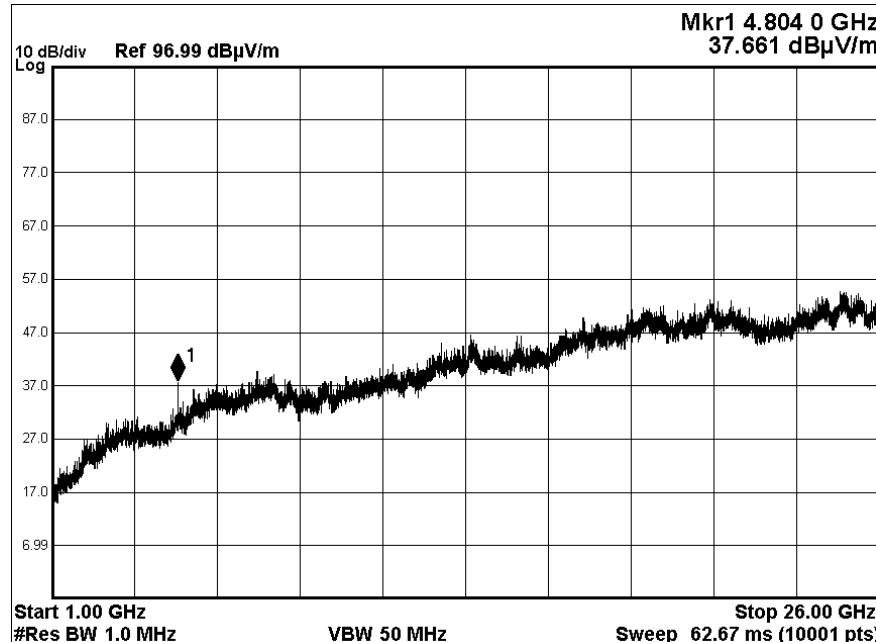
Date : 2020-09-28
No. : HM20080050

Page 15 of 85

Pre-scan graph of result of Tx mode (GFSK) (2402.0 MHz)
Horizontal



Vertical



Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer to the band-edge plot for the level of fundamental frequency

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 16 of 85

Result of Tx mode , GFSK (2402.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2402.0	51.4	27.9	79.3	N/A	N/A	Vertical
2399.9	26.7	27.9	54.6	59.3	4.7	Vertical
4804.0	5.6	32.1	37.7	74.0	36.3	Vertical
7206.0	-2.1	38.6	36.5	74.0	37.5	Vertical
9608.0	-2.1	41.3	39.2	74.0	34.8	Vertical

Field Strength of Spurious Emissions						
Average Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2402.0	48.3	27.9	76.2	N/A	N/A	Vertical
2399.9	22.4	27.9	50.3	56.2	5.9	Vertical
4804.0	0.3	32.1	32.4	54.0	21.6	Vertical
7206.0	-5.2	38.6	33.4	54.0	20.6	Vertical
9608.0	-6.3	41.3	35.0	54.0	19.0	Vertical

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2402.0	62.5	27.9	90.4	N/A	N/A	Horizontal
2399.9	33.6	27.9	61.5	70.4	8.9	Horizontal
4804.0	9.2	32.1	41.3	74.0	32.7	Horizontal
7206.0	-2.1	38.6	36.5	74.0	37.5	Horizontal
9608.0	-2.9	41.3	38.4	74.0	35.6	Horizontal

Field Strength of Spurious Emissions						
Average Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2402.0	58.8	27.9	86.7	N/A	N/A	Horizontal
2399.9	29.6	27.9	57.5	66.7	9.2	Horizontal
4804.0	2.1	32.1	34.2	54.0	19.8	Horizontal
7206.0	-4.9	38.6	33.7	54.0	20.3	Horizontal
9608.0	-6.3	41.3	35.0	54.0	19.0	Horizontal

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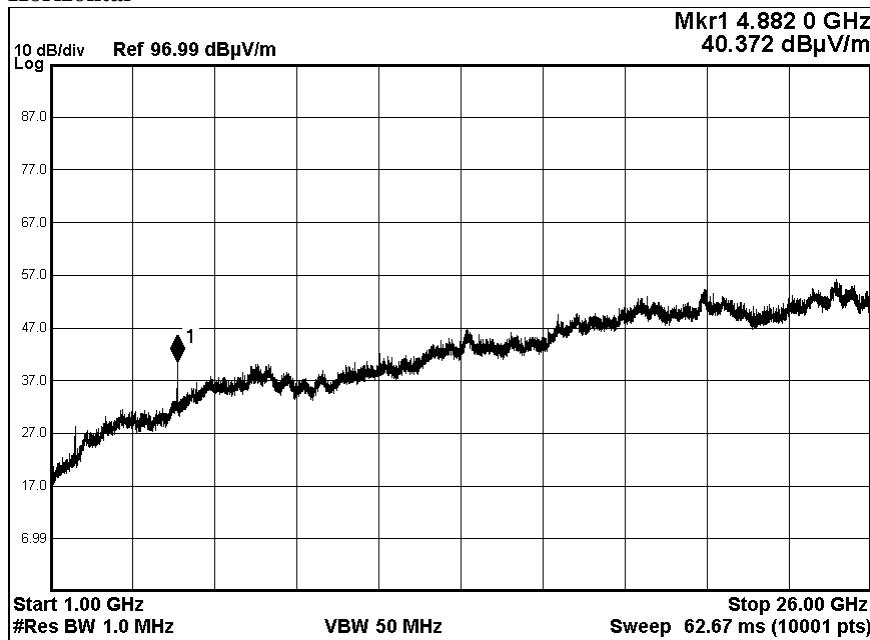


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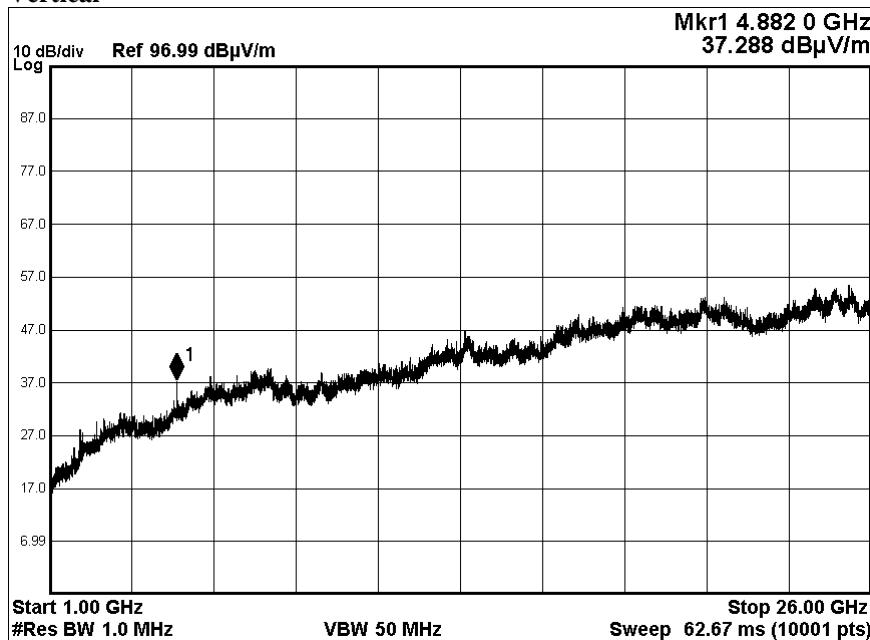
Date : 2020-09-28
No. : HM20080050

Page 17 of 85

Pre-scan graph of result of Tx mode (GFSK) (2441.0 MHz)
Horizontal



Vertical



Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 18 of 85

Result of Tx mode, GFSK (2441.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2441.0	52.7	27.9	80.6	N/A	N/A	Vertical
4882.0	5.2	32.1	37.3	74.0	36.7	Vertical
7323.0	-1.4	38.6	37.2	74.0	36.8	Vertical
9764.0	-4.9	41.3	36.4	74.0	37.6	Vertical
12205.0	-5.7	43.5	37.8	74.0	36.2	Vertical

Field Strength of Spurious Emissions						
Average Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2441.0	48.6	27.9	76.5	N/A	N/A	Vertical
4882.0	1.4	32.1	33.5	54.0	20.5	Vertical
7323.0	-5.4	38.6	33.2	54.0	20.8	Vertical
9764.0	-6.2	41.3	35.1	54.0	18.9	Vertical
12205.0	-6.1	43.5	37.4	54.0	16.6	Vertical

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2441.0	63.1	27.9	91.0	N/A	N/A	Horizontal
4882.0	8.3	32.1	40.4	74.0	33.6	Horizontal
7323.0	1.1	38.6	39.7	74.0	34.3	Horizontal
9764.0	-5.1	41.3	36.2	74.0	37.8	Horizontal
12205.0	-5.7	43.5	37.8	74.0	36.2	Horizontal

Field Strength of Spurious Emissions						
Average Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2441.0	59.7	27.9	87.6	N/A	N/A	Horizontal
4882.0	4.1	32.1	36.2	54.0	17.8	Horizontal
7323.0	-1.9	38.6	36.7	54.0	17.3	Horizontal
9764.0	-6.3	41.3	35.0	54.0	19.0	Horizontal
12205.0	-6.2	43.5	37.3	54.0	16.7	Horizontal

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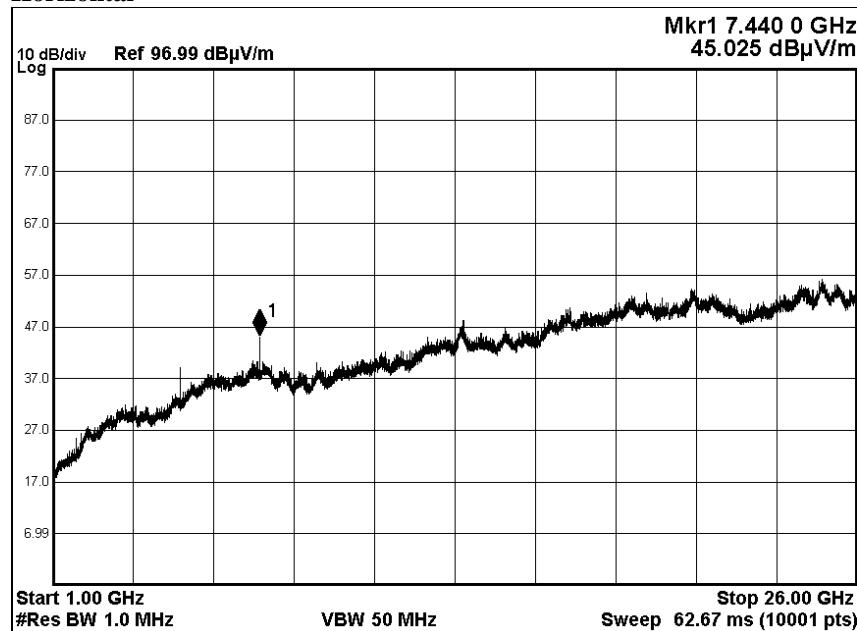
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No. : HM20080050

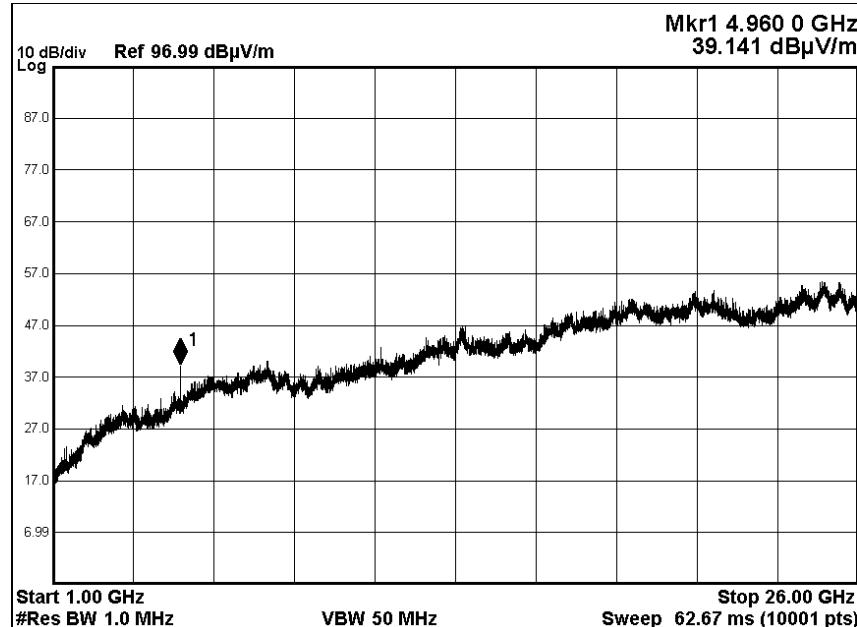
Page 19 of 85

Pre-scan graph of result of Tx mode (GFSK) (2480.0 MHz)

Horizontal



Vertical



Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 20 of 85

Result of Tx mode, GFSK (2480.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2480.0	54.5	27.9	82.4	N/A	N/A	Vertical
4960.0	6.9	32.2	39.1	74.0	34.9	Vertical
7440.0	-1.0	38.6	37.6	74.0	36.4	Vertical
9920.0	-5.1	42.1	37.0	74.0	37.0	Vertical
12400.0	-4.9	44.1	39.2	74.0	34.8	Vertical

Field Strength of Spurious Emissions						
Average Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2480.0	51.1	27.9	79.0	N/A	N/A	Vertical
4960.0	3.3	32.2	35.5	54.0	18.5	Vertical
7440.0	-4.2	38.6	34.4	54.0	19.6	Vertical
9920.0	-6.3	42.1	35.8	54.0	18.2	Vertical
12400.0	-5.9	44.1	38.2	54.0	15.8	Vertical

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2480.0	64.1	27.9	92.0	N/A	N/A	Horizontal
4960.0	7.5	32.2	39.7	74.0	34.3	Horizontal
7440.0	6.4	38.6	45.0	74.0	29.0	Horizontal
9920.0	-5.1	42.1	37.0	74.0	37.0	Horizontal
12400.0	-5.9	44.1	38.2	74.0	35.8	Horizontal

Field Strength of Spurious Emissions						
Average Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
2480.0	60.4	27.9	88.3	N/A	N/A	Horizontal
4960.0	3.2	32.2	35.4	54.0	18.6	Horizontal
7440.0	0.8	38.6	39.4	54.0	14.6	Horizontal
9920.0	-6.1	42.1	36.0	54.0	18.0	Horizontal
12400.0	-6.4	44.1	37.7	54.0	16.3	Horizontal

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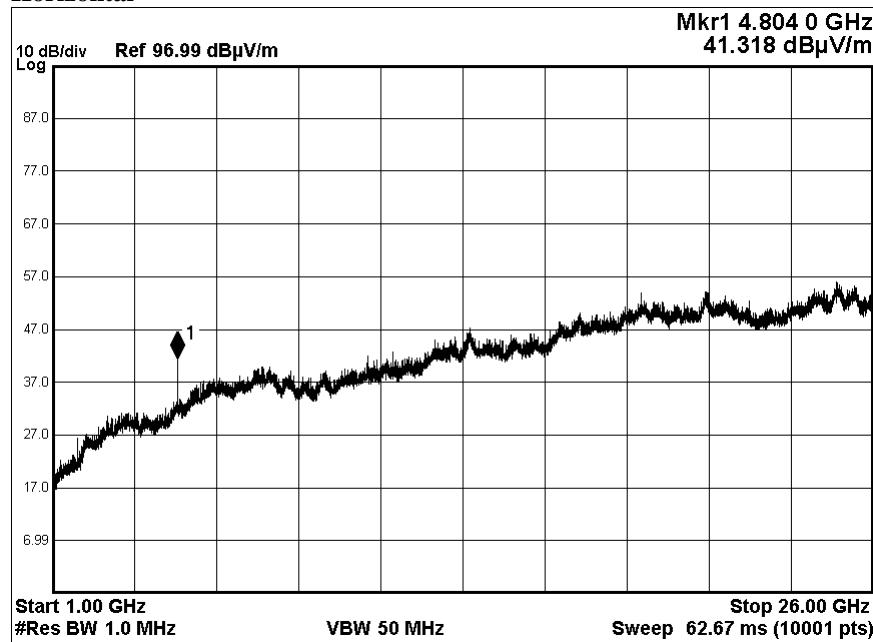


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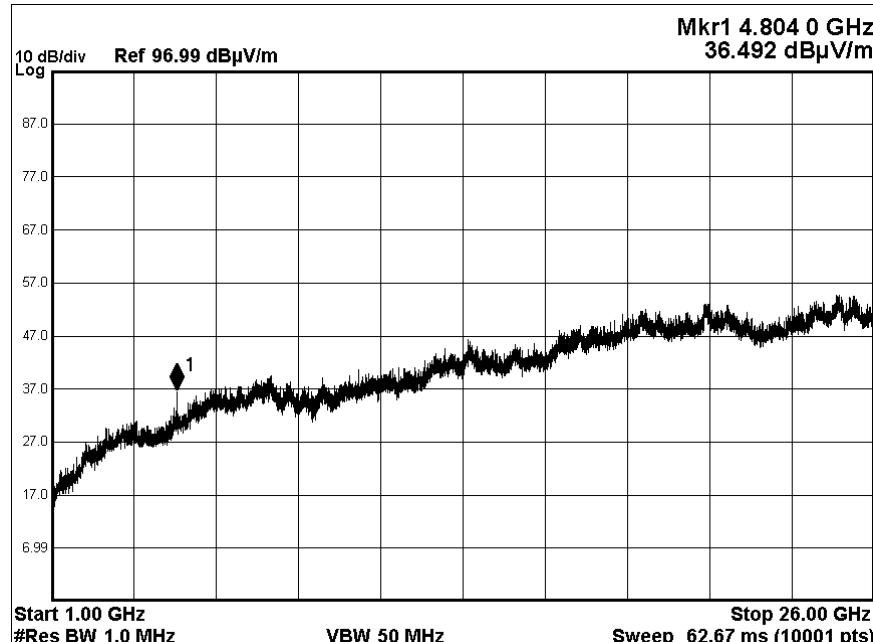
Date : 2020-09-28
No. : HM20080050

Page 21 of 85

Pre-scan graph of result of Tx mode ($\pi/4$ -DQPSK) (2402.0 MHz)
Horizontal



Vertical



Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer to the band-edge plot for the level of fundamental frequency

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 22 of 85

Result of Tx mode, $\pi/4$ -DQPSK (2402.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2402.0	53.1	27.9	81.0	N/A	N/A	Vertical
2399.9	24.3	27.9	52.2	61.0	8.8	Vertical
4804.0	4.4	32.1	36.5	74.0	37.5	Vertical
7206.0	-2.3	38.6	36.3	74.0	37.7	Vertical
9608.0	-3.1	41.3	38.2	74.0	35.8	Vertical

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2402.0	49.7	27.9	77.6	N/A	N/A	Vertical
2399.9	20.8	27.9	48.7	57.6	8.9	Vertical
4804.0	0.2	32.1	32.3	54.0	21.7	Vertical
7206.0	-5.1	38.6	33.5	54.0	20.5	Vertical
9608.0	-6.3	41.3	35.0	54.0	19.0	Vertical

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2402.0	62.7	27.9	90.6	N/A	N/A	Horizontal
2399.9	33.2	27.9	61.1	70.6	9.5	Horizontal
4804.0	9.2	32.1	41.3	74.0	32.7	Horizontal
7206.0	-2.4	38.6	36.2	74.0	37.8	Horizontal
9608.0	-2.6	41.3	38.7	74.0	35.3	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2402.0	58.6	27.9	86.5	N/A	N/A	Horizontal
2399.9	28.3	27.9	56.2	66.5	10.3	Horizontal
4804.0	5.1	32.1	37.2	54.0	16.8	Horizontal
7206.0	-5.1	38.6	33.5	54.0	20.5	Horizontal
9608.0	-5.9	41.3	35.4	54.0	18.6	Horizontal

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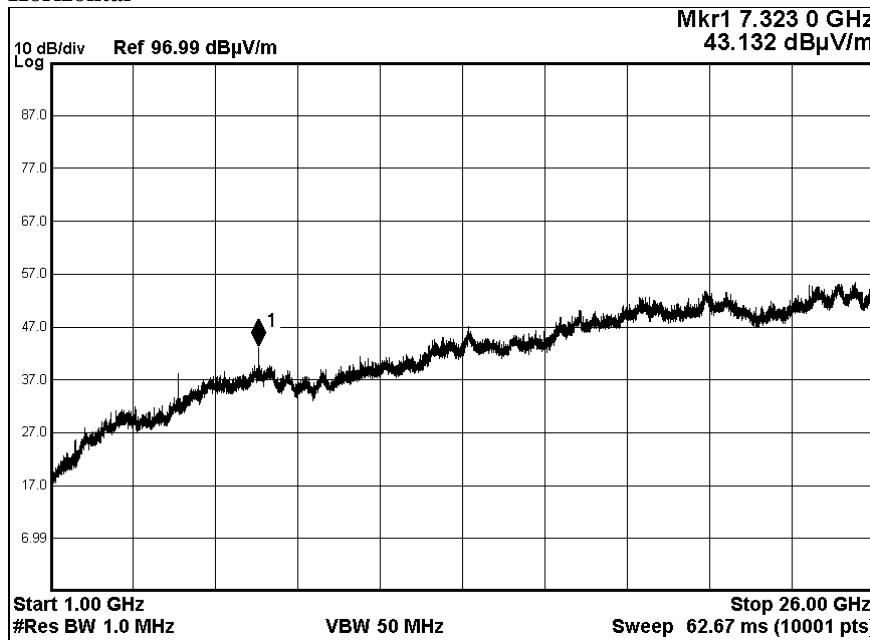


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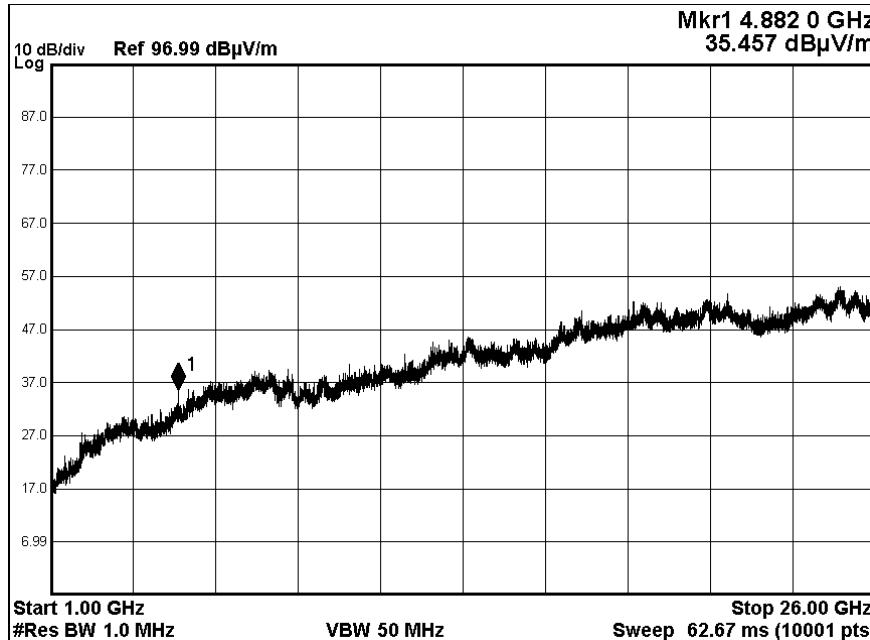
Date : 2020-09-28
No. : HM20080050

Page 23 of 85

Pre-scan graph of result of Tx mode ($\pi/4$ -DQPSK) (2441.0 MHz)
Horizontal



Vertical



Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 24 of 85

Result of Tx mode, $\pi/4$ -DQPSK (2441.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2441.0	54.1	27.9	82.0	N/A	N/A	Vertical
4882.0	3.5	32.1	35.6	74.0	38.4	Vertical
7323.0	-0.7	38.6	37.9	74.0	36.1	Vertical
9764.0	-4.8	41.3	36.5	74.0	37.5	Vertical
12205.0	-5.3	43.5	38.2	74.0	35.8	Vertical

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2441.0	50.2	27.9	78.1	N/A	N/A	Vertical
4882.0	0.1	32.1	32.2	54.0	21.8	Vertical
7323.0	-3.5	38.6	35.1	54.0	18.9	Vertical
9764.0	-5.8	41.3	35.5	54.0	18.5	Vertical
12205.0	-6.1	43.5	37.4	54.0	16.6	Vertical

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2441.0	63.8	27.9	91.7	N/A	N/A	Horizontal
4882.0	7.0	32.1	39.1	74.0	34.9	Horizontal
7323.0	4.5	38.6	43.1	74.0	30.9	Horizontal
9764.0	-4.5	41.3	36.8	74.0	37.2	Horizontal
12205.0	-5.6	43.5	37.9	74.0	36.1	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2441.0	59.1	27.9	87.0	N/A	N/A	Horizontal
4882.0	3.4	32.1	35.5	54.0	18.5	Horizontal
7323.0	0.6	38.6	39.2	54.0	14.8	Horizontal
9764.0	-6.1	41.3	35.2	54.0	18.8	Horizontal
12205.0	-6.6	43.5	36.9	54.0	17.1	Horizontal

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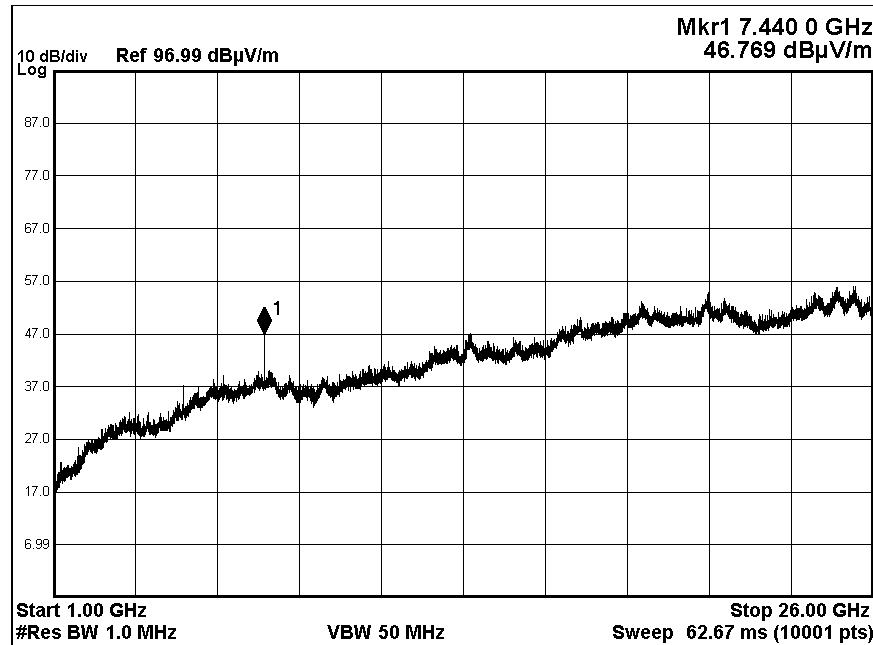
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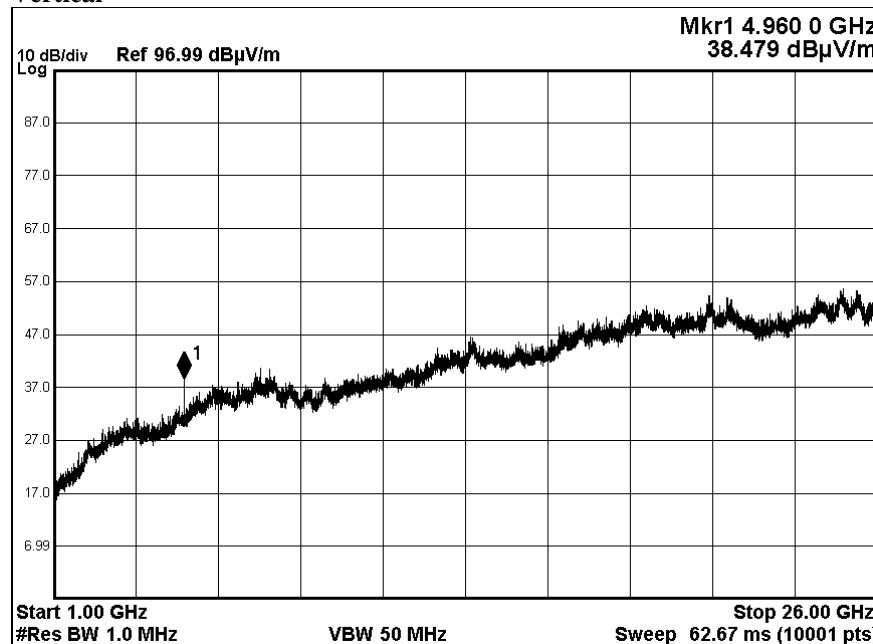
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 No. : HM20080050

Page 25 of 85

Pre-scan graph of result of Tx mode ($\pi/4$ -DQPSK) (2480.0 MHz)
Horizontal



Vertical



Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency

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Date : 2020-09-28

No. : HM20080050

Page 26 of 85

Result of Tx mode, $\pi/4$ -DQPSK (2480.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2480.0	54.1	27.9	82.0	N/A	N/A	Vertical
4960.0	6.3	32.2	38.5	74.0	35.5	Vertical
7440.0	0.7	38.6	39.3	74.0	34.7	Vertical
9920.0	-5.1	42.1	37.0	74.0	37.0	Vertical
12400.0	-4.7	44.1	39.4	74.0	34.6	Vertical

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2480.0	50.8	27.9	78.7	N/A	N/A	Vertical
4960.0	2.3	32.2	34.5	54.0	19.5	Vertical
7440.0	-4.1	38.6	34.5	54.0	19.5	Vertical
9920.0	-6.2	42.1	35.9	54.0	18.1	Vertical
12400.0	-6.1	44.1	38.0	54.0	16.0	Vertical

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2480.0	61.2	27.9	89.1	N/A	N/A	Horizontal
4960.0	5.6	32.2	37.8	74.0	36.2	Horizontal
7440.0	7.2	38.6	45.8	74.0	28.2	Horizontal
9920.0	-4.9	42.1	37.2	74.0	36.8	Horizontal
12400.0	-4.8	44.1	39.3	74.0	34.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2480.0	0.2	27.9	28.1	N/A	N/A	Horizontal
4960.0	1.7	32.2	33.9	54.0	20.1	Horizontal
7440.0	3.5	38.6	42.1	54.0	11.9	Horizontal
9920.0	-6.1	42.1	36.0	54.0	18.0	Horizontal
12400.0	-6.1	44.1	38.0	54.0	16.0	Horizontal

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Date : 2020-09-28
No. : HM20080050

Page 27 of 85

Result of Tx mode (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Remarks:

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz
* Denotes restricted band of operation.

Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty : 9kHz-30MHz 3.3dB
30MHz -1GHz 4.6dB
1GHz -26GHz 4.4dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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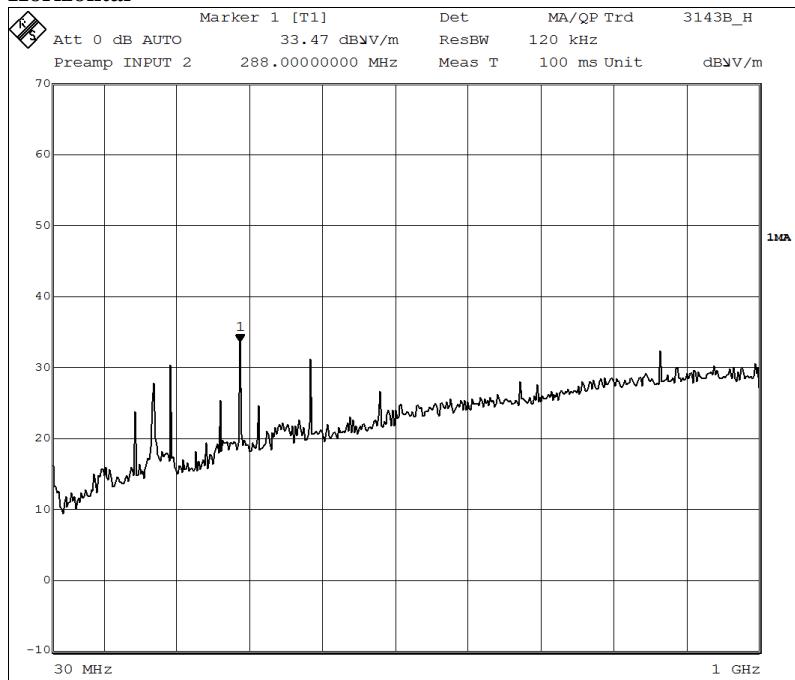
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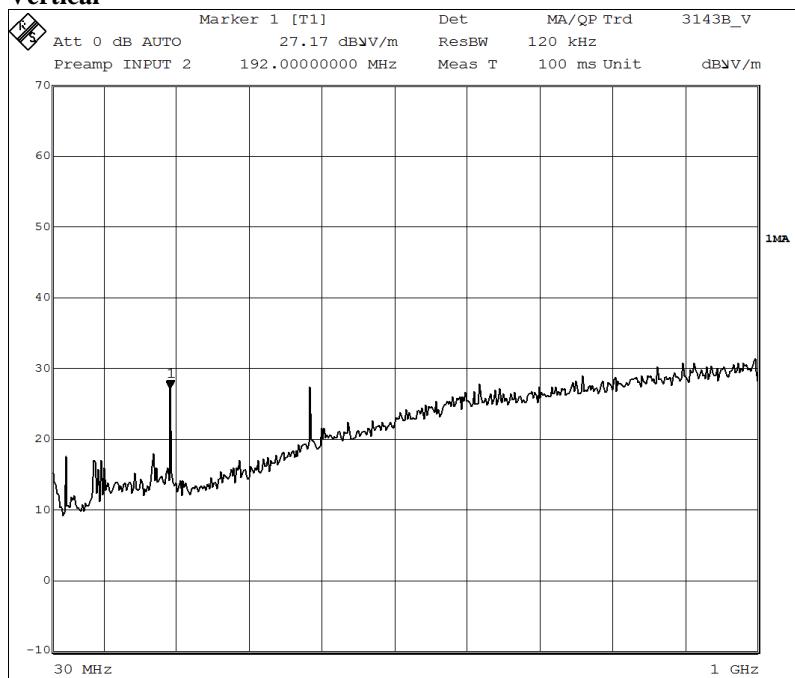
Page 28 of 85

Pre-scan result of Tx mode (30MHz – 1GHz):

Horizontal



Vertical



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 29 of 85

Result of Tx mode (30MHz – 1GHz): PASS

Field Strength of Fundamental and Harmonics Emissions Quasi-Peak Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
168.0	27.3	10.0	37.3	73.3	100	Horizontal
191.3	28.3	10.3	38.6	85.1	150	Horizontal
230.2	28.4	12.0	40.4	104.7	150	Horizontal
243.8	28.6	12.6	41.2	114.8	200	Horizontal
434.0	25.4	17.5	42.9	139.6	200	Horizontal
664.5	20.2	18.2	38.4	83.2	200	Vertical

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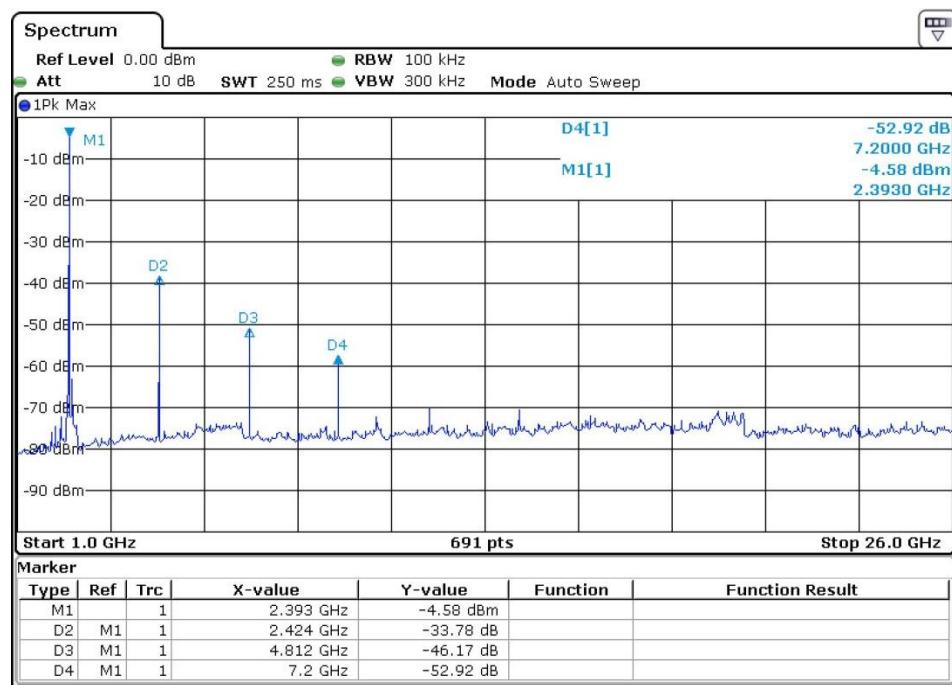
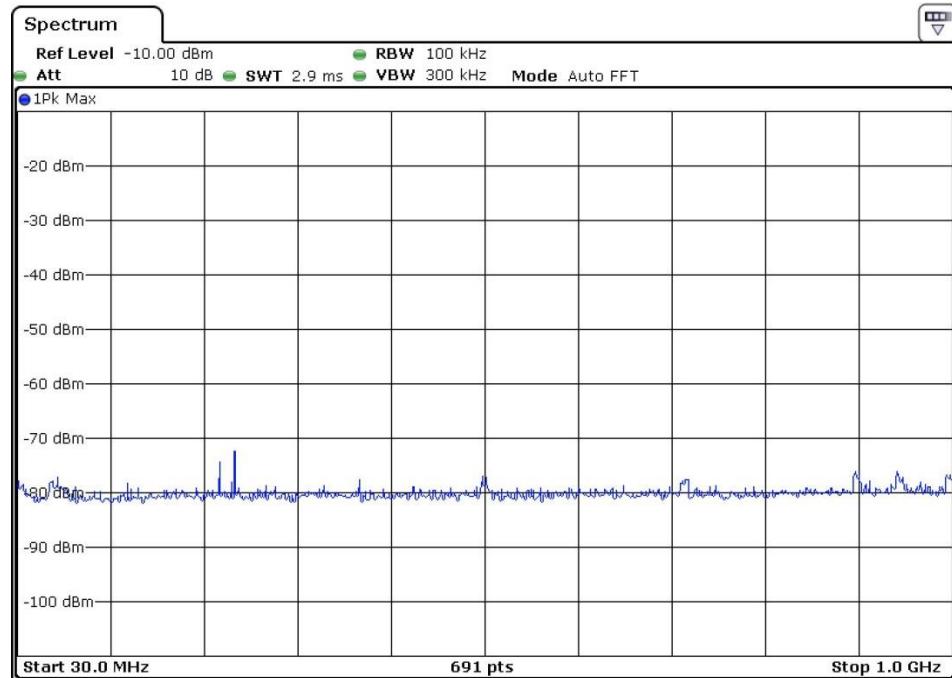
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Date : 2020-09-28
No. : HM20080050

Page 30 of 85

Conducted Spurious Emission

Result of Tx mode, GFSK (2402.0 MHz): Pass



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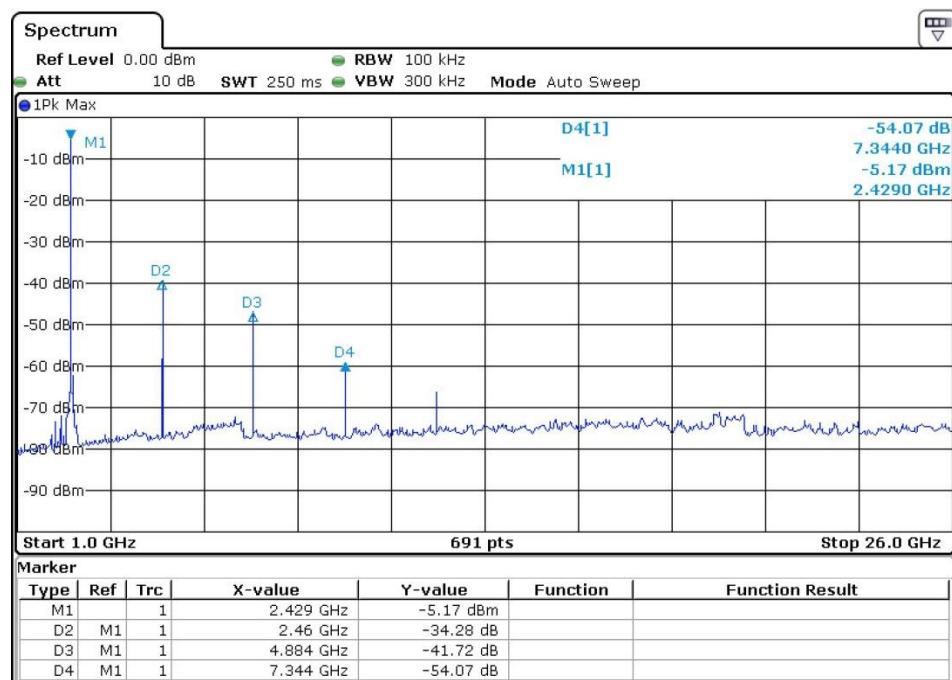
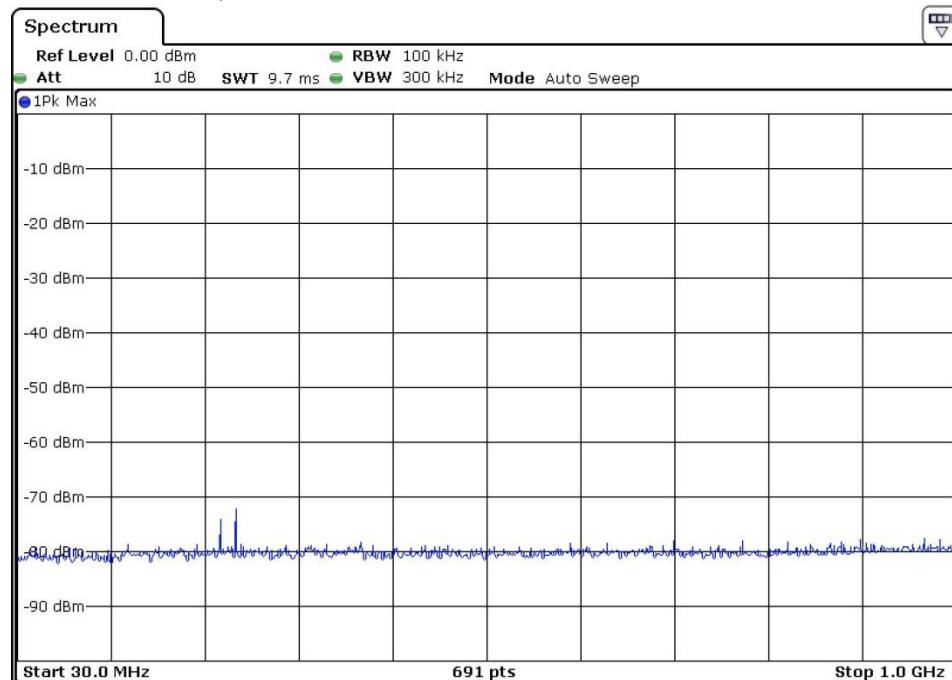


Test Report

Date : 2020-09-28
No. : HM20080050

Page 31 of 85

Result of Tx mode, GFSK (2441.0 MHz): Pass



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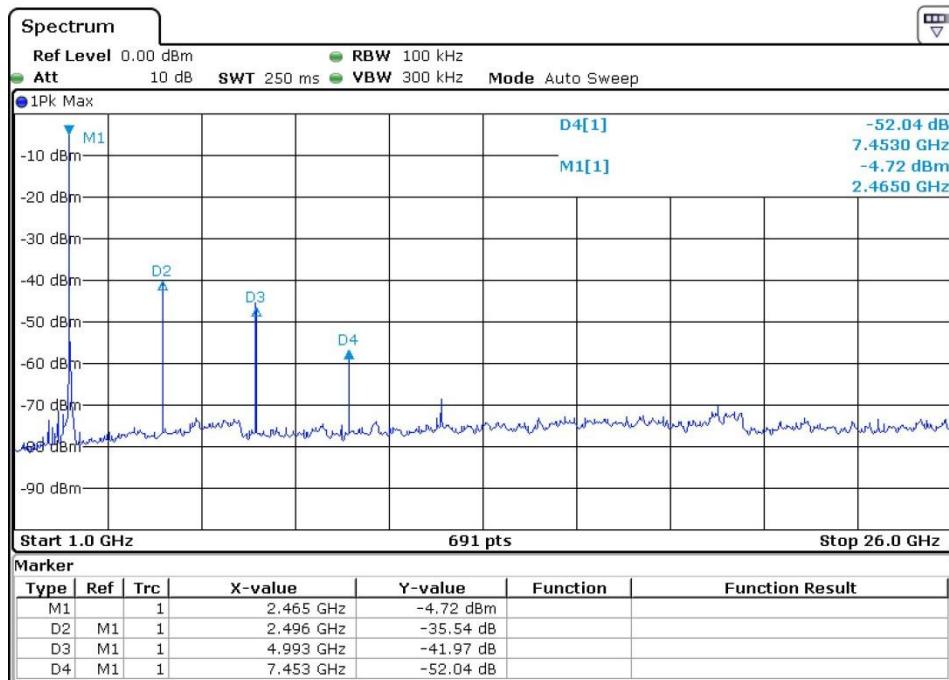
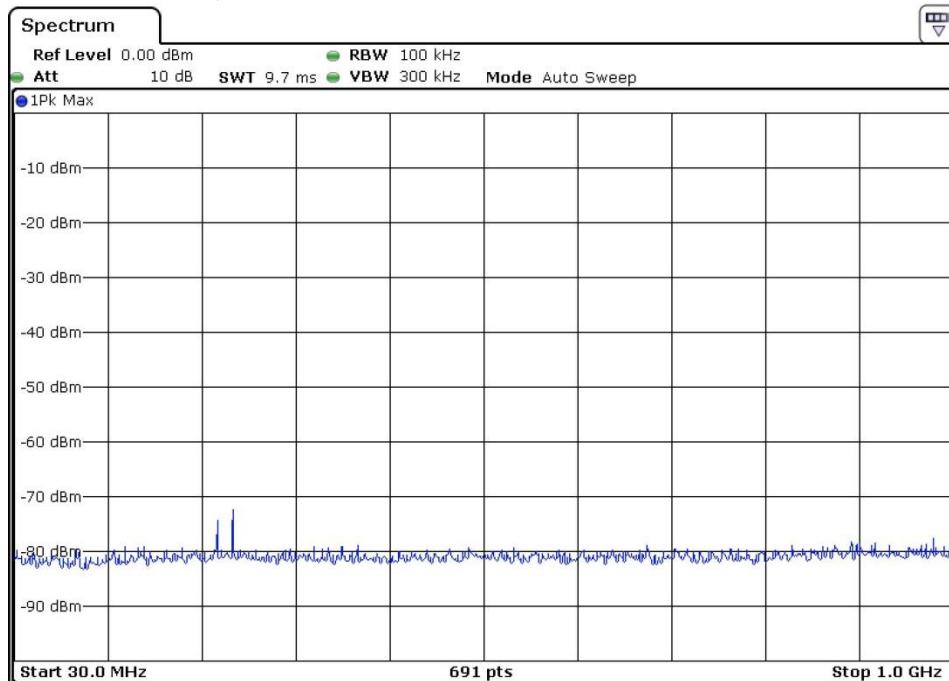


Test Report

Date : 2020-09-28
No. : HM20080050

Page 32 of 85

Result of Tx mode, GFSK (2480.0 MHz): Pass



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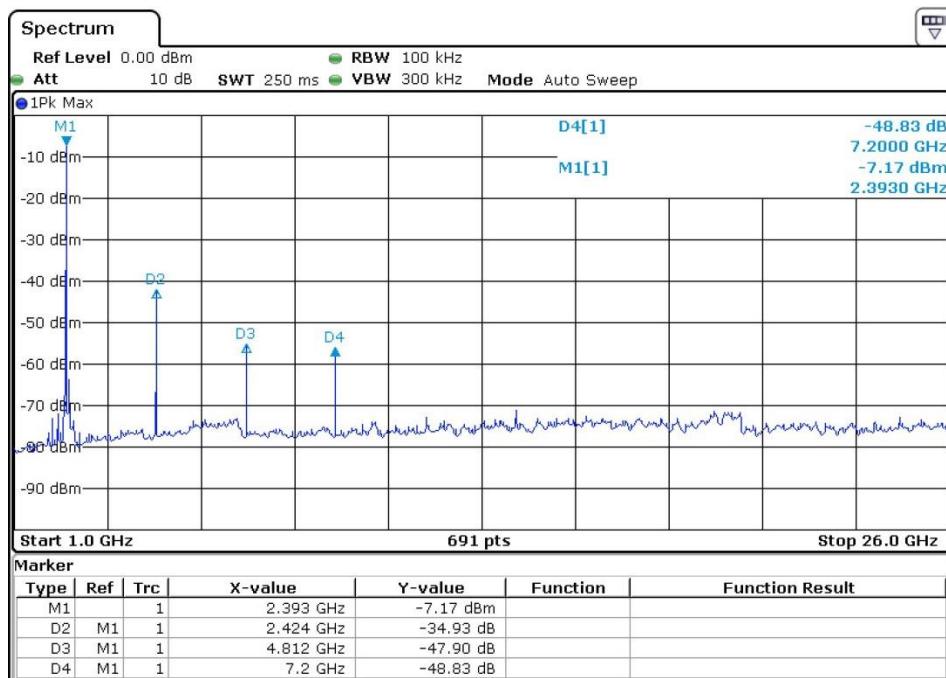
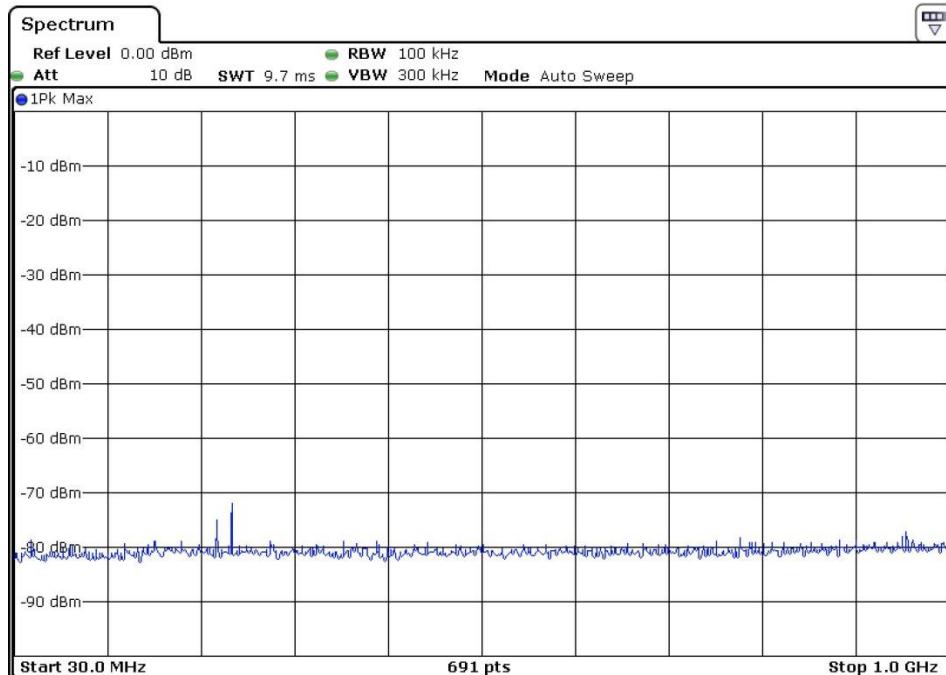


Test Report

Date : 2020-09-28
No. : HM20080050

Page 33 of 85

Result of Tx mode, $\pi/4$ -DQPSK (2402.0 MHz): Pass



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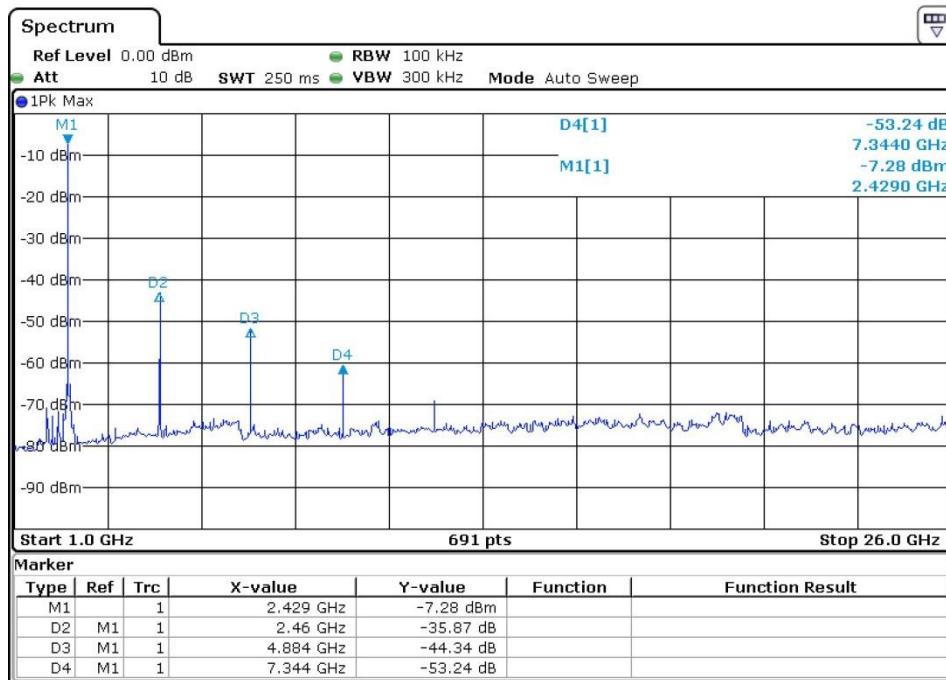
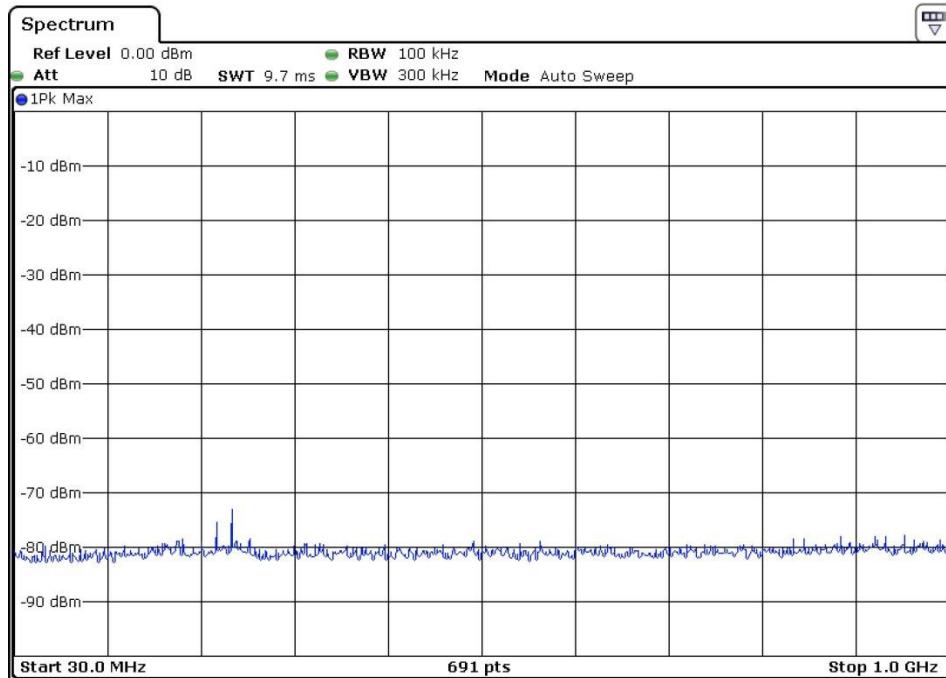


Test Report

Date : 2020-09-28
No. : HM20080050

Page 34 of 85

Result of Tx mode, $\pi/4$ -DQPSK (2441.0 MHz): Pass



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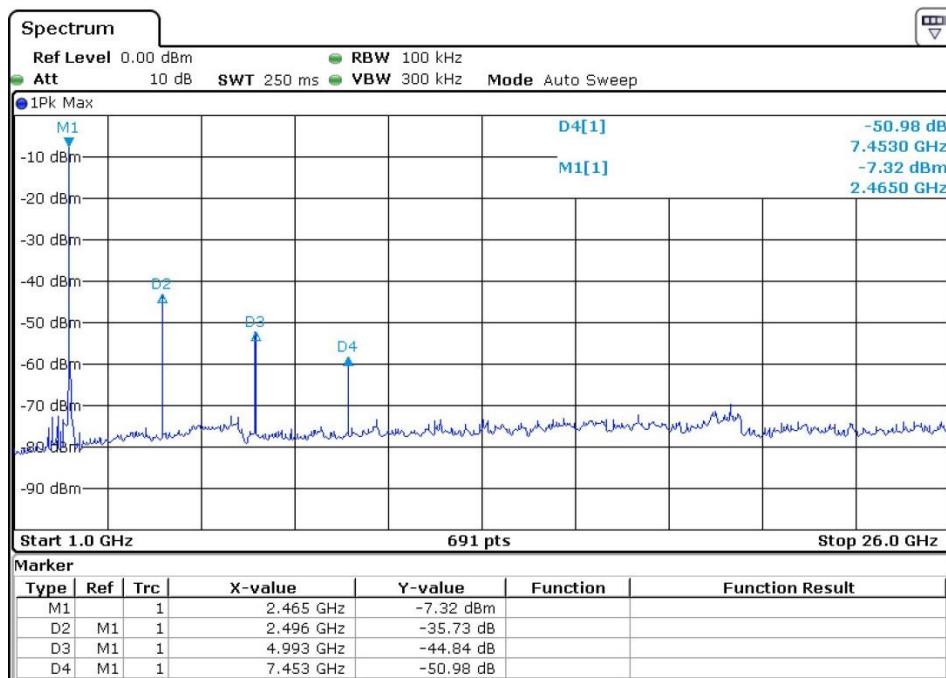
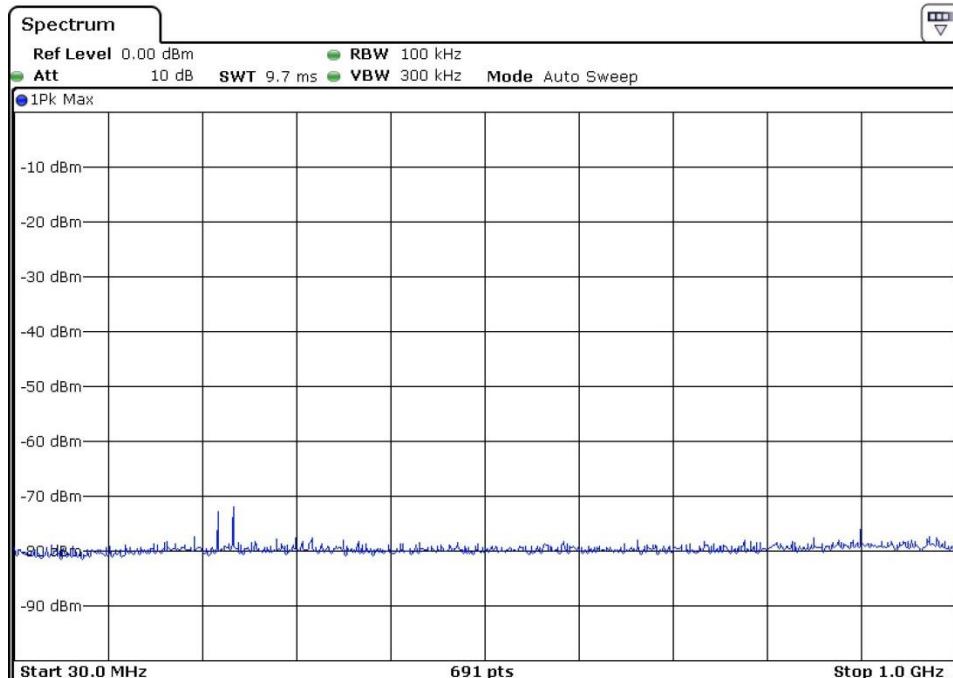


Test Report

Date : 2020-09-28
No. : HM20080050

Page 35 of 85

Result of Tx mode, $\pi/4$ -DQPSK (2480.0 MHz): Pass



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 36 of 85

Remarks:

The pre-scan results are for reference, the frequencies found will perform final measurement which shown on the table below the graphs, therefore, there may be some different in measured frequencies and field strength shown on the graph and the table.

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz
Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty	:	(9kHz – 30MHz):	3.3dB
		(30MHz – 18GHz):	4.6dB
		(18GHz - 26GHz):	4.4dB

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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 37 of 85

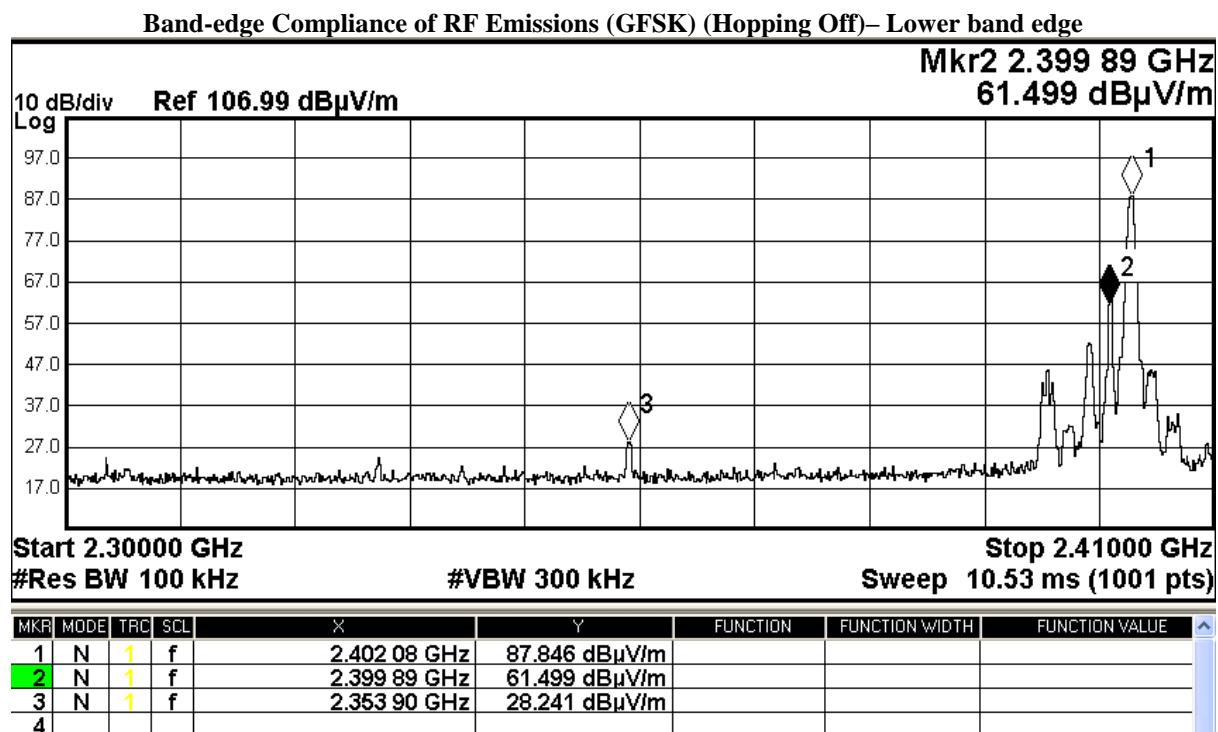
3.1.3

Band Edge Measurement:

Limit :

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	26.3





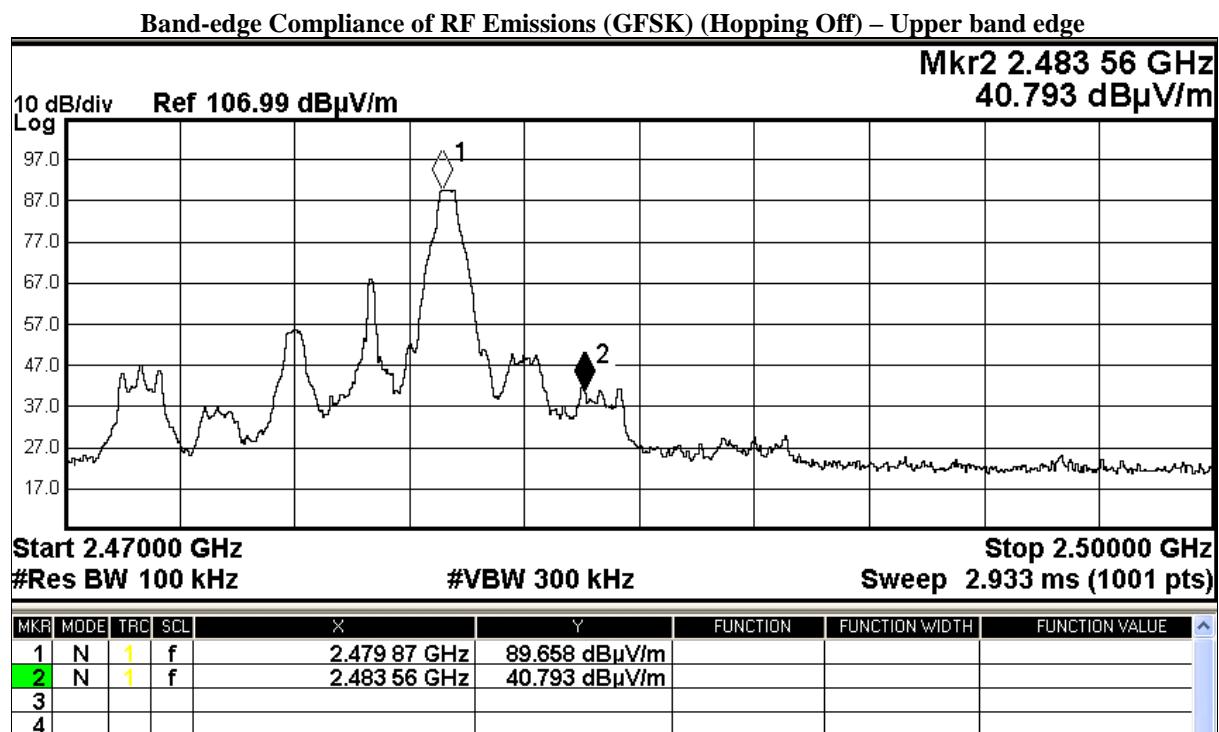
Test Report

Date : 2020-09-28
No. : HM20080050

Page 38 of 85

Band-edge Compliance of RF Emissions Measurement:

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	48.9



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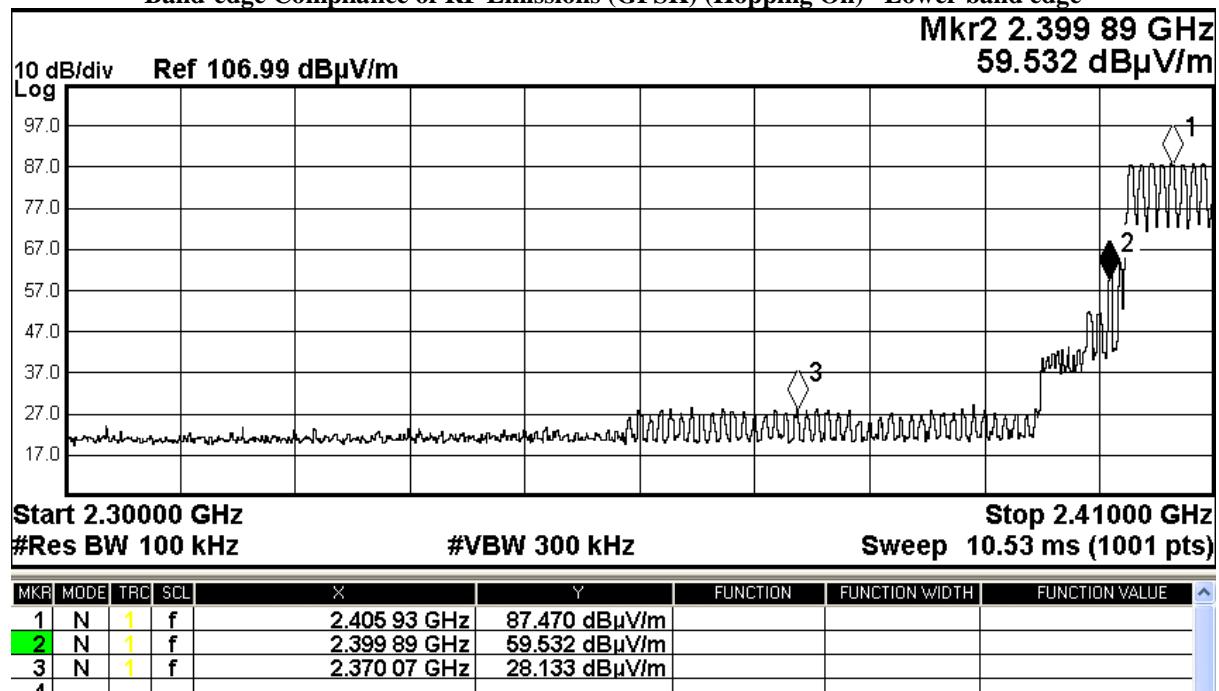
Date : 2020-09-28

Page 39 of 85

No. : HM20080050

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	27.9

Band-edge Compliance of RF Emissions (GFSK) (Hopping On)– Lower band edge



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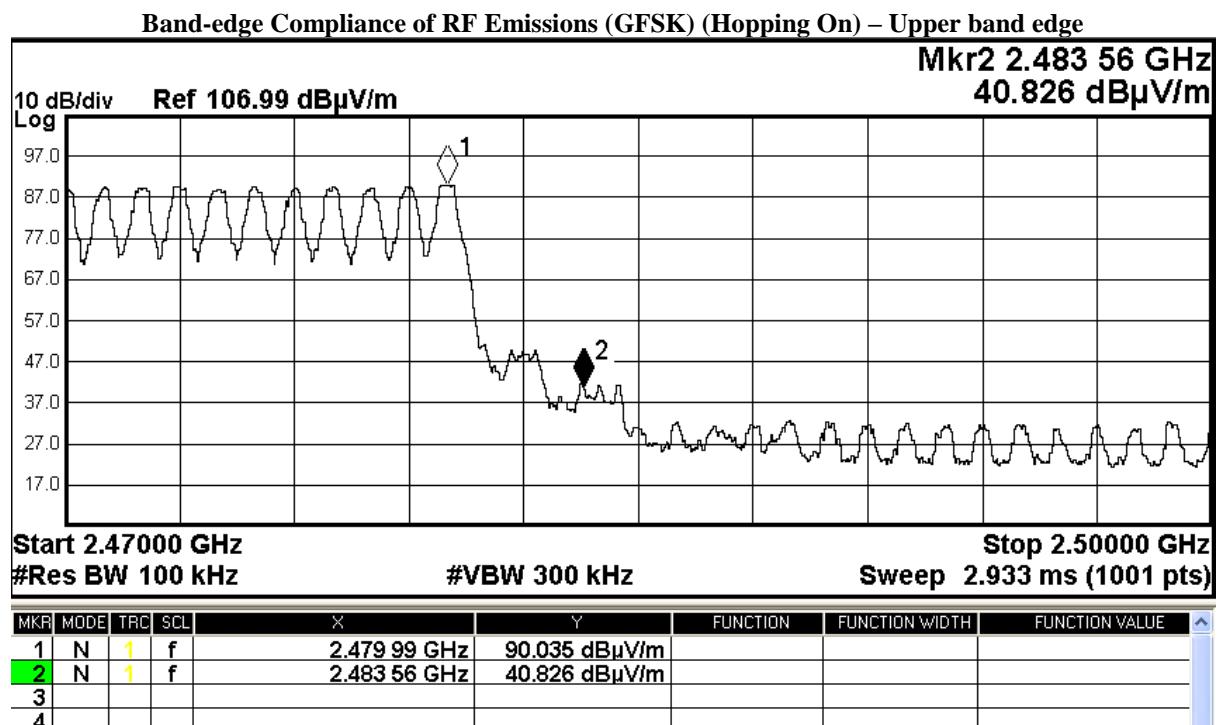
Test Report

Date : 2020-09-28
No. : HM20080050

Page 40 of 85

Band-edge Compliance of RF Emissions Measurement:

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	49.2



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 41 of 85

Radiated Emissions Band-edge and Restricted Band Result:

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2353.9	0.3	27.9	28.2	74.0	45.8	Horizontal
2483.7	12.9	27.9	40.8	74.0	33.2	Horizontal
2370.1	0.2	27.9	28.1	74.0	45.9	Horizontal
2483.6	12.9	27.9	40.8	74.0	33.2	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2353.9	-4.9	27.9	23.0	54.0	31.0	Horizontal
2483.7	2.6	27.9	30.5	54.0	23.5	Horizontal
2370.1	-4.9	27.9	23.0	54.0	31.0	Horizontal
2483.6	2.4	27.9	30.3	54.0	23.7	Horizontal

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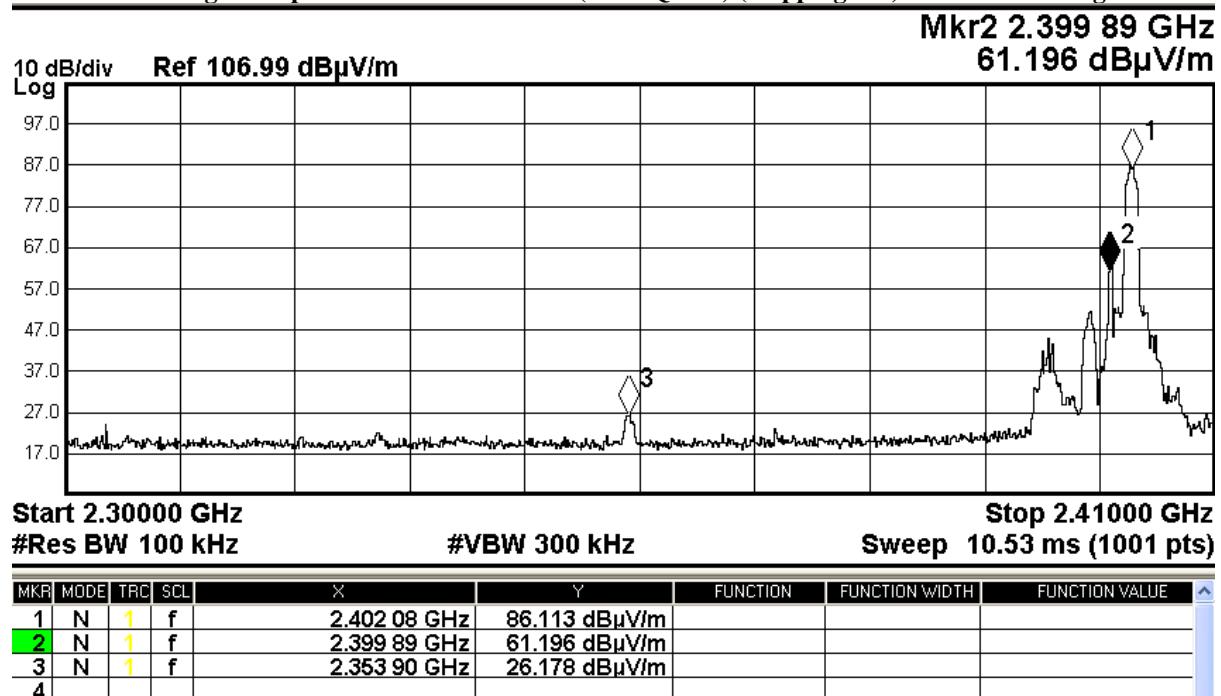
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No. : HM20080050

Page 42 of 85

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	24.9

Band-edge Compliance of RF Emissions ($\pi/4$ -DQPSK) (Hopping Off) – Lower band edge



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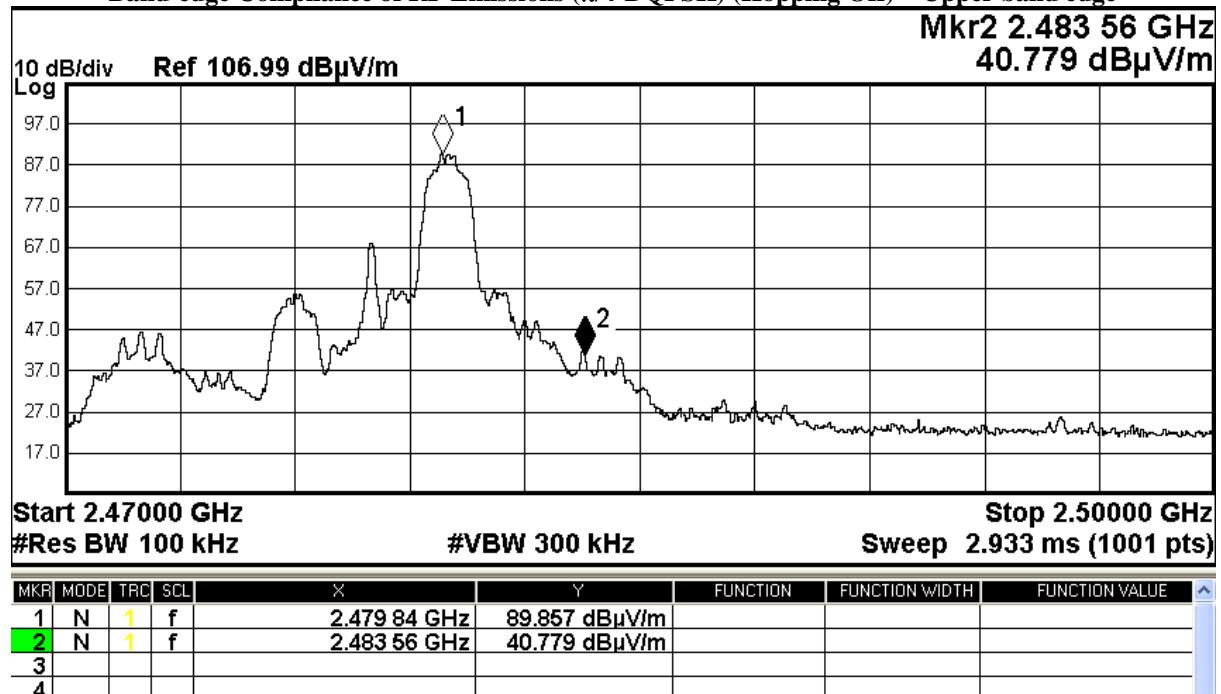
Date : 2020-09-28
No. : HM20080050

Page 43 of 85

Band-edge Compliance of RF Emissions Measurement:

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	49.1

Band-edge Compliance of RF Emissions ($\pi/4$ -DQPSK) (Hopping Off) – Upper band edge



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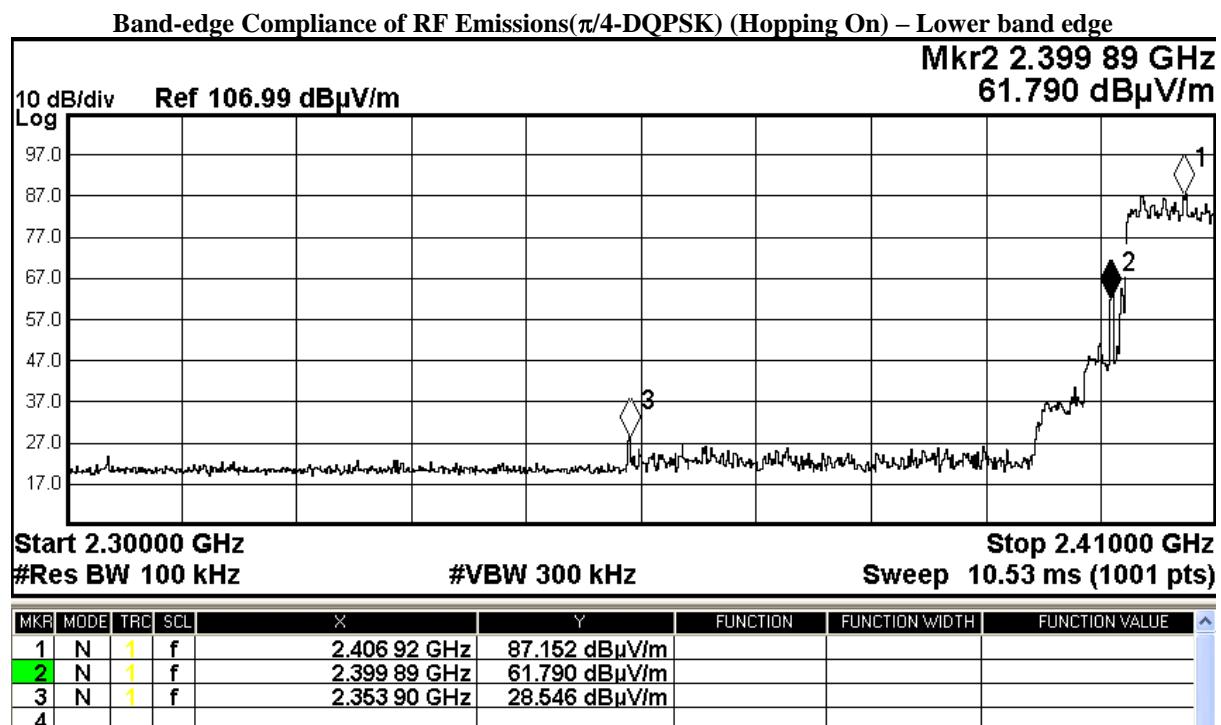


Test Report

Date : 2020-09-28
No. : HM20080050

Page 44 of 85

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	25.4



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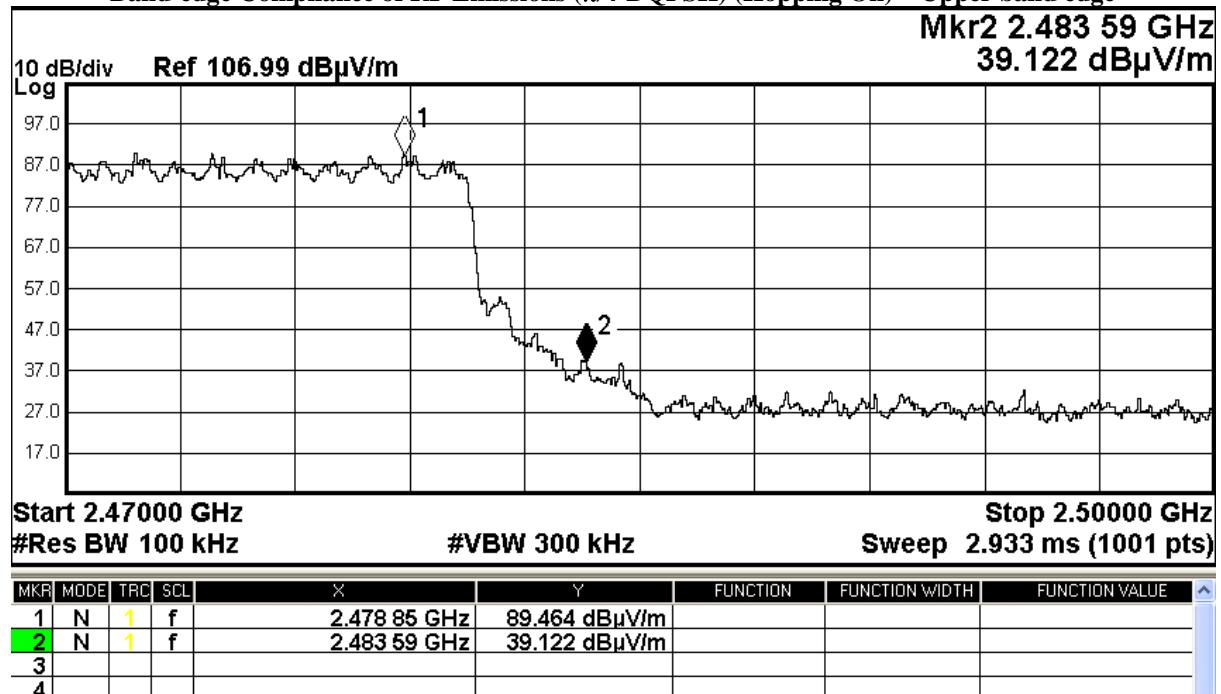
Date : 2020-09-28
No. : HM20080050

Page 45 of 85

Band-edge Compliance of RF Emissions Measurement:

Frequency Range [MHz]	Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	50.3

Band-edge Compliance of RF Emissions ($\pi/4$ -DQPSK) (Hopping On) – Upper band edge



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 46 of 85

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2353.9	0.7	27.9	28.6	74.0	45.4	Horizontal
2483.6	12.9	27.9	40.8	74.0	33.2	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2353.9	-4.2	27.9	23.7	54.0	30.3	Horizontal
2483.7	2.7	27.9	30.6	54.0	23.4	Horizontal

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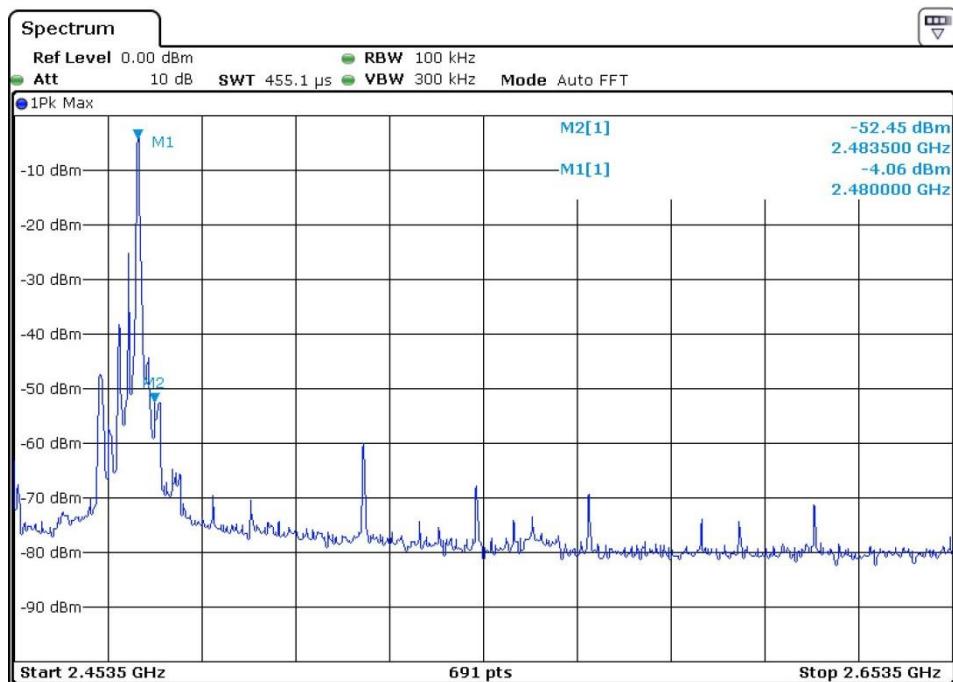
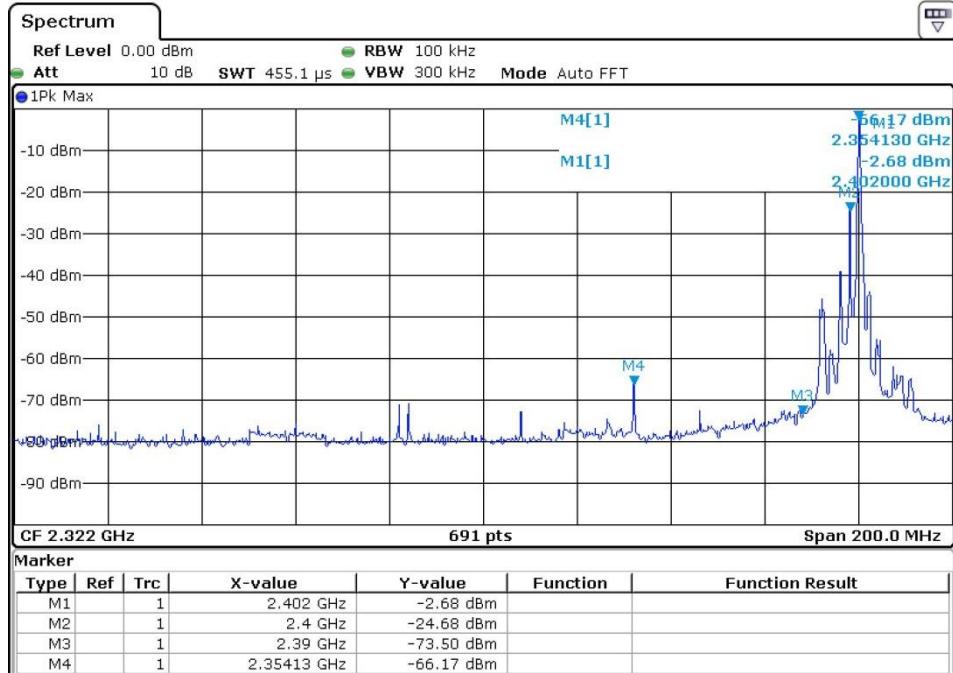
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No. : HM20080050

Page 47 of 85

Conducted Band-edge measurement

Band-edge Compliance of conducted measurement (GFSK – Hopping Off)



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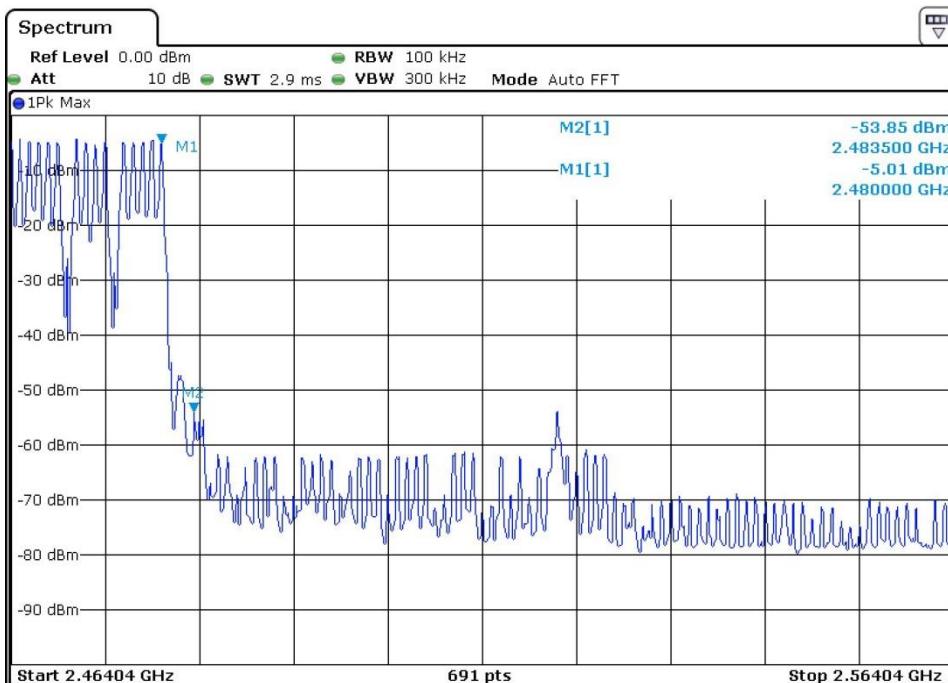
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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 48 of 85

Band-edge Compliance of conducted measurement (GFSK – Hopping On)



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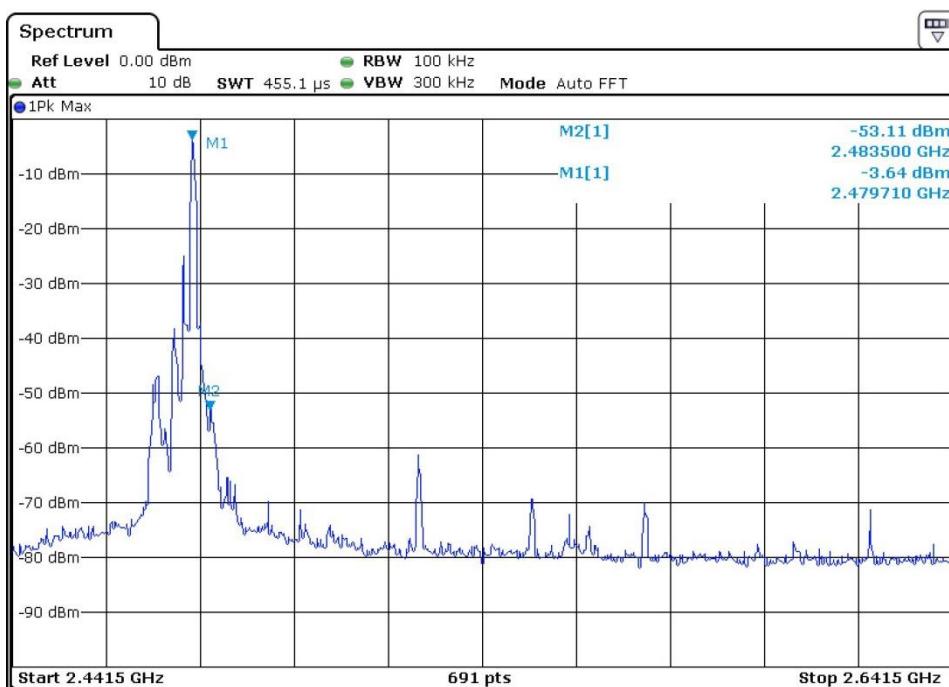
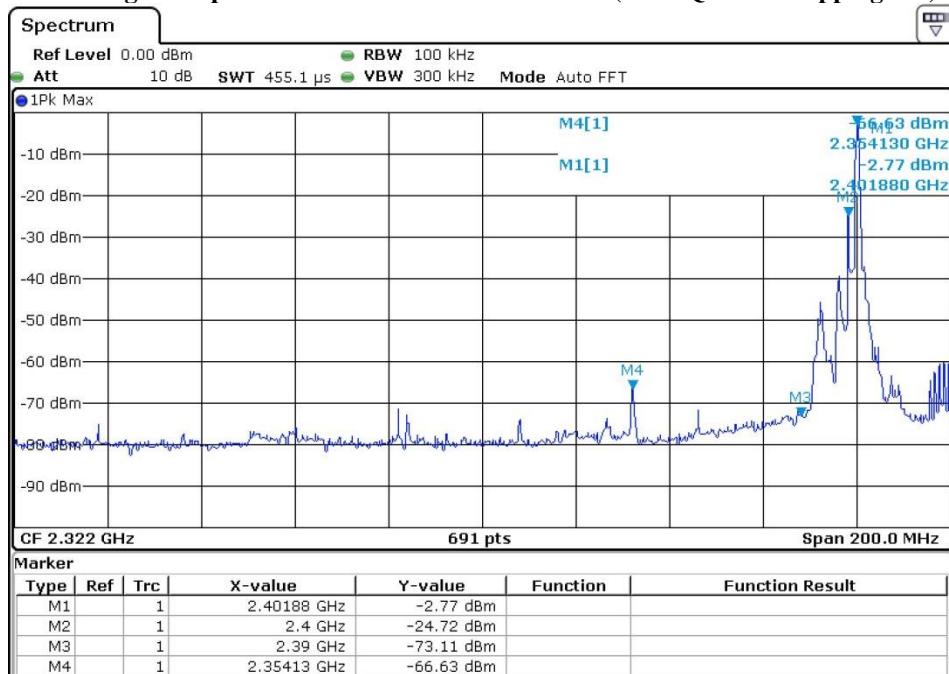
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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 49 of 85

Band-edge Compliance of conducted measurement ($\pi/4$ -DQPSK – Hopping Off)



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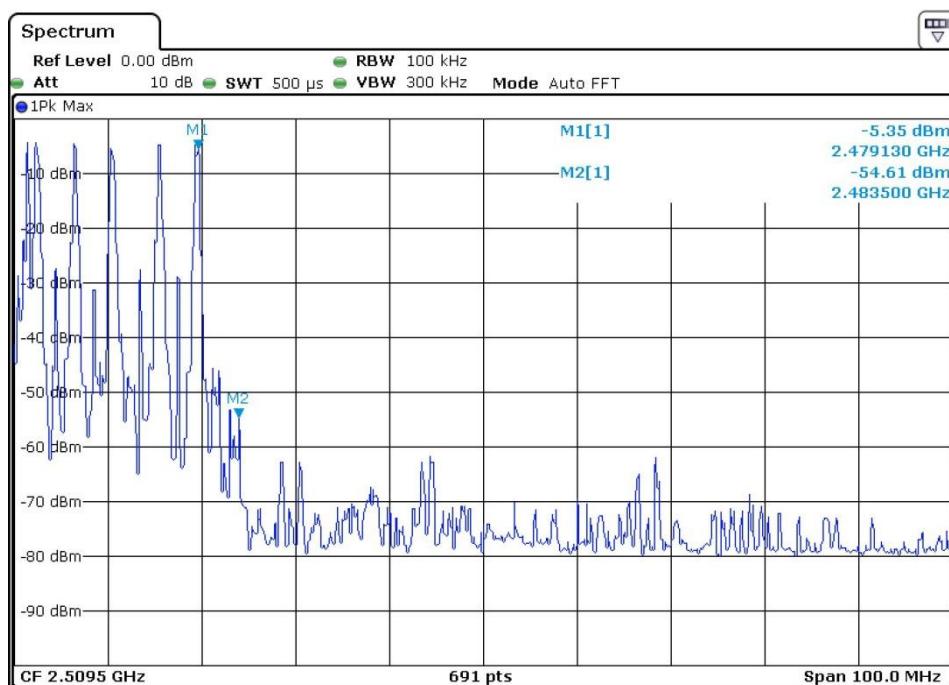
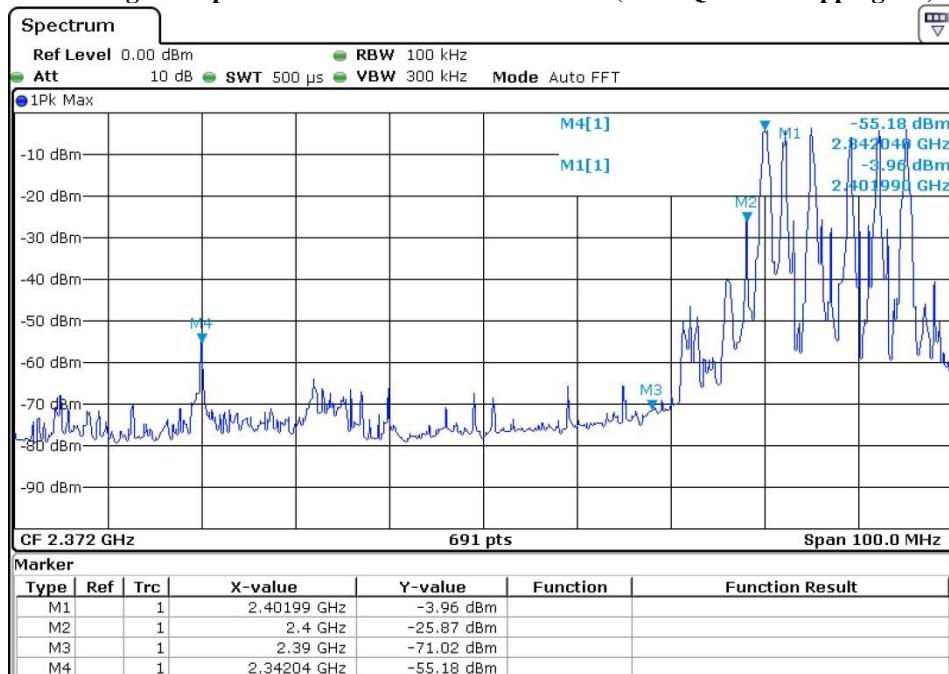
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Date : 2020-09-28
 No. : HM20080050

Page 50 of 85

Band-edge Compliance of conducted measurement ($\pi/4$ -DQPSK – Hopping On)



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 51 of 85

3.1.4 Number of Hopping Frequency

Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels

Test Method:

The RF output of the EUT was connected to the spectrum analyzer by a low loss cable.

Spectrum Analyzer Setting:

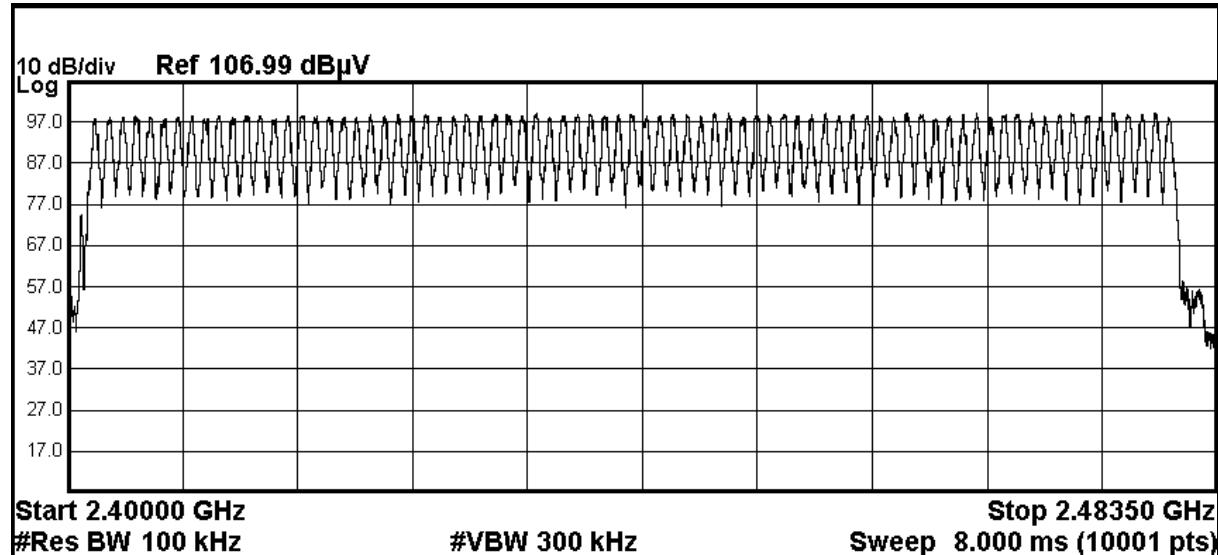
RBW = 100kHz, VBW \geq RBW, Sweep = Auto, Span = the frequency band of operation
Detector = Peak, Trace = Max. hold

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Measurement Data:

GFSK: 79 of 79 Channel



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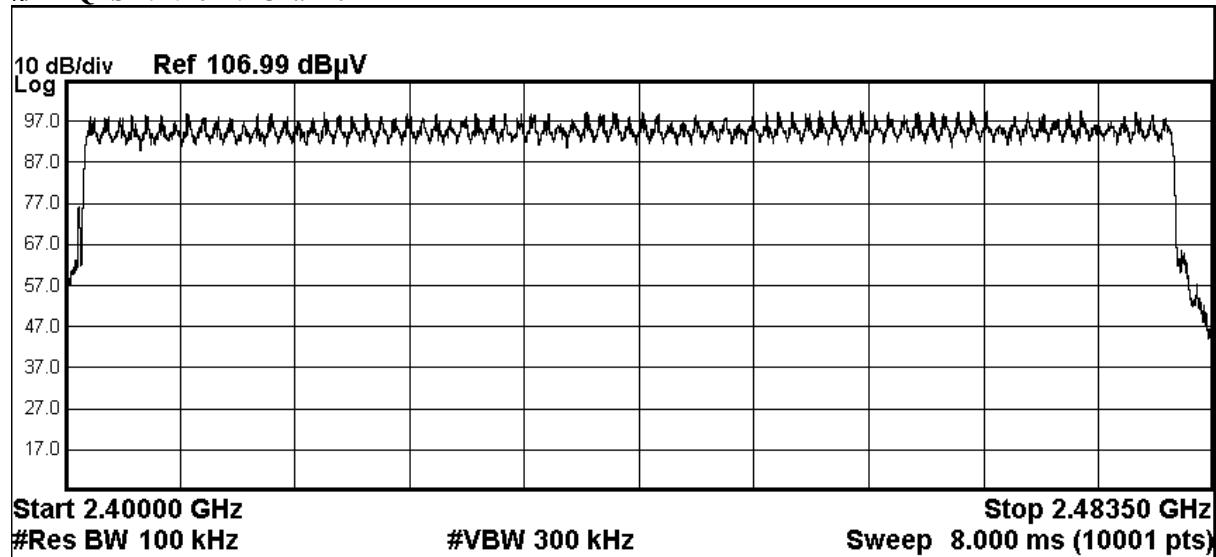


Test Report

Date : 2020-09-28
No. : HM20080050

Page 52 of 85

π/4-DQPSK: 79 of 79 Channel



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 53 of 85

3.1.5 20dB Bandwidth

Test Requirement:	FCC 47CFR 15.247(a)(1)
Test Method:	ANSI C63.10:2013
Test Date:	2020-09-12
Mode of Operation:	Tx mode :GFSK/π/4-DQPSK

Remark:

The result has been done on all the possible configurations for searching the worst cases.

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Spectrum Analyzer Setting:

RBW = 30kHz, VBW \geq RBW, Sweep = Auto, Span = two times and five times the OBW
Detector = Peak, Trace = Max. hold

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

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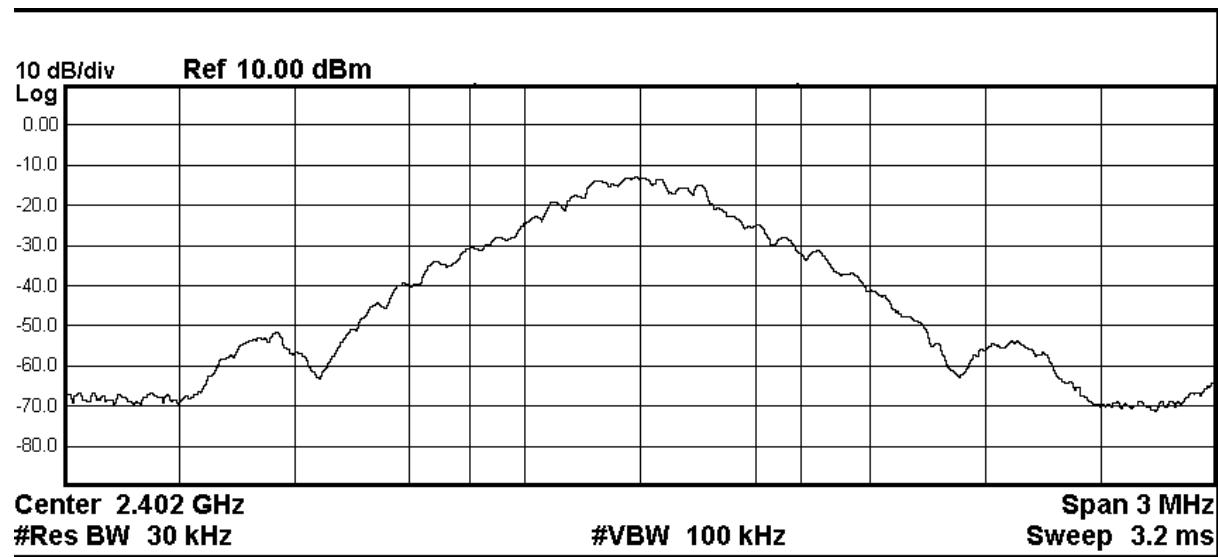
Test Report

Date : 2020-09-28
No. : HM20080050

Page 54 of 85

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2402	951.5	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)



Occupied Bandwidth

854.72 kHz

Total Power

-3.64 dBm

Transmit Freq Error

-9.570 kHz

OBW Power

99.00 %

x dB Bandwidth

951.5 kHz

x dB

-20.00 dB

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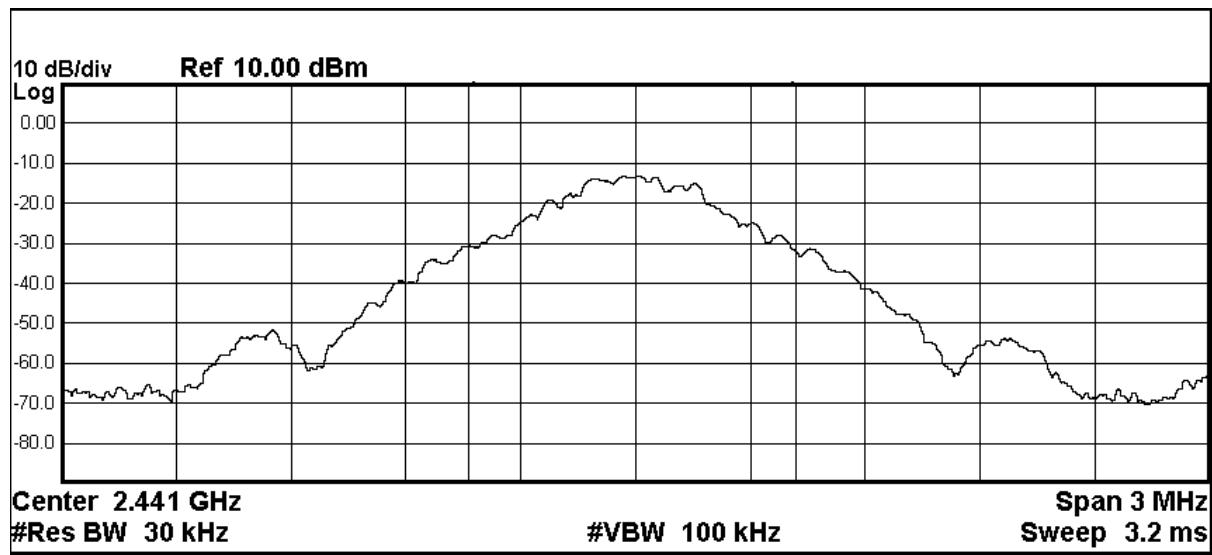
Test Report

Date : 2020-09-28
No. : HM20080050

Page 55 of 85

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2441	959.6	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



Occupied Bandwidth Total Power -3.67 dBm

855.42 kHz

Transmit Freq Error	-8.762 kHz	OBW Power	99.00 %
x dB Bandwidth	959.6 kHz	x dB	-20.00 dB

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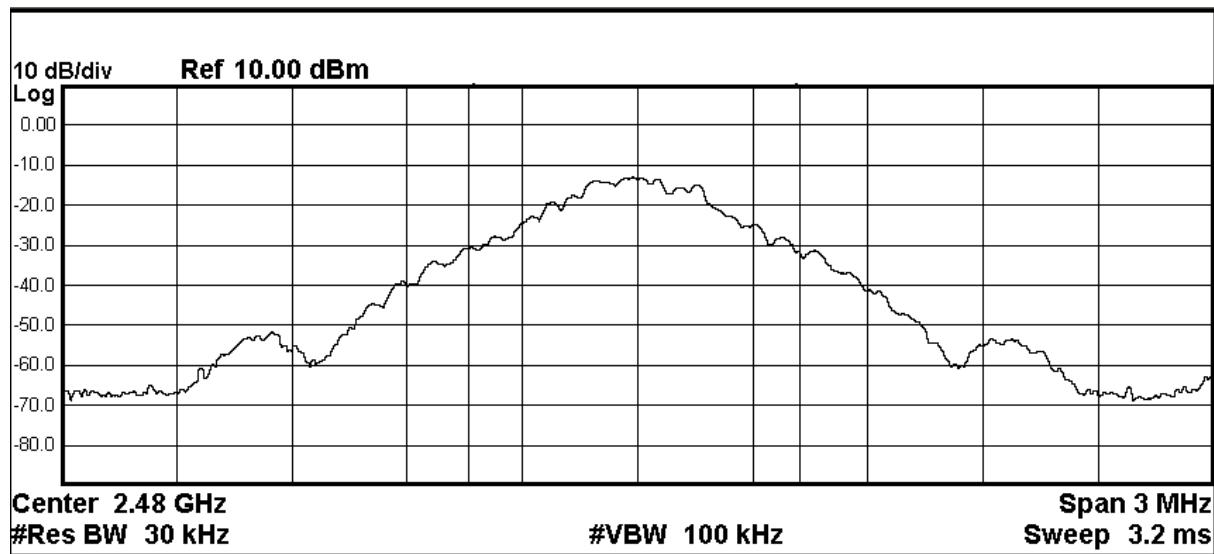
Test Report

Date : 2020-09-28
No. : HM20080050

Page 56 of 85

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2480	954.1	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)



Occupied Bandwidth

Total Power

-3.63 dBm

858.60 kHz

Transmit Freq Error

-7.128 kHz

OBW Power

99.00 %

x dB Bandwidth

954.1 kHz

x dB

-20.00 dB

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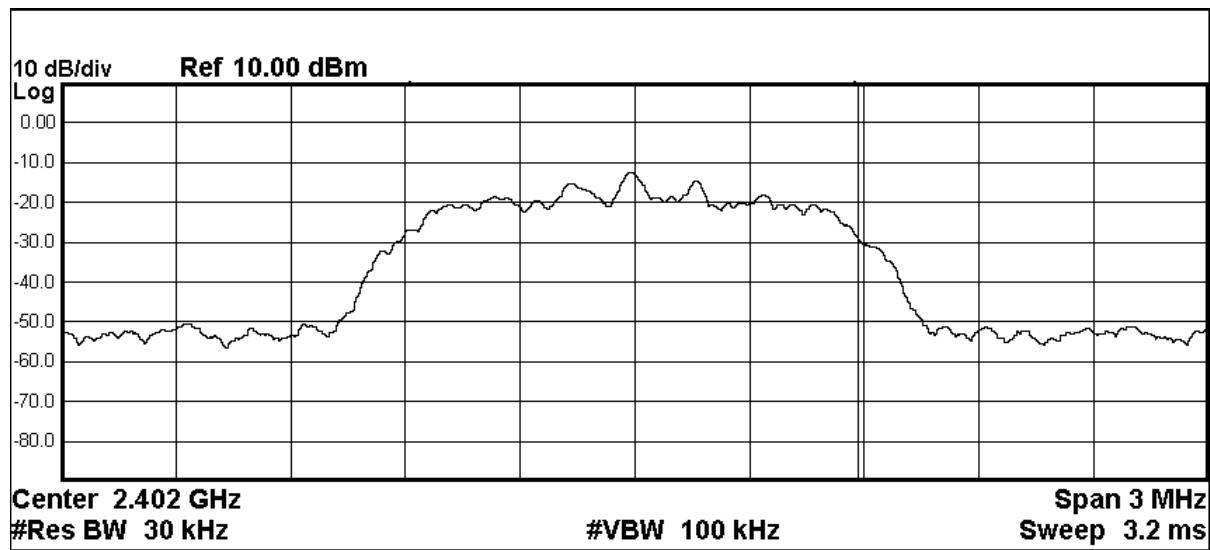
Test Report

Date : 2020-09-28
No. : HM20080050

Page 57 of 85

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.31	Within 2400-2483.5

(Lowest Operating Frequency) - ($\pi/4$ DQPSK)



Occupied Bandwidth		Total Power	-3.33 dBm
1.1812 MHz			
Transmit Freq Error	-8.616 kHz	OBW Power	99.00 %
x dB Bandwidth	1.311 MHz	x dB	-20.00 dB

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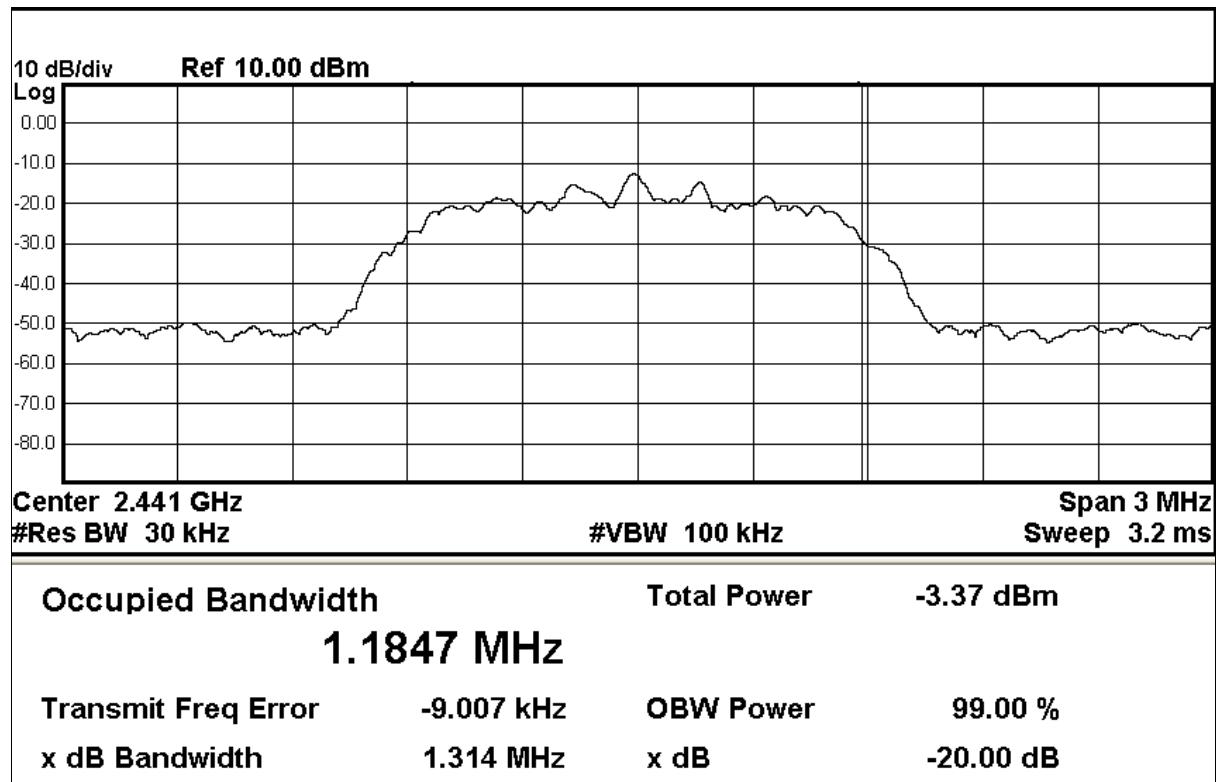
Test Report

Date : 2020-09-28
No. : HM20080050

Page 58 of 85

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.31	Within 2400-2483.5

(Middle Operating Frequency) - ($\pi/4$ DQPSK)



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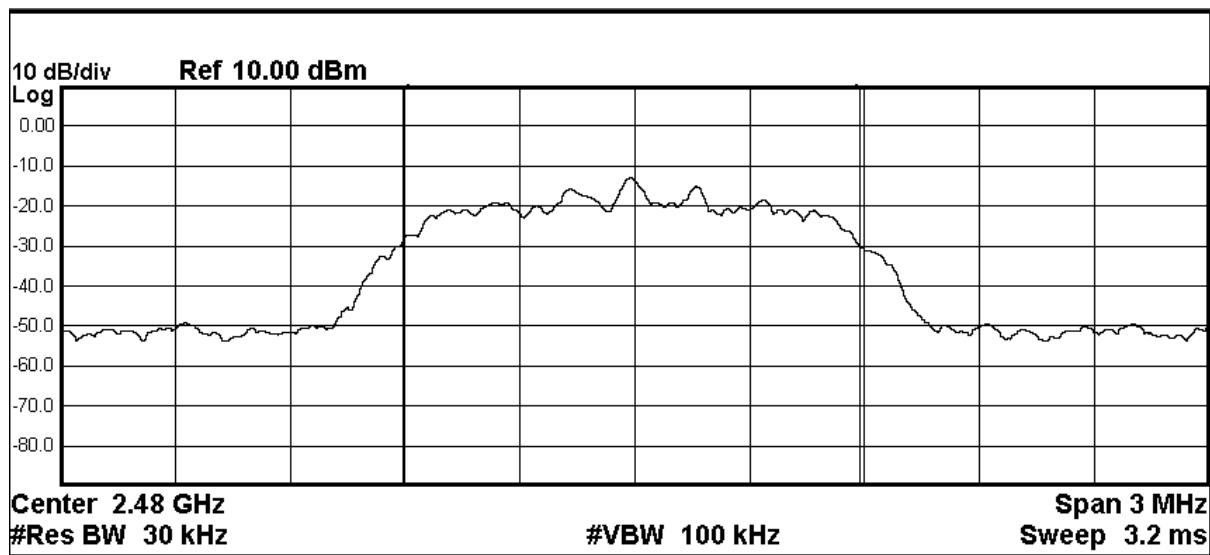
Test Report

Date : 2020-09-28
No. : HM20080050

Page 59 of 85

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.32	Within 2400-2483.5

(Highest Operating Frequency) - ($\pi/4$ DQPSK)



Occupied Bandwidth

1.1890 MHz

Total Power

-3.77 dBm

Transmit Freq Error

-8.515 kHz

OBW Power

99.00 %

x dB Bandwidth

1.315 MHz

x dB

-20.00 dB

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 60 of 85

3.1.6 Hopping Channel Separation

Requirements:

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Spectrum Analyzer Setting:

RBW = 30kHz, VBW \geq RBW, Sweep = Auto,
Span = Wide enough to capture the peaks of two adjacent channels
Detector = Peak, Trace = Max. hold

Limit:

GFSK: The measured maximum bandwidth * 2/3 = 0.960MHz * 2/3 = 640kHz

$\pi/4$ DQPSK: The measured maximum bandwidth * 2/3 = 1.312Hz * 2/3 = 874.7kHz

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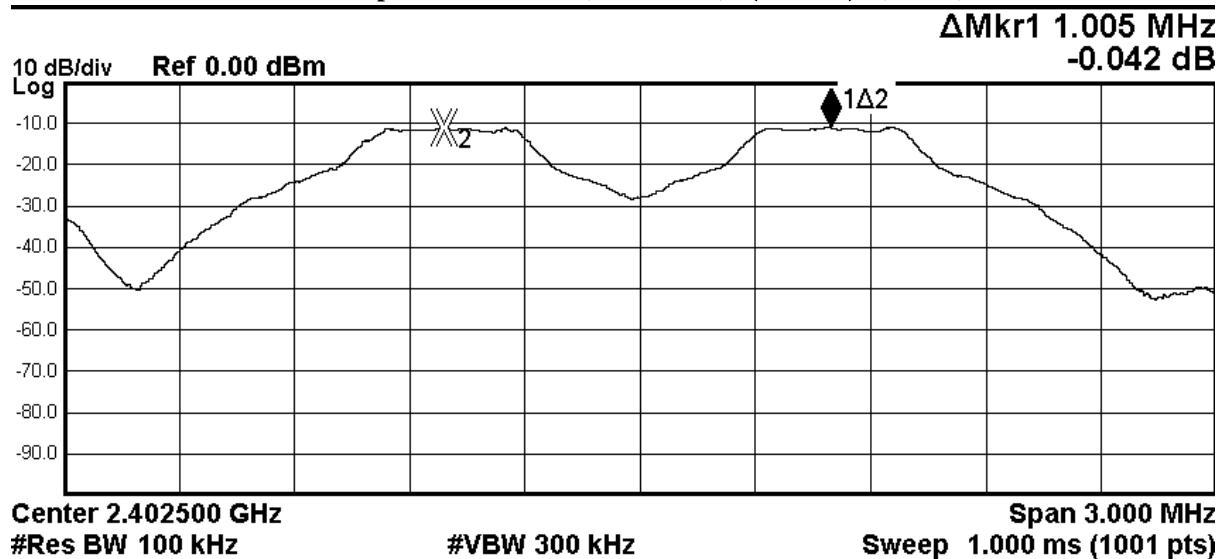
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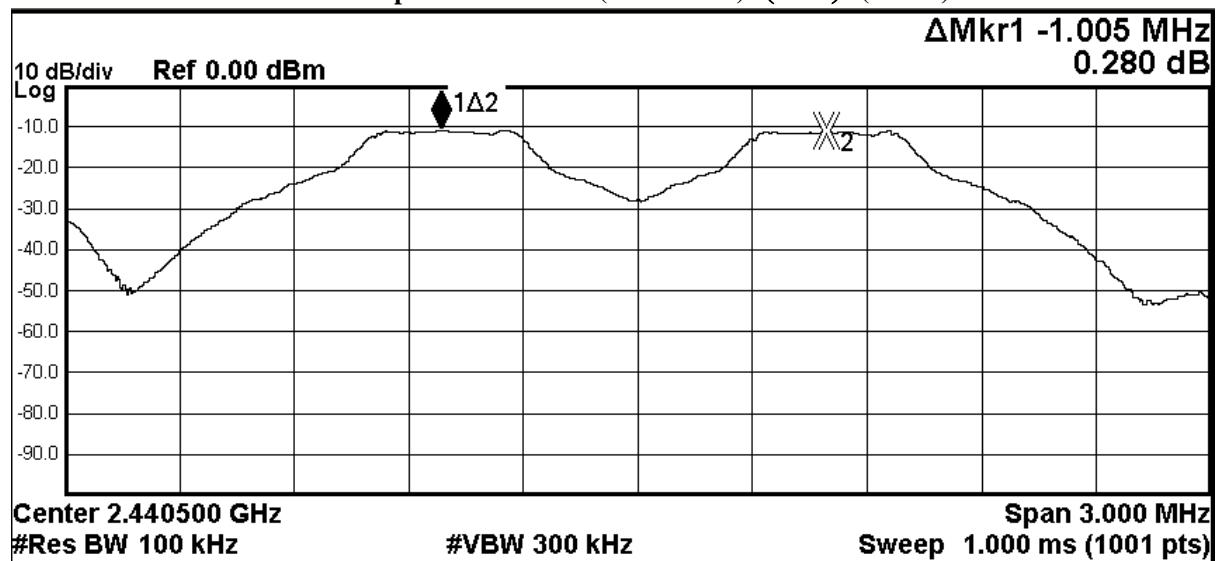
Date : 2020-09-28
 No. : HM20080050

Page 61 of 85

Channel separation = 1MHz (>2/3 of BW) (Lowest) (GFSK)



Channel separation = 1MHz (>2/3 of BW) (Mid) (GFSK)



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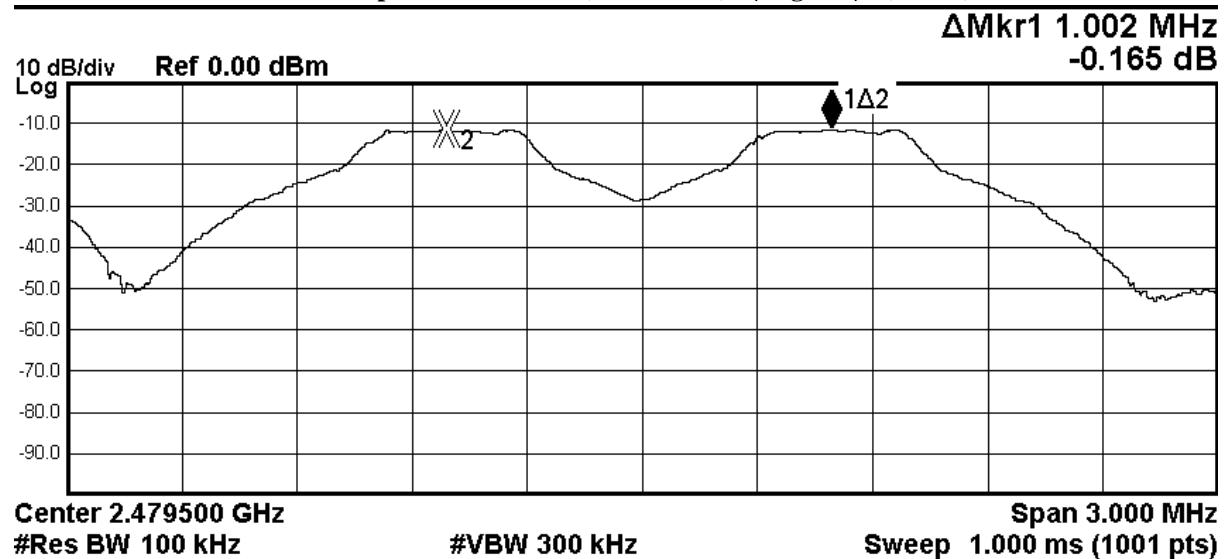
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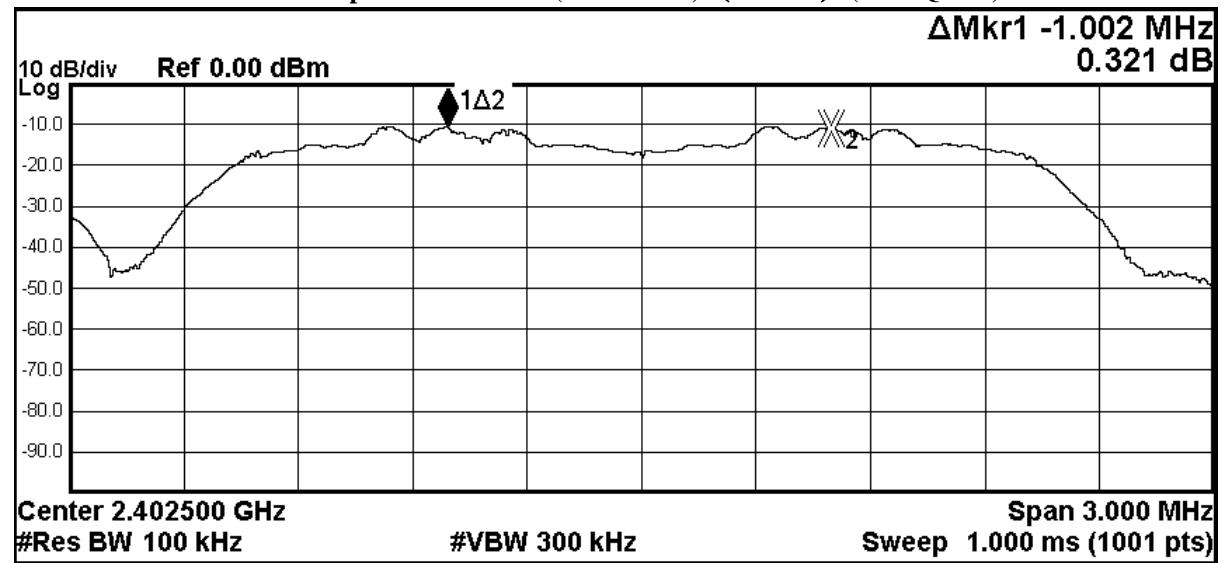
Date : 2020-09-28
 No. : HM20080050

Page 62 of 85

Channel separation = 1MHz (>2/3 of BW) (Highest) (GFSK)



Channel separation = 1MHz (>2/3 of BW) (Lowest) ($\pi/4$ DQPSK)

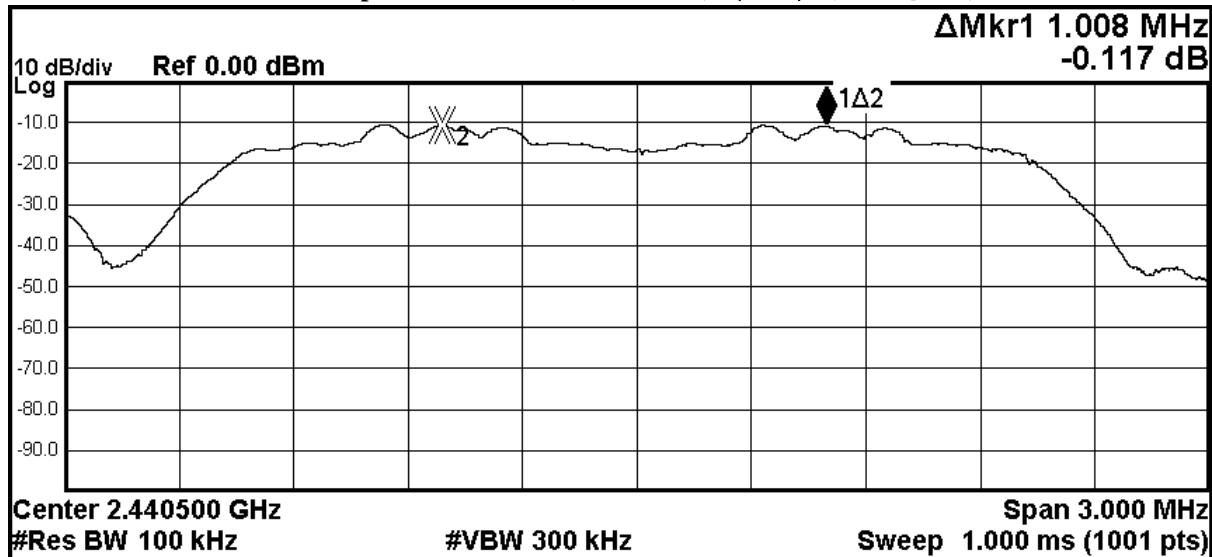


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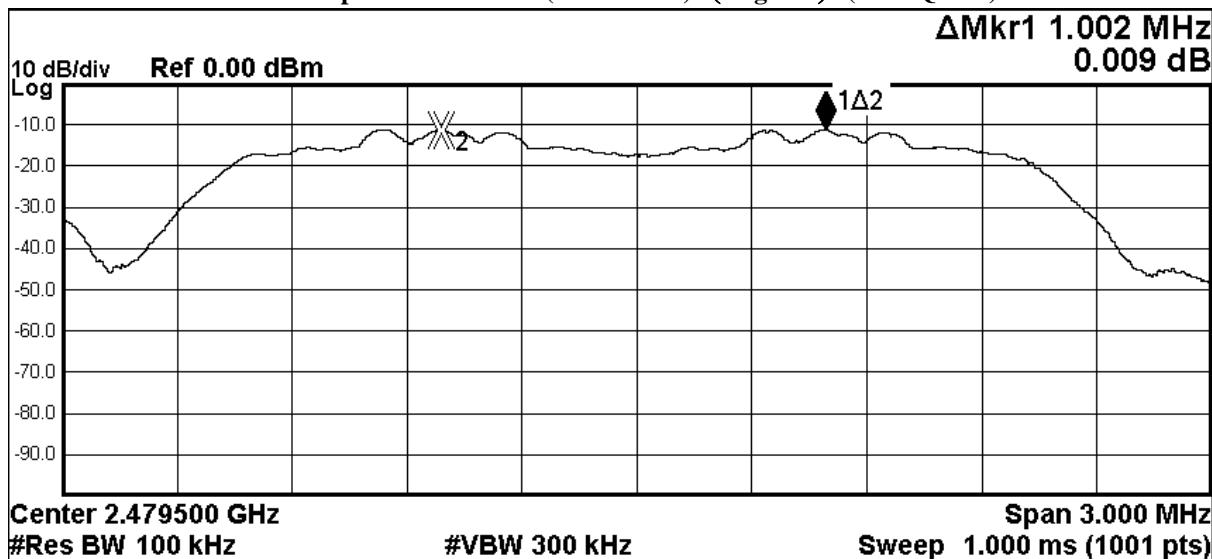
Date : 2020-09-28
 No. : HM20080050

Page 63 of 85

Channel separation = 1MHz (>2/3 of BW) (Mid) ($\pi/4$ DQPSK)



Channel separation = 1MHz (>2/3 of BW) (Highest) ($\pi/4$ DQPSK)





Test Report

Date : 2020-09-28
No. : HM20080050

Page 64 of 85

3.1.7 Time of Occupancy (Dwell Time)

Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channel employed.

No requirements for Digital Transmission System.

Spectrum Analyzer Setting:

RBW = 300kHz, VBW \geq RBW,

Sweep = A longer sweep time to show two successive hops on a channel,

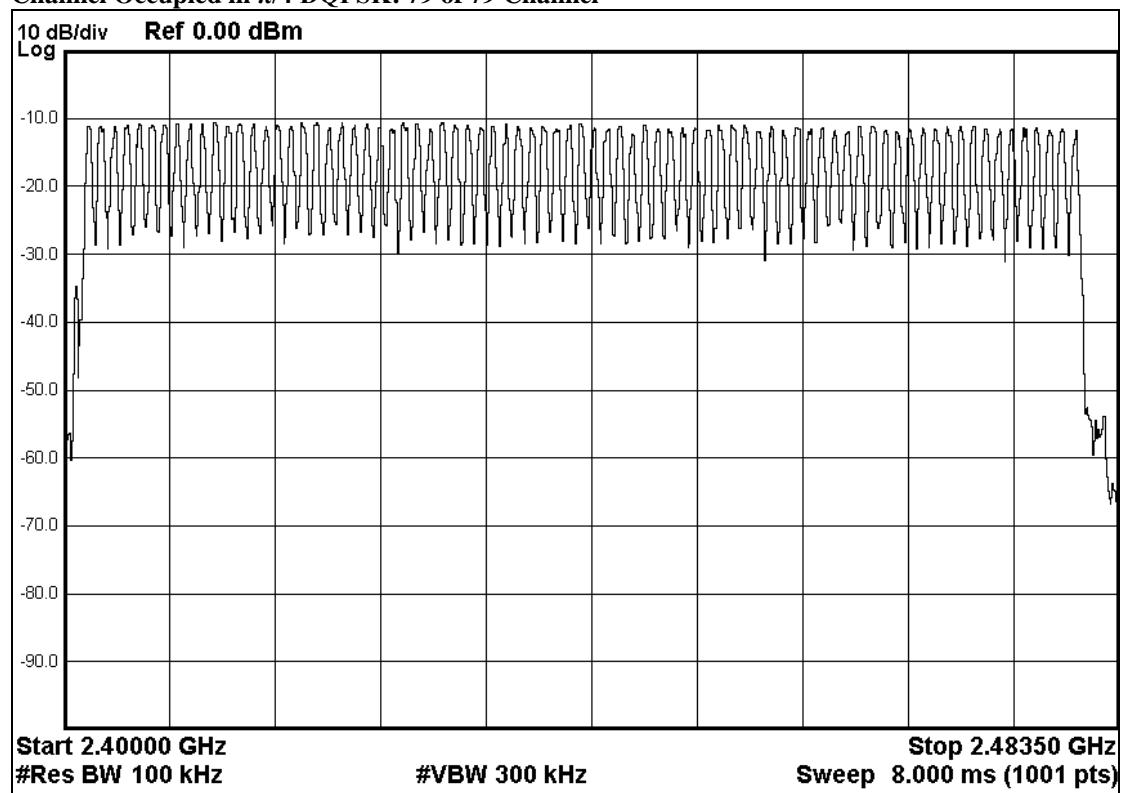
Span = Zero, Detector = Peak, Trace = Max. hold

Dwell Time = Pulse Duration * hop rate / number of channel * observation duration

Observed duration: 0.4s x 79 = 31.6s

Measurement Data:

Channel Occupied in $\pi/4$ DQPSK: 79 of 79 Channel



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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 65 of 85

2DH5 Packet:

2DH5 Packet permit maximum $1600/79/6 = 3.37$ hops per second in each channel (5 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times $3.37 \times 31.6 = 106.6$ within 31.6 seconds

Fig. A
[Pulse duration of Lowest Channel]

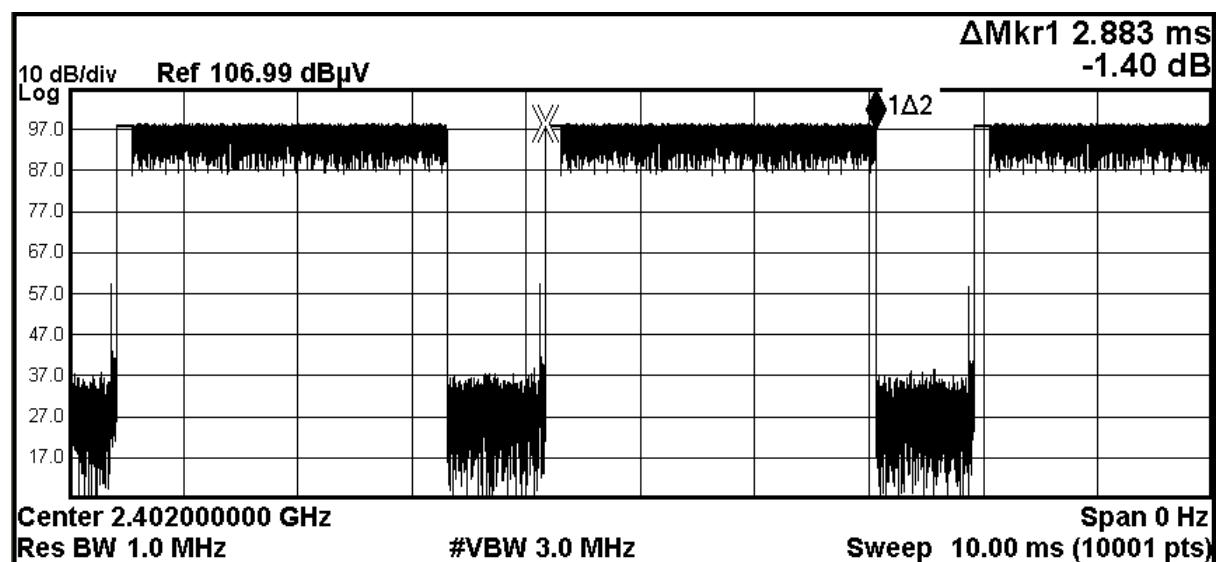
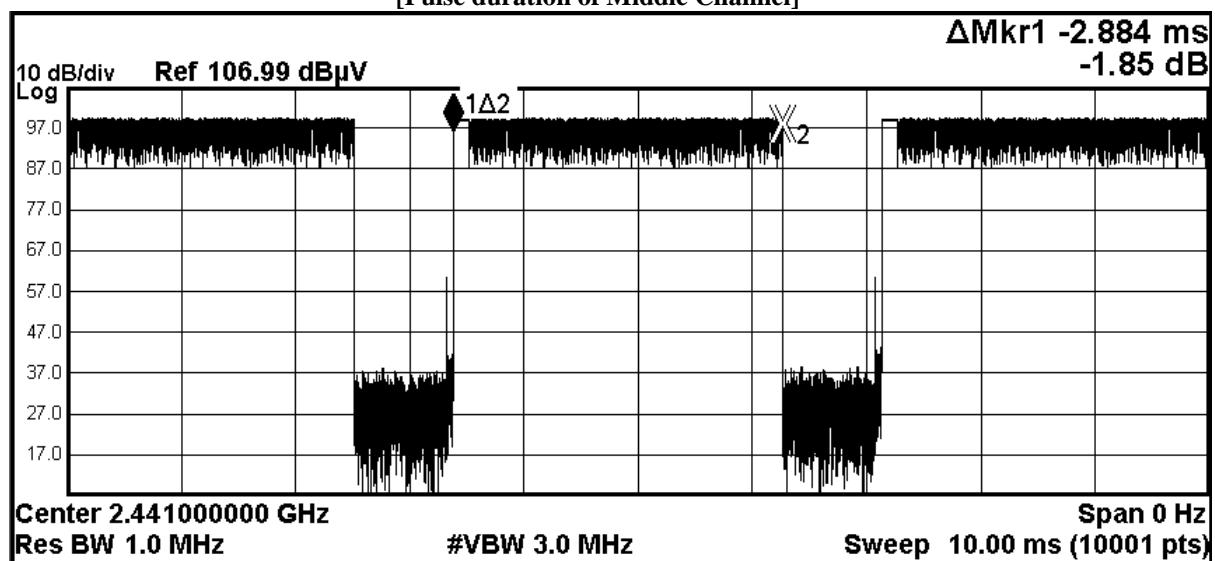


Fig. B
[Pulse duration of Middle Channel]

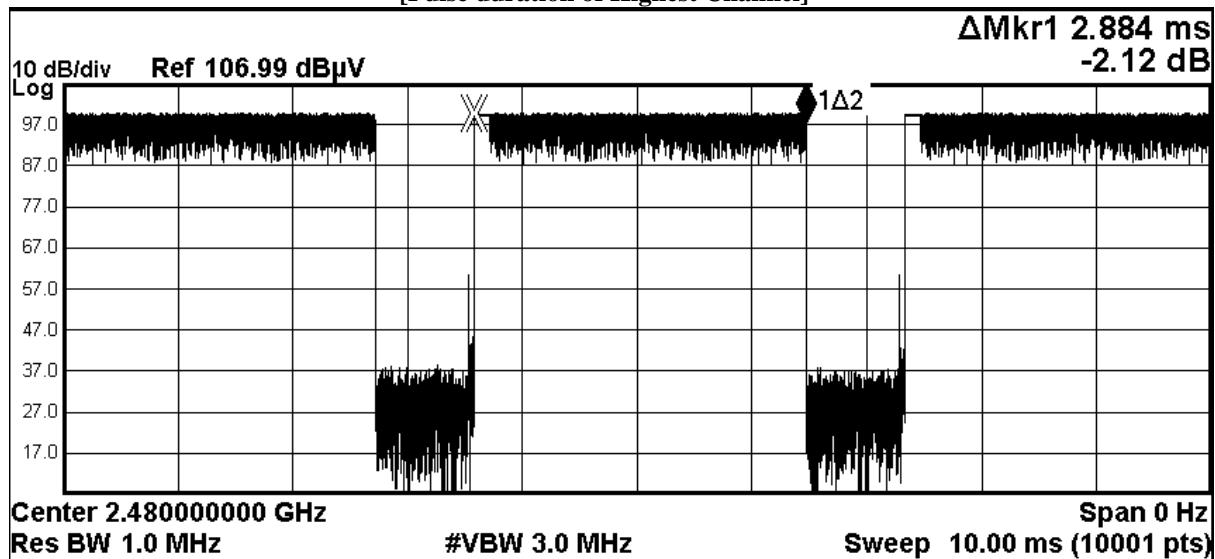


Test Report

Date : 2020-09-28
No. : HM20080050

Page 66 of 85

Fig. C
[Pulse duration of Highest Channel]



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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 67 of 85

2DH3 Packet:

2DH3 Packet permit maximum $1600/79/4 = 5.06$ hops per second in each channel (3 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times $5.06 \times 31.6 = 160$ within 31.6 seconds

Fig. D
 [Pulse duration of Lowest Channel]

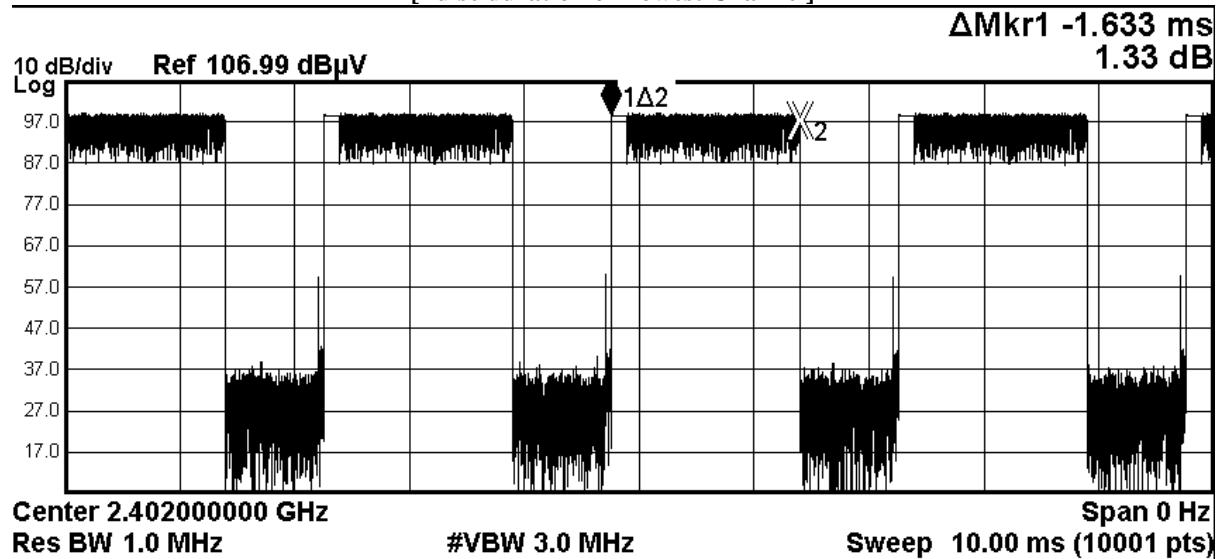
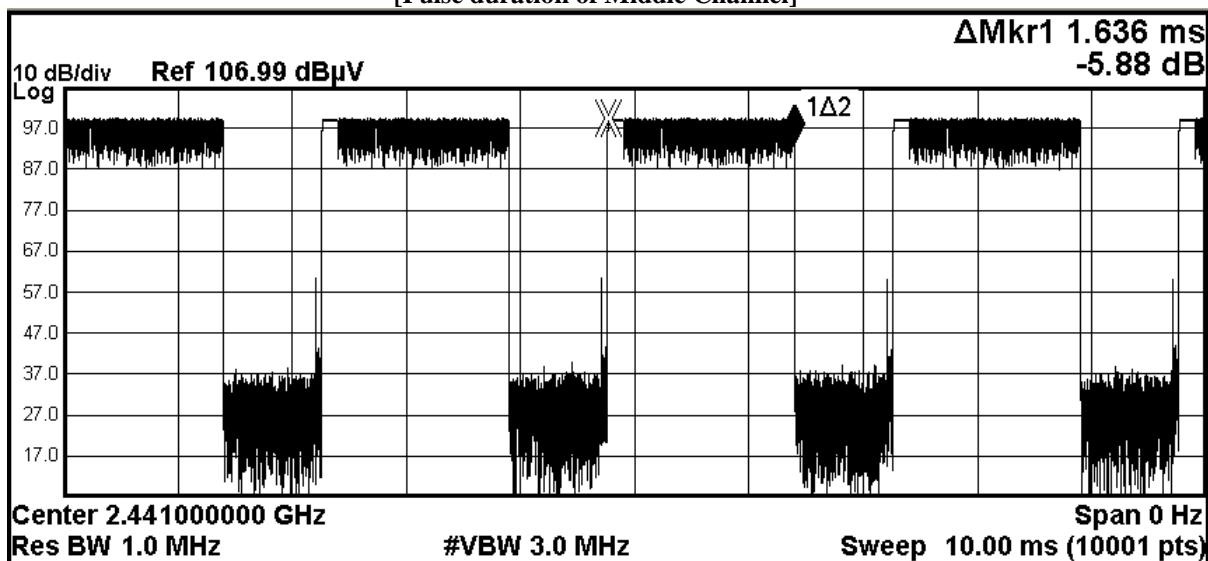


Fig. E
 [Pulse duration of Middle Channel]

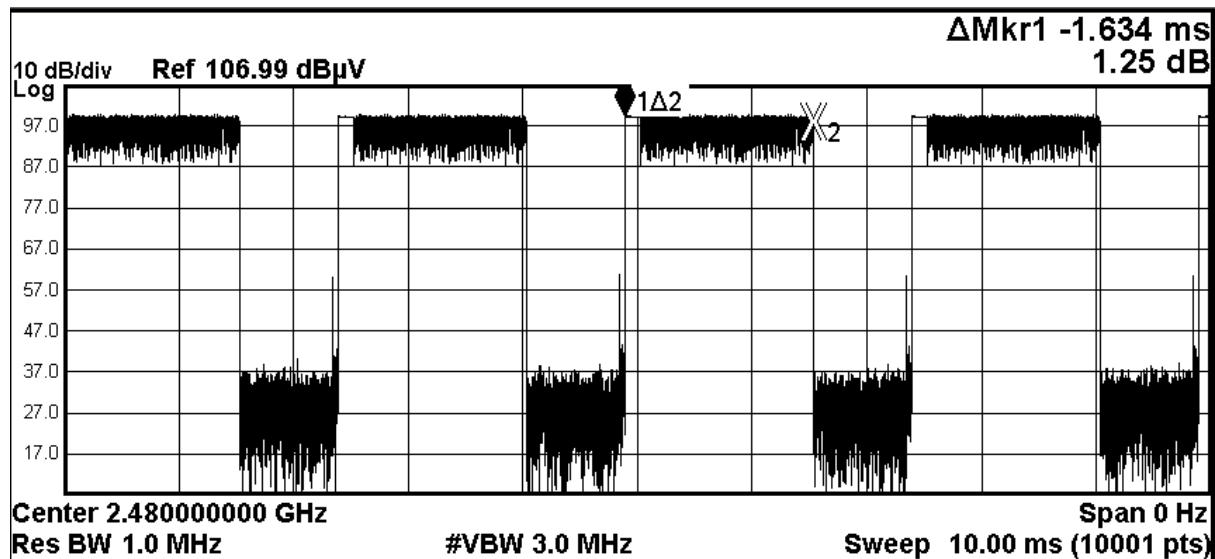


Test Report

Date : 2020-09-28
No. : HM20080050

Page 68 of 85

Fig. F
[Pulse duration of Highest Channel]



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Test Report

Date : 2020-09-28
 No. : HM20080050

Page 69 of 85

2DH1 Packet:

2DH1 Packet permit maximum $1600/79/2 = 10.12$ hops per second in each channel (3 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times $10.12 \times 31.6 = 320$ within 31.6 seconds

Fig. G
 [Pulse duration of Lowest Channel]

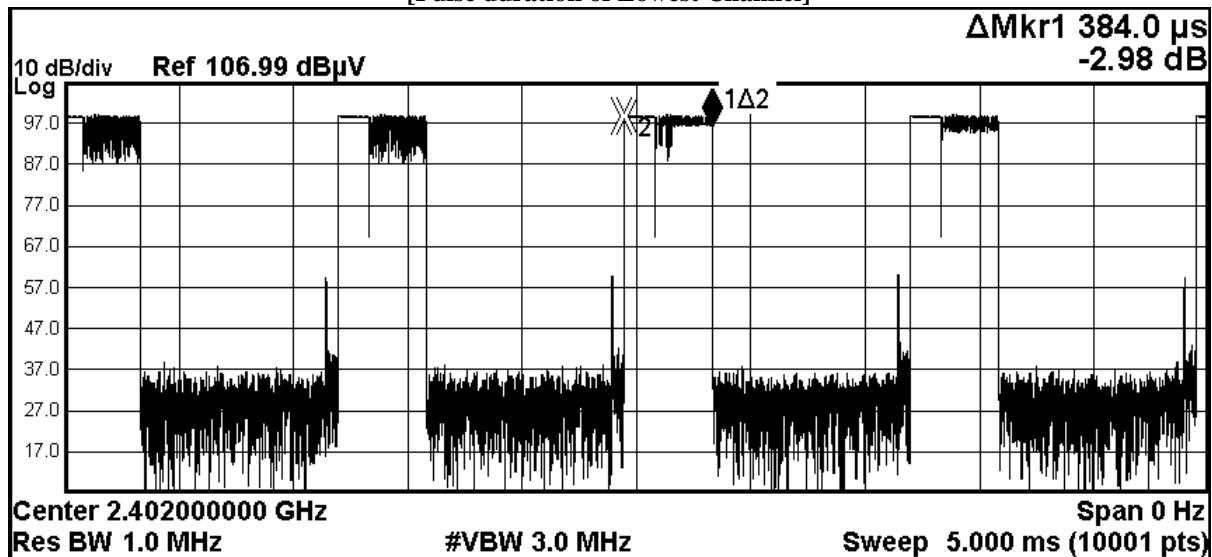
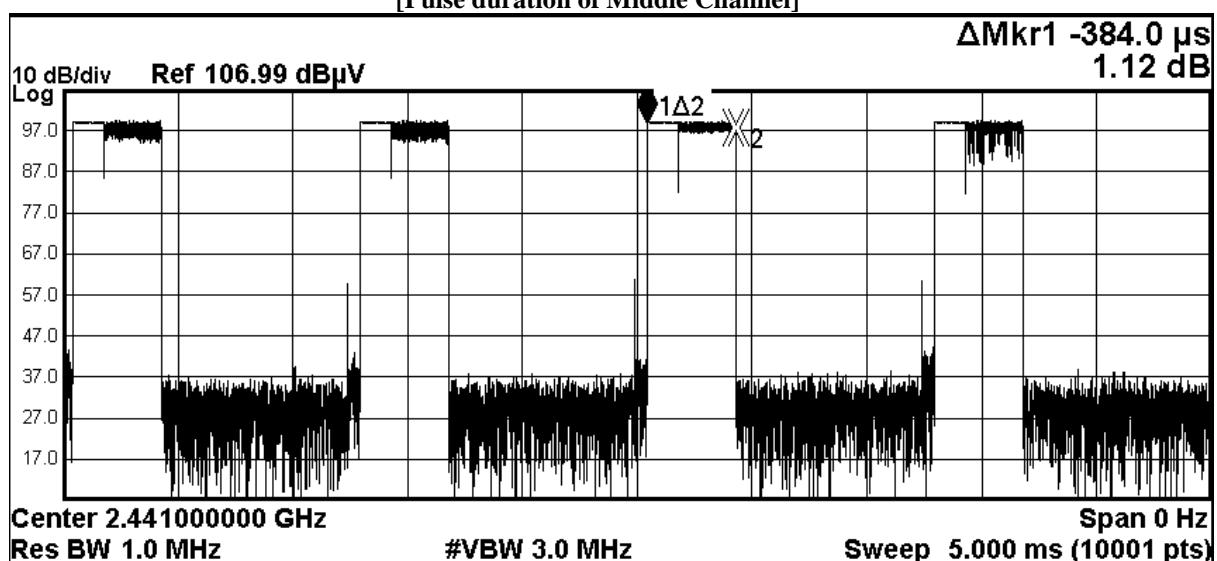


Fig. H
 [Pulse duration of Middle Channel]

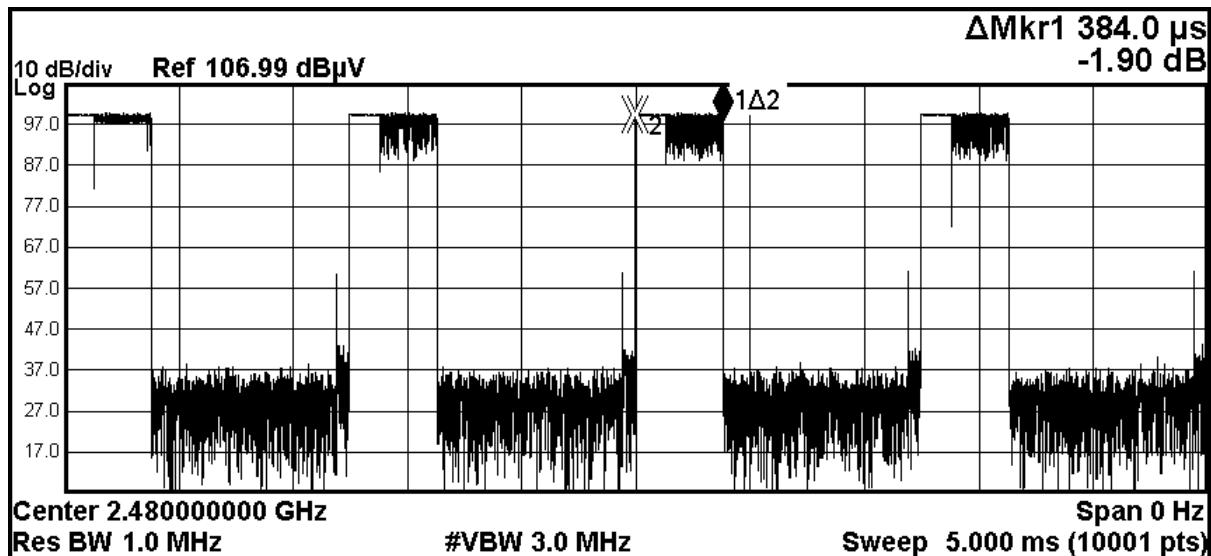


Test Report

Date : 2020-09-28
 No. : HM20080050

Page 70 of 85

Fig. I
 [Pulse duration of Highest Channel]



Time of occupancy (Dwell Time):

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Results
2DH5	2402	2.883	0.307	0.400	Complies
2DH5	2441	2.884	0.307	0.400	Complies
2DH5	2480	2.884	0.307	0.400	Complies
2DH3	2402	1.633	0.261	0.400	Complies
2DH3	2441	1.636	0.262	0.400	Complies
2DH3	2480	1.634	0.261	0.400	Complies
2DH1	2402	0.384	0.123	0.400	Complies
2DH1	2441	0.384	0.123	0.400	Complies
2DH1	2480	0.384	0.123	0.400	Complies

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 71 of 85

3.1.8 Channel Centre Frequency

Requirements:

Frequency hopping system in the 2400-2483.5MHz band shall use at least 79 (Channel 1 to 79) non-overlapping channels.

The EUT operates in accordance with the Bluetooth system specification within the 2400 - 2483.5 MHz frequency band.

RF channels for Bluetooth systems are spaced 1 MHz and are ordered in channel number k. In order to comply with out-of-band regulations, a lower frequency guard band of 2.0 MHz and a higher frequency guard band of 3.5MHz is used.

The operating frequencies of each channel are as follows:

First RF channel start from 2400MHz + 2MHz guard band = 2402MHz

Frequency of RF Channel = 2402+k MHz, k = 1,...,79 (Channel separation = 1MHz)

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Test Report

Date : 2020-09-28

No. : HM20080050

Page 72 of 85

3.1.9 Pseudorandom Hopping Algorithm

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

EUT Pseudorandom Hopping Algorithm

The EUT is a Bluetooth device, the Pseudo-random hopping pattern; hopping characteristics and algorithm are based on the Bluetooth specification.

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 73 of 85

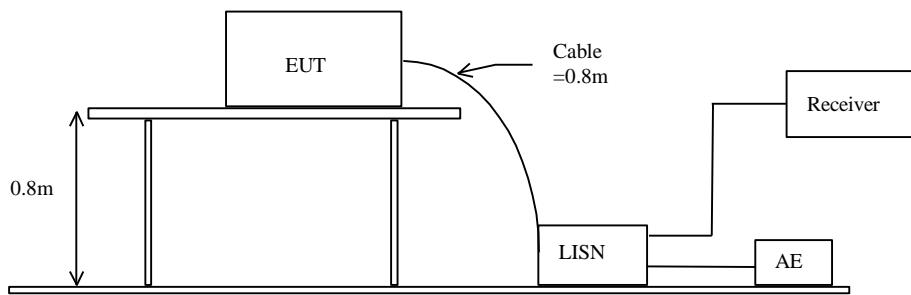
3.1.10 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207 Class B
Test Method:	ANSI C63.10: 2013
Test Date:	2020-09-12
Mode of Operation:	TX mode

Test Method:

The test was performed in accordance with ANSI C63.10: 2013, with the following: initial measurements were performed in peak and average detection modes on the live line, any emissions recorded within 30dB of the relevant limit lines were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Test Setup:



Test Report

Date : 2020-09-28
 No. : HM20080050

Page 74 of 85

Limits for Conducted Emissions (FCC 47 CFR 15.207):

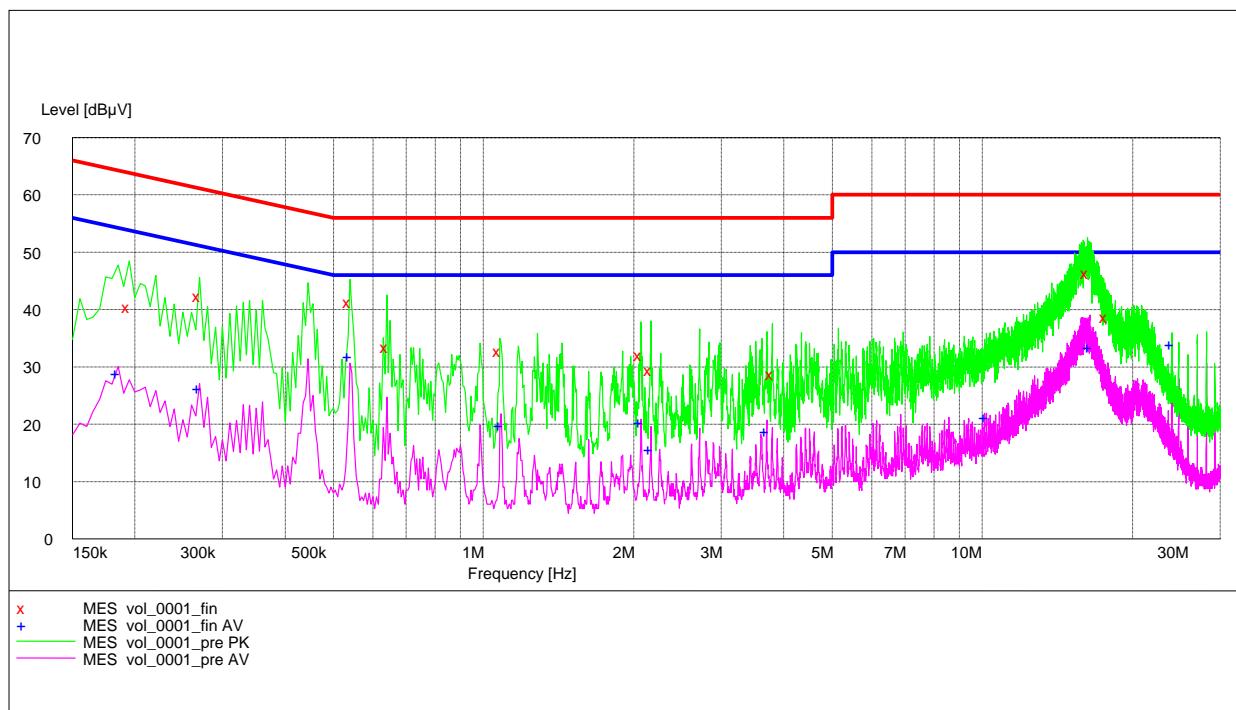
Frequency Range [MHz]	Quasi-Peak Limits [dB μ V]	Average [dB μ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of TX mode (Live and Neutral): PASS

Please refer to the following diagram for individual results.





Test Report

Date : 2020-09-28
No. : HM20080050

Page 75 of 85

MEASUREMENT RESULT: "vol_0001_fin_QP"

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Line	PE
0.195000	40.50	9.9	64	23.3	N	GND
0.270000	42.40	9.9	61	18.7	L1	GND
0.540000	41.50	10.0	56	14.5	L1	GND
0.640000	33.60	10.0	56	22.4	N	GND
1.080000	32.80	10.0	56	23.2	N	GND
2.070000	32.20	10.1	56	23.8	N	GND
2.170000	29.60	10.1	56	26.4	N	GND
3.795000	28.80	10.2	56	27.2	N	GND
16.250000	46.50	10.5	60	13.5	N	GND
17.780000	38.80	10.3	60	21.2	N	GND

MEASUREMENT RESULT: "vol_0001_fin_AV"

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Line	PE
0.185000	29.10	9.9	54	25.2	L1	GND
0.270000	26.40	9.9	51	24.8	N	GND
0.540000	32.00	10.0	46	14.0	N	GND
1.085000	20.00	10.0	46	26.0	N	GND
2.070000	20.50	10.1	46	25.5	N	GND
2.170000	15.70	10.1	46	30.3	L1	GND
3.700000	19.00	10.2	46	27.0	L1	GND
10.200000	21.30	10.4	50	28.7	L1	GND
16.435000	33.60	10.5	50	16.4	N	GND
24.000000	34.10	10.8	50	15.9	L1	GND

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 76 of 85

3.1.11 Antenna Requirement

Test Requirements: § 15.203

Test Specification:

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 shall be considered sufficient to comply with the provisions of this section. 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.

Test Results:

This is Circuit printed meander line antenna. There is no external antenna port, the antenna gain = 0.0dBi. User is unable to remove or changed the Antenna.

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 77 of 85

3.1.12 RF Exposure

RF Exposure

Test Requirement: FCC 47CFR 15.247(i)
Test Date: 2020-09-12
Mode of Operation: Tx mode

Requirements:

In 15.247(i), an equipment shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the limits in §§ 1.1310 and 2.1093 of this chapter. Applications to the Commission for construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities must contain a statement confirming compliance with the limits unless the facility, operation, or transmitter is categorically excluded, as discussed below. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	* 100	6
3.0-30	1842/f	4.89/f	* 900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* 100	30
1.34-30	824/f	2.19/f	* 180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density



Test Report

Date : 2020-09-28
No. : HM20080050

Page 78 of 85

An MPE evaluation was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm. For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Results:

Measurement uncertainty = 1.7 dB
Maximum conducted output power = -2.54dBm (0.56mW) @ 2402 MHz
Antenna gain = 0.0 dBi = 1.0
Tune-up EIRP = -0.84 dBm (0.82 mW)

Applicant stated minimum distance = 20 cm
MPE Limit at 2402MHz = 1.00 mW/cm²

Power Density = 0.16mW/cm²

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 79 of 85

Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2020/04/13	2021/04/13
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2020/05/13	2021/05/13
EM022	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2019/11/30	2021/11/30
EM276	BROADBAND HORN ANTENNA	A-INFOMW	JXTXLB-10180-SF	J2031090903007	2019/03/15	2021/03/15
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2019/05/13	2021/05/13
EM354	BICONILOG ANTENNA	ETS-LINDGREN	3143B	142073	2020/06/17	2022/06/17

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2020/06/30	2021/06/30
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2020/05/13	2021/05/13
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2020/01/13	2021/01/11

Support Equipment

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.
COMPUTER - THINKPAD X1 CARBON	LENOVO	TP00086A	SL10P98060
USB 5V ADAPTOR	APPLE	A1299	QU119D0PWT3DAG
USB TO MICRO CABLE (1M)	MOMAX	DM16	N/A

Remarks:-

CM Corrective Maintenance
N/A Not Applicable
TBD To Be Determined

The Hong Kong Standards and Testing Centre Limited

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Test Report

Date : 2020-09-28
No. : HM20080050

Page 80 of 85

Appendix B

Photographs of EUT

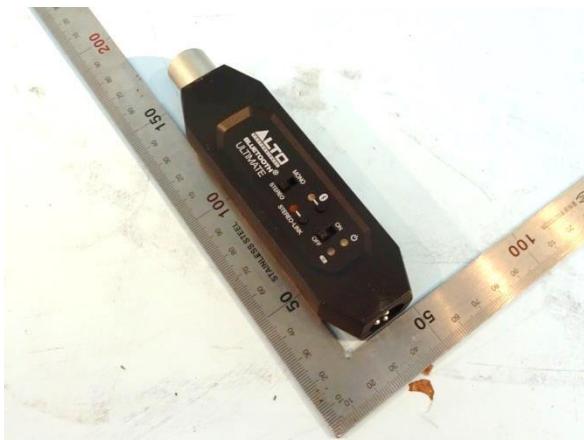
Front View of the product



Rear View of the product



Front View of the product



Rear View of the product



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 81 of 85

Photographs of EUT

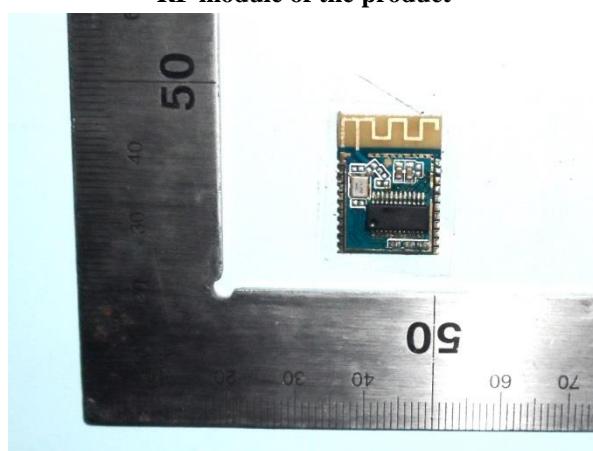
Front View of the PCB of the product



Rear View of the PCB of the product



RF module of the product



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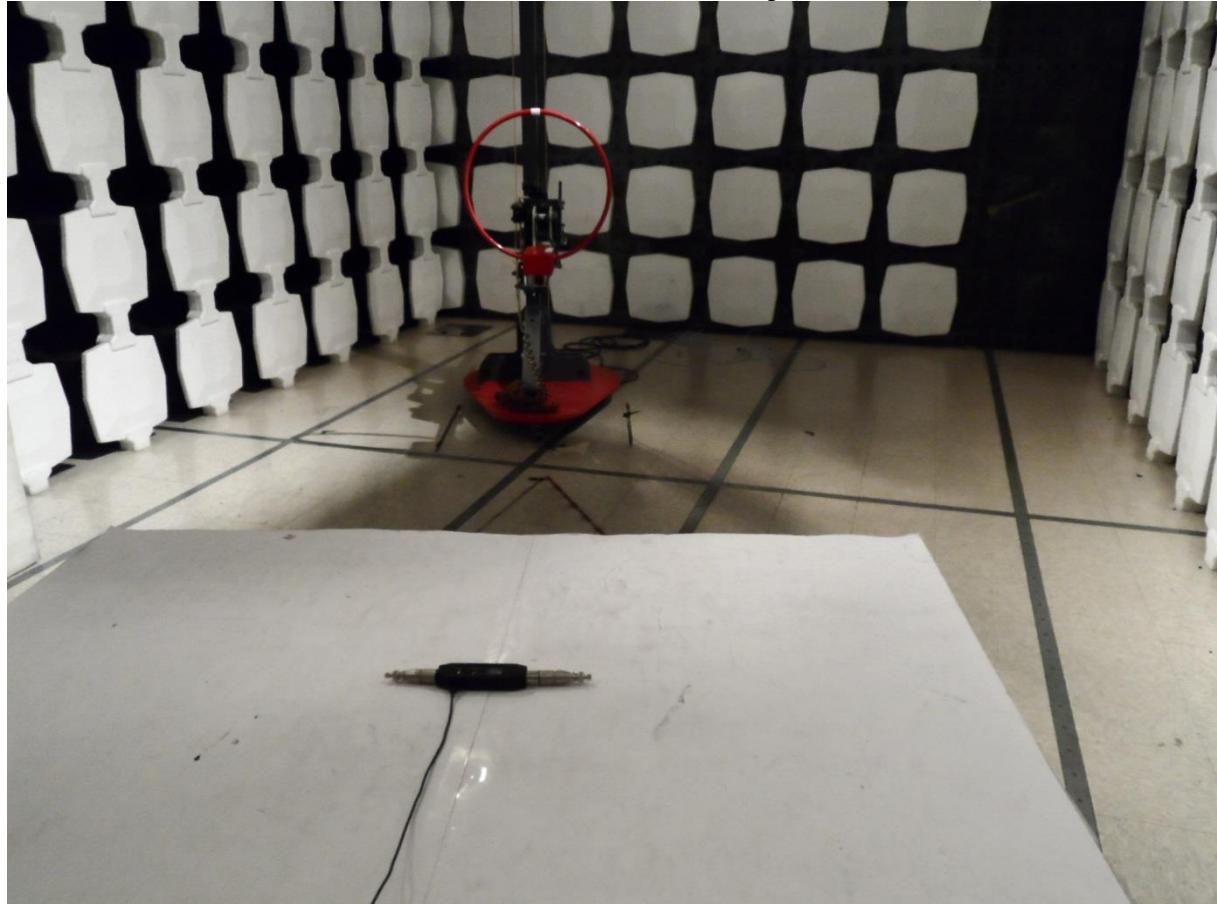
Test Report

Date : 2020-09-28
No. : HM20080050

Page 82 of 85

Photographs of EUT

Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)



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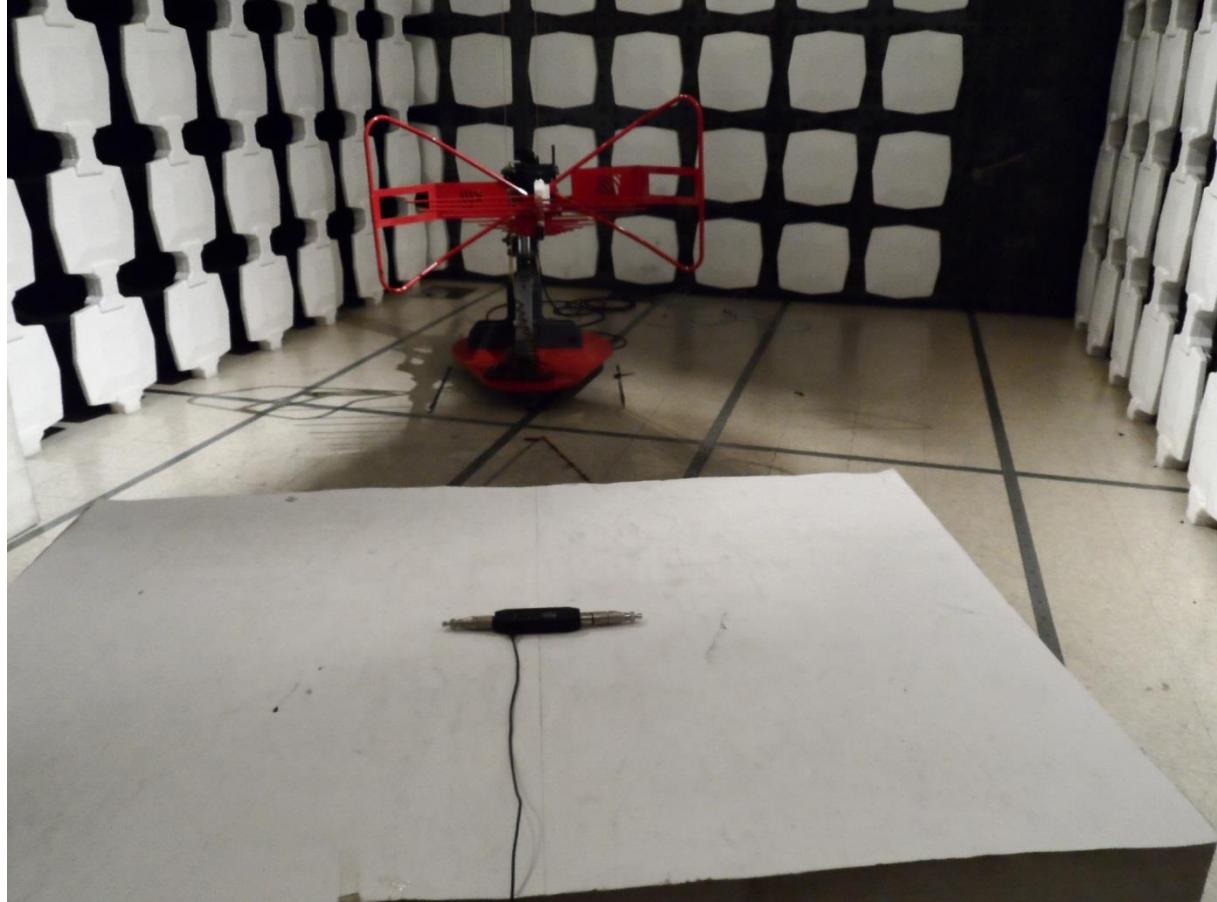
Test Report

Date : 2020-09-28
No. : HM20080050

Page 83 of 85

Photographs of EUT

Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)



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Test Report

Date : 2020-09-28
No. : HM20080050

Page 84 of 85

Photographs of EUT

Measurement of Radiated Emission Test Set Up (above 1000MHz)



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No. : HM20080050

Page 85 of 85

Photographs of EUT

Measurement of Conducted Emission Test Set Up



***** End of Test Report *****

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