



Test Report

Date : 2018-01-08

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No. : HM17120028 (Ref.: HM171018)

Applicant: Acoustmax International Co., Ltd
Unit D, 16/F, Cheuk Nang Plaza, 250 Hennessy Road, Wanchai,
Hong Kong

Manufacturer: Shenzhen Maniway Electronics Limited
Bldg 8, Sanlian Hebei Industrial Estate, Longhua Street, Bao' an
District, Shenzhen, China

Description of Sample(s):

Product:	LUMIN, PORTABLE BLUETOOTH LED SPEAKER
Brand Name:	AM Lifestyles
Model Number:	AL-LMGR
FCC ID:	2AAIN-ALLMGR

Date Sample(s) Received: 2017-10-25

Date Tested: 2017-11-03 to 2017-11-08

Investigation Requested: Perform ElectroMagnetic Interference measurement in accordance with FCC 47 CFR [Codes of Federal Regulations] Part 15: 2017 and ANSI C63.10: 2013 for FCC Certification.

Conclusion(s): 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.

Remark(s): Bluetooth FHSS (GFSK/ $\pi/4$ -DQPSK/ 8DPSK)




CHEUNG Chi, Kenneth

Authorized Signatory

ElectroMagnetic Compatibility Department

For and on behalf of

The Hong Kong Standards and Testing Centre Ltd.

The Hong Kong Standards and Testing Centre Limited

Head Office: 10 Dai Wang Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong

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1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
10 Dai Wang Street, Taipo Industrial Estate

Telephone: (852) 26661888
Fax: (852) 26644353

1.2 Equipment Under Test [EUT] Description of Sample(s)

Product: LUMIN, PORTABLE BLUETOOTH LED SPEAKER
Manufacturer: Shenzhen Maniway Electronics Limited
Bldg 8, Sanlian Hebei Industrial Estate, Longhua
Street, Bao' an District, Shenzhen, China
Brand Name: AM Lifestyles
Model Number: AL-LMGR
Rating: 12Vd.c, the AC Adaptor used for the tests was provided by
the applicant with the following details: Model
PSEC120150UW, Input: 100-240Va.c. 50-60Hz. 0.5A,
Output: 12.0Vd.c. 1.5A

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is Bluetooth Lamp with Speaker. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC; the type of modulation used was frequency hopping spread spectrum Modulation.

1.3 Date of Order

2017-10-25

1.4 Submitted Sample(s):

2 Samples

1.5 Test Duration

2017-11-03 to 2017-11-08

1.6 Country of Origin

China

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1.7 Antenna Details

Antenna Type (Bluetooth): Circuit board printed meander line antenna

Antenna Gain (Bluetooth): -0.48dBi

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

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2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations. ANSI C63.10:2013 for FCC Certification.

2.2 Test Standards and Results Summary Tables

EMISSION (BLUETOOTH)						
Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Fail	N/A
Maximum Peak Output Power (EIRP)	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	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 (Radiated)	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 type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Note: N/A – Not Applicable

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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 Items

Maximum Peak Output Power (EIRP)	GFSK / $\pi/4$ -DQPSK/ 8DPSK
Hopping Channel Separation	GFSK / $\pi/4$ -DQPSK/ 8DPSK
Number of Hopping Frequency	GFSK / $\pi/4$ -DQPSK/ 8DPSK
Time of Occupancy(Dwell Time)	8DPSK (DH1 / DH3 / DH5)
Radiated Spurious Emissions	GFSK / $\pi/4$ -DQPSK/ 8DPSK

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3.0 Test Results

3.1 Emission

3.1.1 Maximum Peak Output Power (EIRP)

Test Requirement:	FCC 47CFR 15.247(b)(2)
Test Method:	ANSI C63.10:2013
Test Date:	2017-11-06
Mode of Operation:	Tx mode :GFSK/ π /4-DQPSK/ 8DPSK

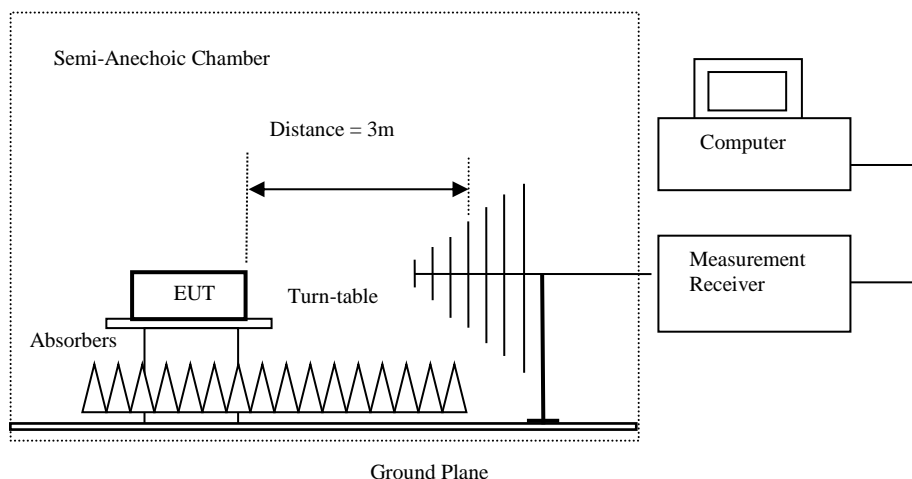
Test Method:

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.

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FCC Test Firm Registration Number 723883 Designation Number HK0001

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.

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Limits for Maximum Peak Output Power [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 output power (EIRP)

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.00771
39	2441	0.00487
78	2480	0.00865

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

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.00509
39	2441	0.00378
78	2480	0.00521

Results of Bluetooth Communication mode (8DPSK) (Fundamental Power): Pass Maximum output power (EIRP)

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.00613
39	2441	0.00405
78	2480	0.00687

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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3.1.2 Conducted Emissions (0.15MHz to 30MHz)

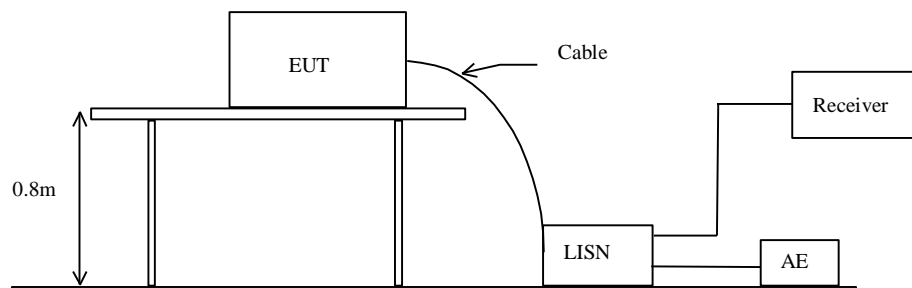
Test Requirement: FCC 47CFR 15.207
Test Method: ANSI C63.10:2013
Test Date: 2017-11-08

Mode of Operation: Tx mode

Test Method:

The test was performed in accordance with ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line 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:



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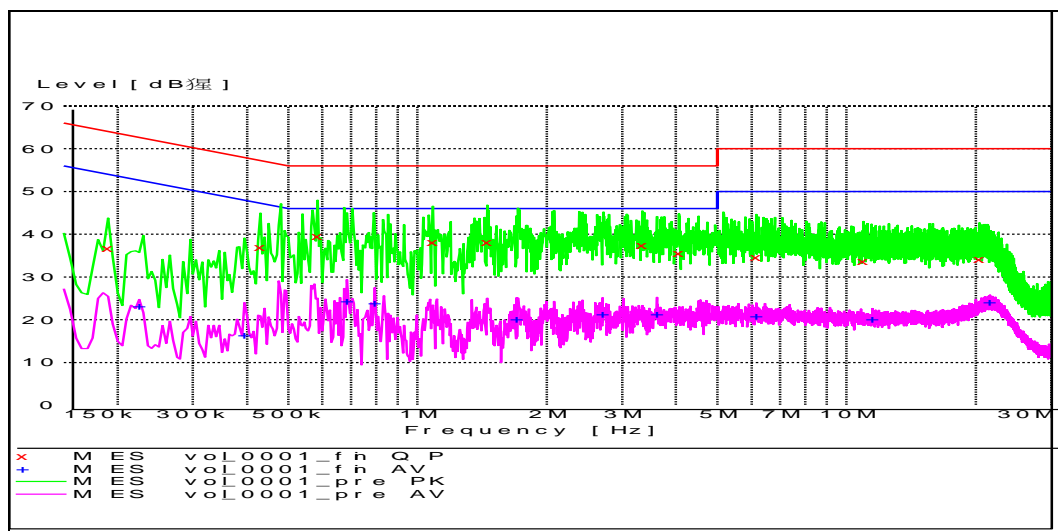
Limit for Conducted Emissions (FCC 47CFR 15.207):

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



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MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.190000	36.80	9.9	64	27.3	L1	GND
0.430000	37.10	10.0	57	20.2	L1	GND
0.585000	39.50	9.9	56	16.5	L1	GND
1.085000	38.00	9.8	56	18.0	L1	GND
1.455000	38.20	9.9	56	17.8	N	GND
3.340000	37.50	10.4	56	18.5	L1	GND
4.065000	35.70	10.5	56	20.3	L1	GND
6.155000	34.70	10.6	60	25.3	N	GND
10.950000	33.60	10.4	60	26.4	L1	GND
20.405000	34.10	10.8	60	25.9	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.225000	23.30	9.9	53	29.3	L1	GND
0.395000	16.30	10.0	48	31.7	L1	GND
0.685000	24.30	9.9	46	21.7	L1	GND
0.795000	23.80	9.9	46	22.2	L1	GND
1.700000	20.20	10.0	46	25.8	N	GND
2.695000	21.20	10.3	46	24.8	L1	GND
3.615000	21.40	10.4	46	24.6	L1	GND
6.155000	20.80	10.6	50	29.2	N	GND
11.505000	20.10	10.5	50	29.9	L1	GND
21.560000	24.20	10.8	50	25.8	N	GND

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3.1.3 Radiated Spurious Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2017-11-06
Mode of Operation:	Tx mode :GFSK/ π /4-DQPSK/8DPSK BT communication mode with lamp

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.

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FCC Test Firm Registration Number 723883 Designation Number HK0001

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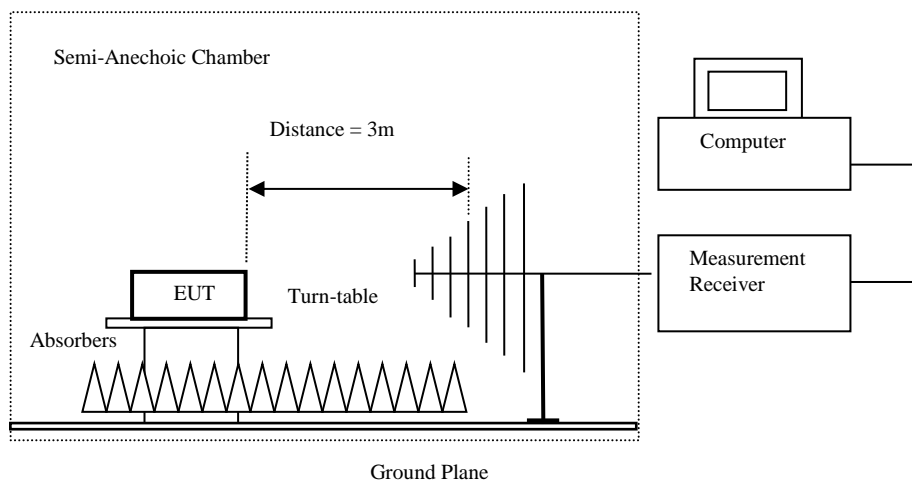
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Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW: 10kHz
	VBW: 30kHz
	Sweep: Auto
	Span: Fully capture the emissions being measured
	Trace: Max. hold
30MHz – 1GHz (QP)	RBW: 120kHz
	VBW: 120kHz
	Sweep: Auto
	Span: Fully capture the emissions being measured
	Trace: Max. hold
Above 1GHz (Pk & Av)	RBW: 1MHz
	VBW: 3MHz
	Sweep: Auto
	Span: Fully capture the emissions being measured
	Trace: Max. hold

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.

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Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

Frequency Range	Quasi-Peak Limits
[MHz]	[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
Above960	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.

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Result of Tx mode (GFSK: 2402.0 MHz) (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 FCC Limits						

Result of Tx mode (GFSK: 2402.0 MHz) (30MHz – 1GHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

Result of Tx mode (GFSK: 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 dB	E-Field Polarity
2402.0	76.3	27.8	104.1	N/A	N/A	Vertical
4804.0	1.3	42.4	43.7	74.0	30.3	Vertical
7206.0	0.2	46.7	46.9	74.0	27.1	Vertical
9608.0	1.1	48.4	49.5	74.0	24.5	Vertical
12010.0	0.9	53.1	54.0	74.0	20.0	Vertical

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

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 dB	E-Field Polarity
2402.0	65.3	27.8	93.1	N/A	N/A	Vertical
4804.0	-7.3	42.4	35.1	54.0	18.9	Vertical
7206.0	-11.2	46.7	35.5	54.0	18.5	Vertical
9608.0	-13.2	48.4	35.2	54.0	18.8	Vertical
12010.0	-12.7	53.1	40.4	54.0	13.6	Vertical

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Tel: +852 2666 1888 Fax: +852 2664 4353 Email: hkstc@hkstc.org Website: www.stc-group.org

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Result of Tx mode (GFSK: 2441.0 MHz) (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 FCC Limits						

Results of Tx mode (GFSK: 2441.0 MHz) (30MHz – 1000MHz): PASS

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

Result of Tx mode (GFSK: 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 dB	E-Field Polarity
2441.0	74.3	27.8	102.1	N/A	N/A	Vertical
4882.0	2.9	42.5	45.4	74.0	28.6	Vertical
7323.0	1.1	47.1	48.2	74.0	25.8	Vertical
9764.0	1.3	49.3	50.6	74.0	23.4	Vertical
12205.0	0.7	53.1	53.8	74.0	20.2	Vertical

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

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 dB	E-Field Polarity
2441.0	60.7	27.8	88.5	N/A	N/A	Vertical
4882.0	-8.1	42.5	34.4	54.0	19.6	Vertical
7323.0	-9.3	47.1	37.8	54.0	16.2	Vertical
9764.0	-12.1	49.3	37.2	54.0	16.8	Vertical
12205.0	-12.9	53.1	40.2	54.0	13.8	Vertical

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Result of Tx mode (GFSK: 2480.0 MHz) (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 FCC Limits						

Results of Tx mode (GFSK: 2480.0 MHz) (30MHz – 1000MHz): PASS

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

Result of Tx mode (GFSK: 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 dB	E-Field Polarity
2480.0	76.8	27.8	104.6	N/A	N/A	Vertical
4960.0	2.7	43.2	45.9	74.0	28.1	Vertical
7440.0	1.1	46.2	47.3	74.0	26.7	Vertical
9920.0	1.3	50.9	52.2	74.0	21.8	Vertical
12400.0	0.7	54.3	55.0	74.0	19.0	Vertical

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

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 dB	E-Field Polarity
2480.0	65.4	27.8	93.2	N/A	N/A	Vertical
4960.0	-9.1	43.2	34.1	54.0	19.9	Vertical
7440.0	-12.1	46.2	34.1	54.0	19.9	Vertical
9920.0	-11.3	50.9	39.6	54.0	14.4	Vertical
12400.0	-12.7	54.3	41.6	54.0	12.4	Vertical

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

Result of Tx mode ($\pi/4$ -DQPSK: 2402.0 MHz) (30MHz – 1GHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

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 dB	E-Field Polarity
4804.0	74.5	27.8	102.3	N/A	N/A	Vertical
4804.0	2.1	42.4	44.5	74.0	29.5	Vertical
7206.0	0.3	46.7	47.0	74.0	27.0	Vertical
9608.0	1.2	48.4	49.6	74.0	24.4	Vertical
12010.0	0.3	53.1	53.4	74.0	20.6	Vertical

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

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 dB	E-Field Polarity
4804.0	59.3	27.8	87.1	54.0	-33.1	Vertical
7206.0	-10.9	46.7	35.8	54.0	18.2	Vertical
9608.0	-12.3	48.4	36.1	54.0	17.9	Vertical
12010.0	-12.1	53.1	41.0	54.0	13.0	Vertical

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

Results of Tx mode ($\pi/4$ -DQPSK: 2441.0 MHz) (30MHz – 1000MHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

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 dB	E-Field Polarity
2441.0	73.2	27.8	101.0	N/A	N/A	Vertical
4882.0	1.9	42.5	44.4	74.0	29.6	Vertical
7323.0	1.3	47.1	48.4	74.0	25.6	Vertical
9764.0	0.7	49.3	50.0	74.0	24.0	Vertical
12205.0	0.5	53.1	53.6	74.0	20.4	Vertical

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

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 dB	E-Field Polarity
2441.0	59.3	27.8	87.1	N/A	N/A	Vertical
4882.0	-8.9	42.5	33.6	54.0	20.4	Vertical
7323.0	-9.8	47.1	37.3	54.0	16.7	Vertical
9764.0	-11.6	49.3	37.7	54.0	16.3	Vertical
12205.0	-12.7	53.1	40.4	54.0	13.6	Vertical

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

Results of Tx mode ($\pi/4$ -DQPSK: 2480.0 MHz) (30MHz – 1000MHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

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 dB	E-Field Polarity
2480.0	74.6	27.8	102.4	N/A	N/A	Vertical
4960.0	2.1	43.2	45.3	74.0	28.7	Vertical
7440.0	1.3	46.2	47.5	74.0	26.5	Vertical
9920.0	1.1	50.9	52.0	74.0	22.0	Vertical
12400.0	0.5	54.3	54.8	74.0	19.2	Vertical

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

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 dB	E-Field Polarity
2480.0	58.6	27.8	86.4	54.0	-32.4	Vertical
4960.0	-9.4	43.2	33.8	54.0	20.2	Vertical
7440.0	-11.1	46.2	35.1	54.0	18.9	Vertical
9920.0	-12.4	50.9	38.5	54.0	15.5	Vertical
12400.0	-12.3	54.3	42.0	54.0	12.0	Vertical

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Result of Tx mode (8DPSK: 2402.0 MHz) (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 FCC Limits						

Result of Tx mode (8DPSK: 2402.0 MHz) (30MHz – 1GHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

Result of Tx mode (8DPSK: 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 dB	E-Field Polarity
2402.0	75.3	27.8	103.1	N/A	N/A	Vertical
4804.0	2.4	42.4	44.8	74.0	29.2	Vertical
7206.0	1.7	46.7	48.4	74.0	25.6	Vertical
9608.0	1.9	48.4	50.3	74.0	23.7	Vertical
12010.0	0.7	53.1	53.8	74.0	20.2	Vertical

Result of Tx mode (8DPSK: 2402.0 MHz) (Above 1GHz): Pass

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 dB	E-Field Polarity
2402.0	57.3	27.8	85.1	N/A	N/A	Vertical
4804.0	-8.4	42.4	34.0	54.0	20.0	Vertical
7206.0	-10.3	46.7	36.4	54.0	17.6	Vertical
9608.0	-11.5	48.4	36.9	54.0	17.1	Vertical
12010.0	-11.9	53.1	41.2	54.0	12.8	Vertical

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Result of Tx mode (8DPSK: 2441.0 MHz) (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 FCC Limits						

Results of Tx mode (8DPSK: 2441.0 MHz) (30MHz – 1000MHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

Result of Tx mode (8DPSK: 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 dB	E-Field Polarity
2441.0	73.5	27.8	101.3	N/A	N/A	Vertical
4882.0	2.3	42.5	44.8	74.0	29.2	Vertical
7323.0	1.1	47.1	48.2	74.0	25.8	Vertical
9764.0	1.3	49.3	50.6	74.0	23.4	Vertical
12205.0	0.3	53.1	53.4	74.0	20.6	Vertical

Result of Tx mode (8DPSK: 2441.0 MHz) (Above 1GHz): Pass

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 dB	E-Field Polarity
2441.0	56.3	27.8	84.1	N/A	N/A	Vertical
4882.0	-8.8	42.5	33.7	54.0	20.3	Vertical
7323.0	-9.9	47.1	37.2	54.0	16.8	Vertical
9764.0	-11.5	49.3	37.8	54.0	16.2	Vertical
12205.0	-12.3	53.1	40.8	54.0	13.2	Vertical

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Result of Tx mode (8DPSK: 2480.0 MHz) (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 FCC Limits						

Results of Tx mode (8DPSK: 2480.0 MHz) (30MHz – 1000MHz): Pass

Field Strength of Spurious Emissions Quasi-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 FCC Limits						

Result of Tx mode (8DPSK: 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 dB	E-Field Polarity
2480.0	75.8	27.8	103.6	N/A	N/A	Vertical
4960.0	1.7	43.2	44.9	74.0	29.1	Vertical
7440.0	2.1	46.2	48.3	74.0	25.7	Vertical
9920.0	0.9	50.9	51.8	74.0	22.2	Vertical
12400.0	0.3	54.3	54.6	74.0	19.4	Vertical

Result of Tx mode (8DPSK: 2480.0 MHz) (Above 1GHz): Pass

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 dB	E-Field Polarity
2480.0	57.1	27.8	84.9	N/A	N/A	Vertical
4960.0	-8.6	43.2	34.6	54.0	19.4	Vertical
7440.0	-11.3	46.2	34.9	54.0	19.1	Vertical
9920.0	-10.9	50.9	40.0	54.0	14.0	Vertical
12400.0	-12.6	54.3	41.7	54.0	12.3	Vertical

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Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

Frequency Range [MHz]	Quasi-Peak Limits [μV/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.

Result of BT communication mode with lamp, (9kHz – 30MHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

Result of BT communication mode with lamp, (30MHz – 1GHz): PASS

Field Strength of Fundamental and Harmonics Emissions Quasi-Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
67.6	20.0	7.2	27.2	22.9	100	Horizontal
192.0	25.5	10.3	35.8	61.7	150	Horizontal
288.0	26.1	13.7	39.8	97.7	150	Horizontal
40.8	26.3	10.0	36.3	65.3	200	Vertical
174.3	28.4	9.9	38.3	82.2	200	Vertical
480.1	23.1	19.1	42.2	128.8	200	Vertical

Result of BT communication mode with lamp, (1GHz – 26GHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

Remarks:

- * 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): 2.4dB
(30MHz - 18GHz): 5.0dB
(18GHz - 26GHz): 5.24dB

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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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:

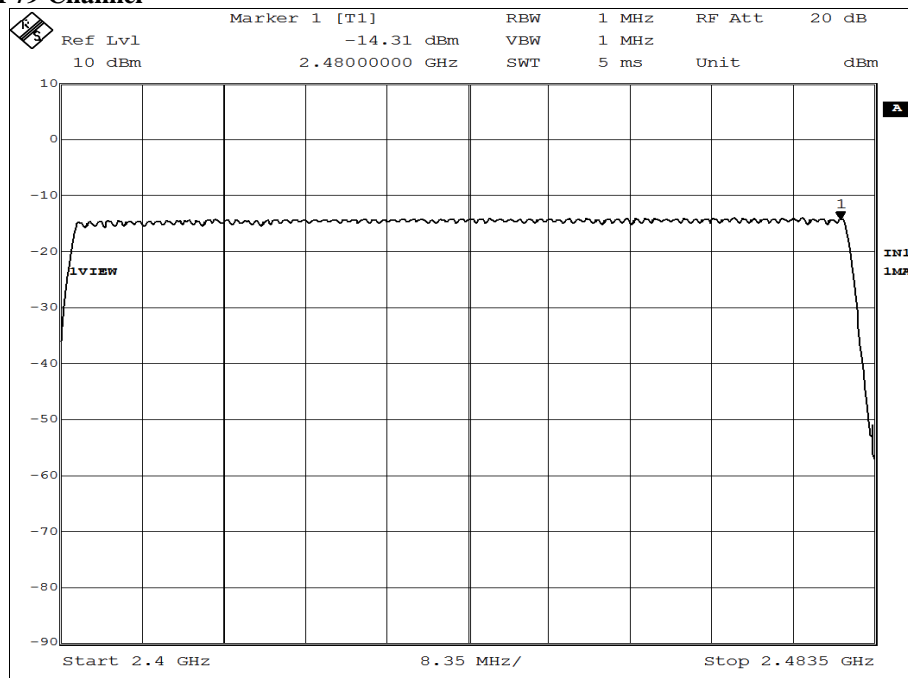
RBW = 300kHz, VBW \geq RBW, Sweep = Auto, Span = the frequency band of operation
Detector = Peak, Trace = Max. hold

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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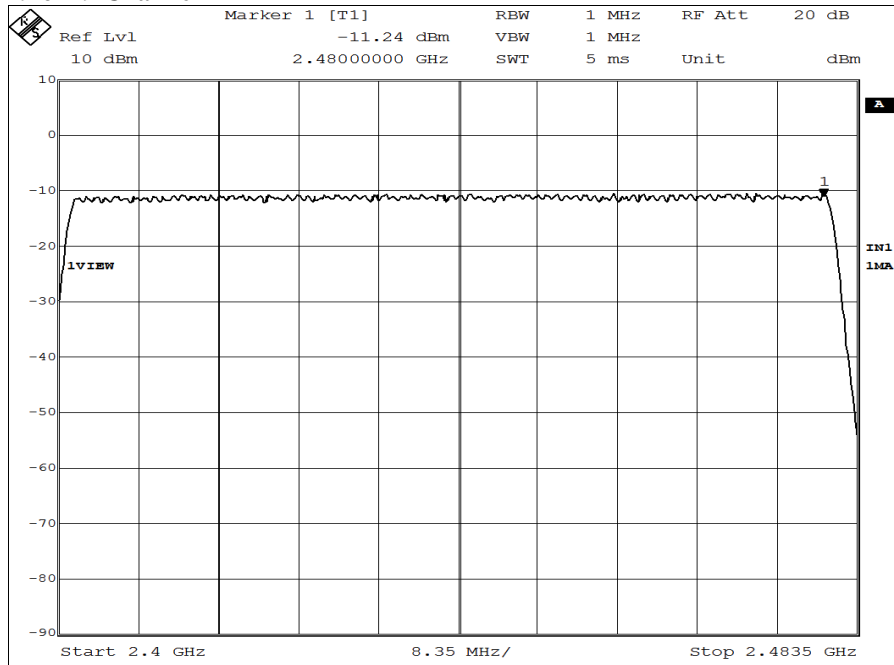
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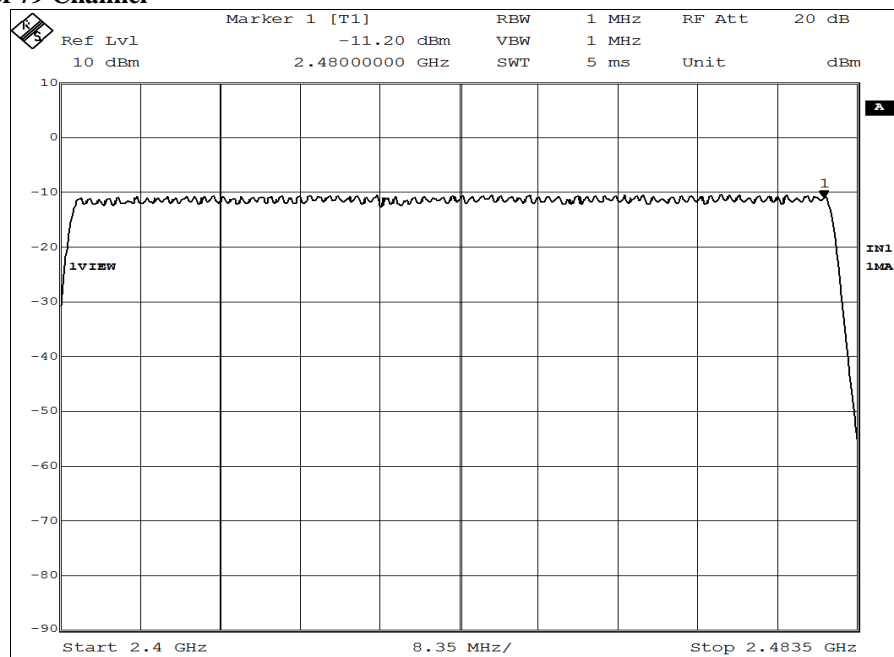
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$\pi/4$ -DQPSK: 79 of 79 Channel



8DPSK: 79 of 79 Channel



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No. : HM17120028 (Ref.: HM171018)

3.1.5 20dB Bandwidth

Test Requirement:	FCC 47CFR 15.247(a)(1)
Test Method:	ANSI C63.10:2013
Test Date:	2017-11-06
Mode of Operation:	Tx mode :GFSK/ $\pi/4$ -DQPSK/8DPSK

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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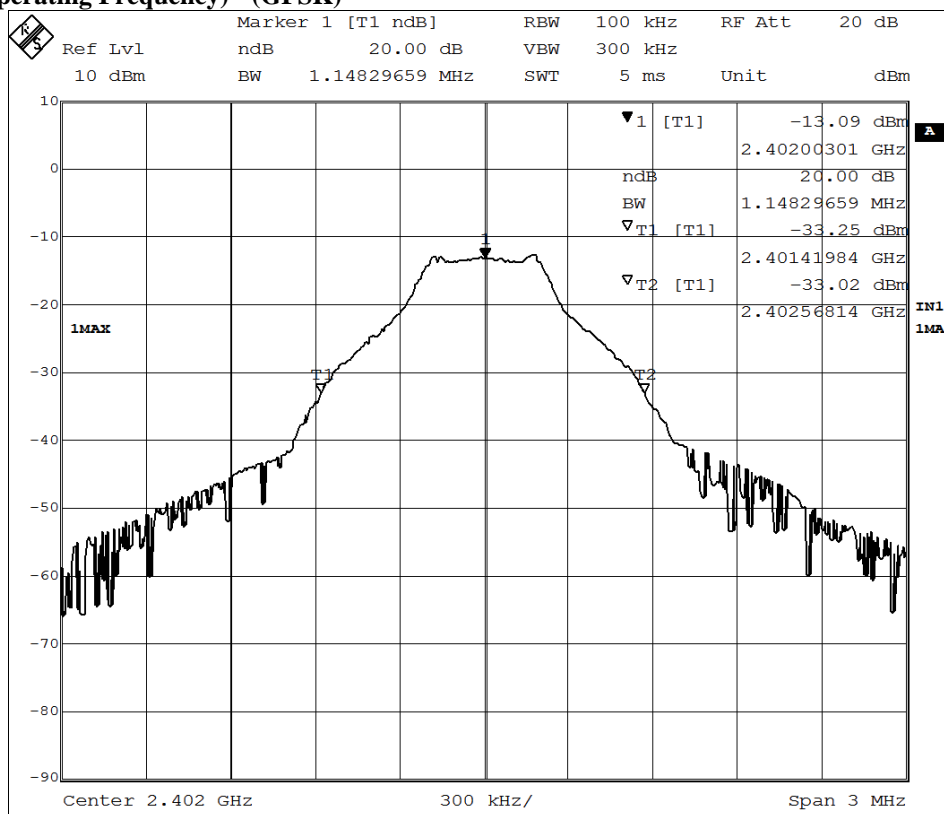
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.15	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)



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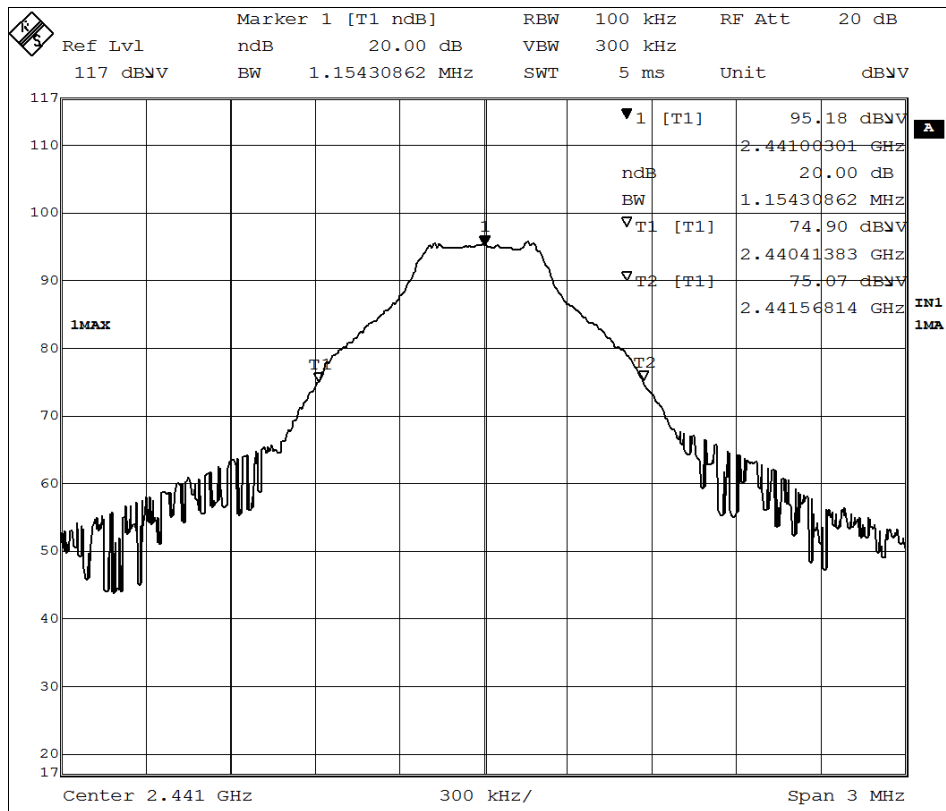
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No. : HM17120028 (Ref.: HM171018)

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.15	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



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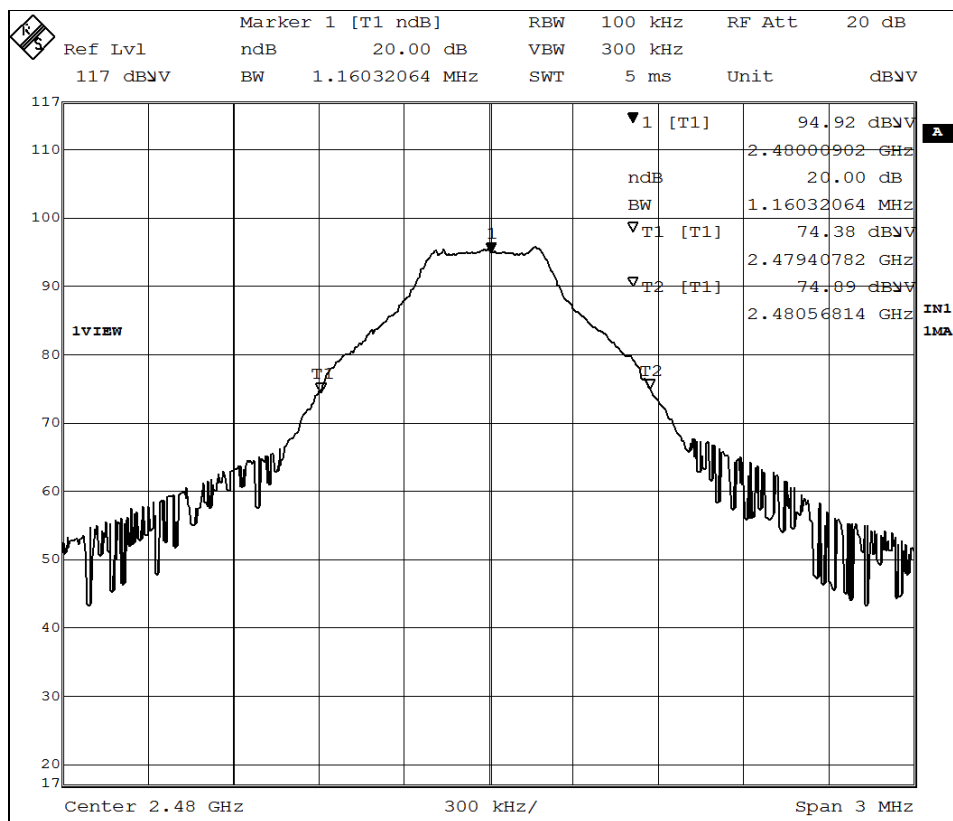
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.16	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)



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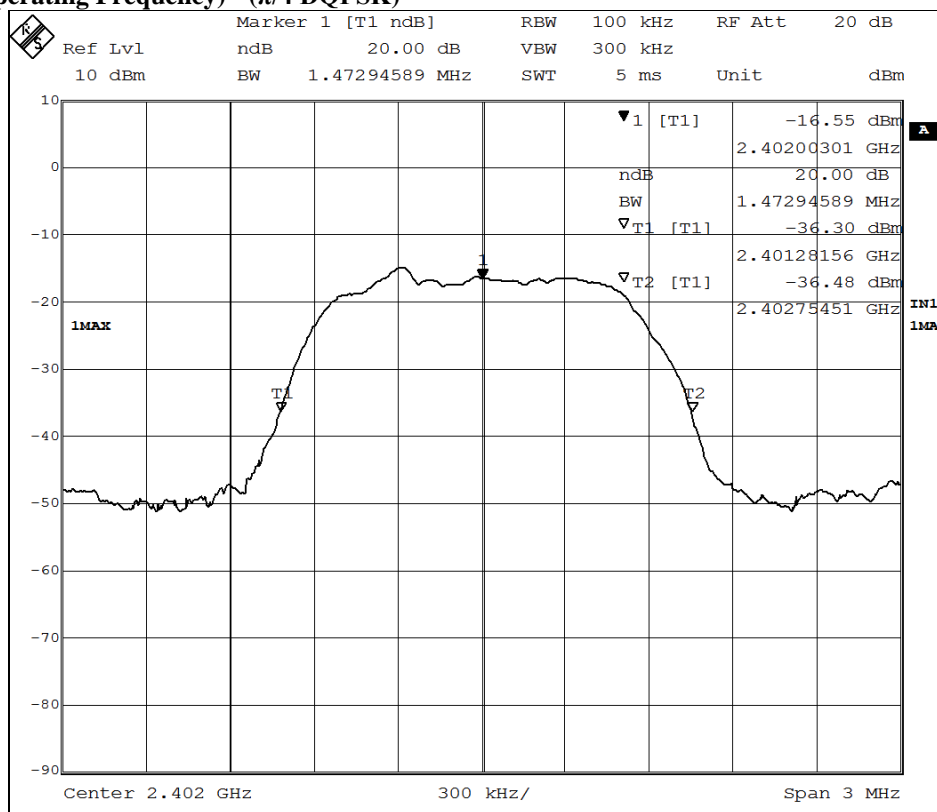
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No. : HM17120028 (Ref.: HM171018)

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.47	Within 2400-2483.5

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



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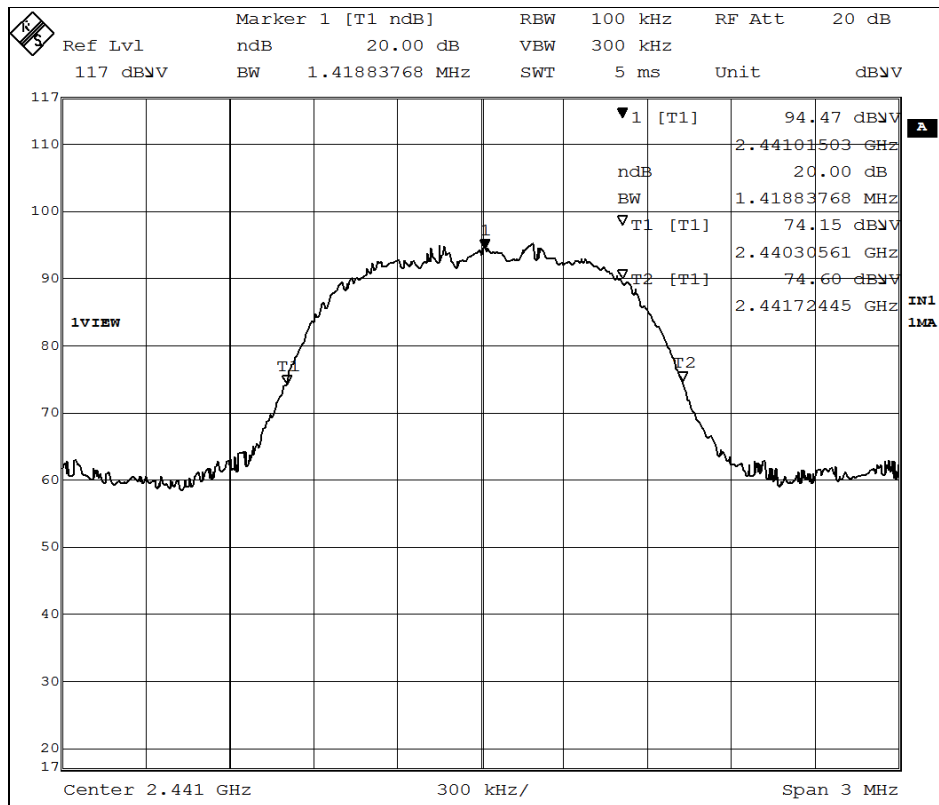
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.42	Within 2400-2483.5

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



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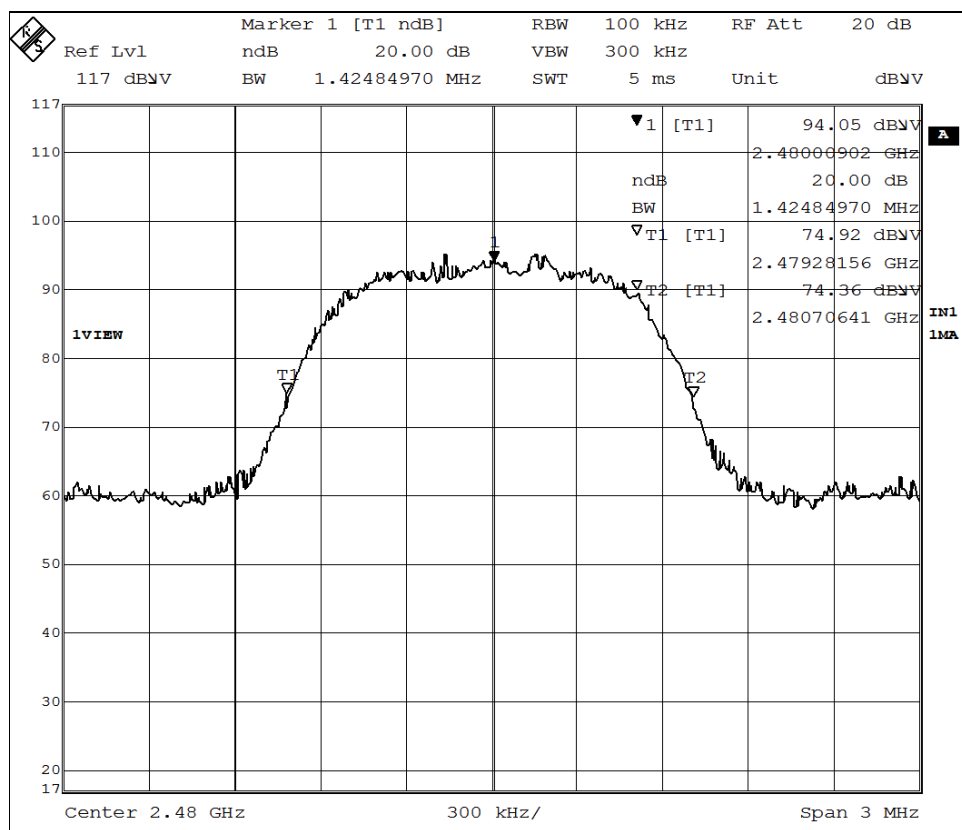
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.42	Within 2400-2483.5

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



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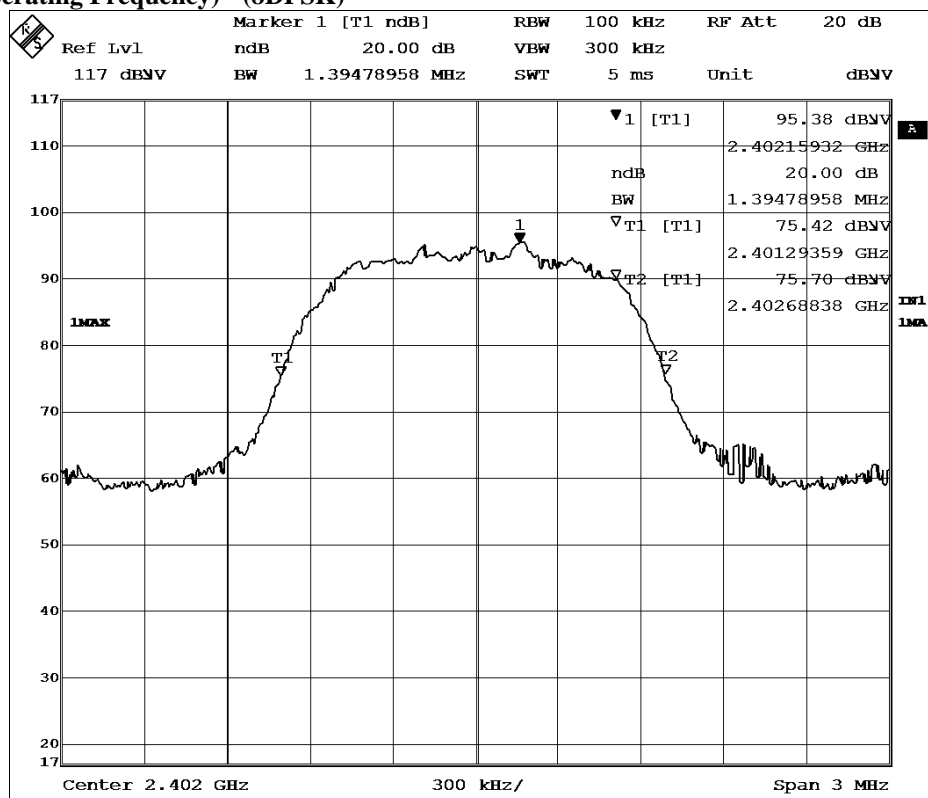
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.39	Within 2400-2483.5

(Lowest Operating Frequency) - (8DPSK)



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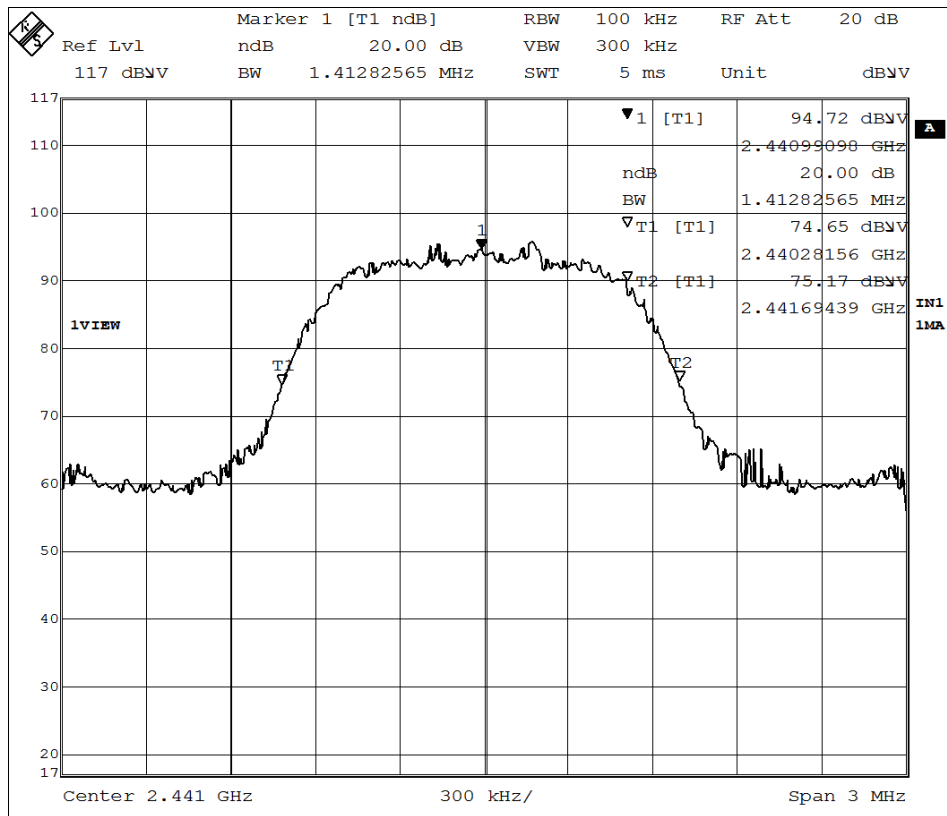
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.41	Within 2400-2483.5

(Middle Operating Frequency) - (8DPSK)



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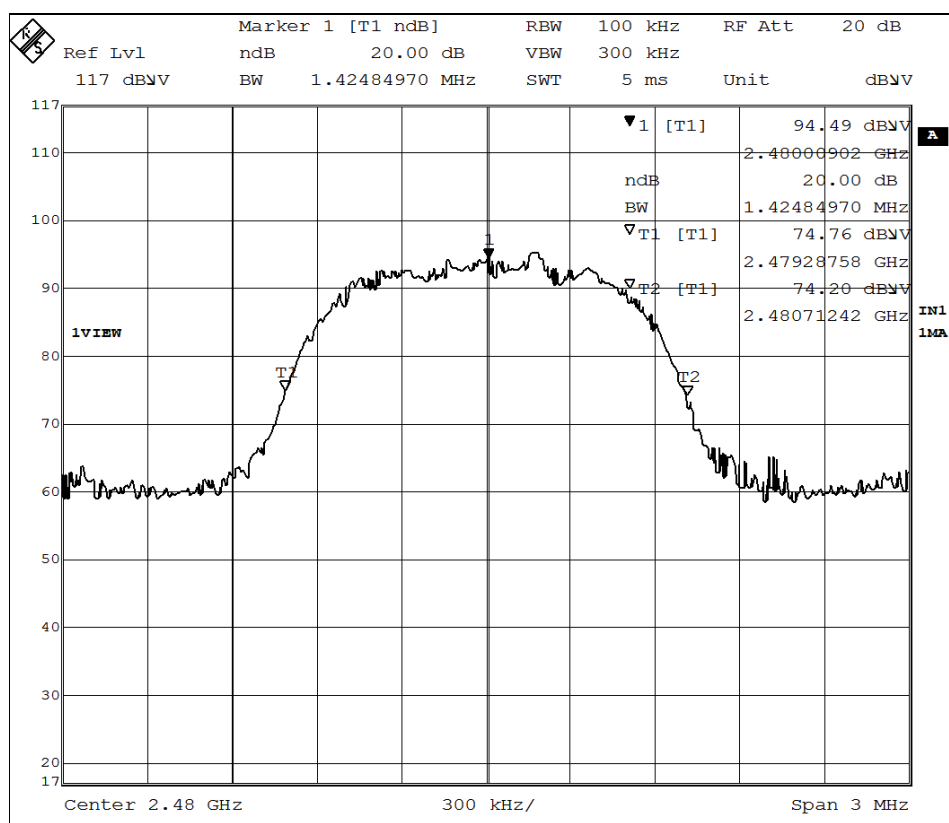
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.42	Within 2400-2483.5

(Highest Operating Frequency) - (8DPSK)



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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 = 300kHz, 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 * $\frac{2}{3}$ = 1.16MHz * $\frac{2}{3}$ = 773.3kHz

$\pi/4$ DQPSK: The measured maximum bandwidth * $\frac{2}{3}$ = 1.47MHz * $\frac{2}{3}$ = 980.0kHz

8DPSK: The measured maximum bandwidth * $\frac{2}{3}$ = 1.42MHz * $\frac{2}{3}$ = 946.7kHz

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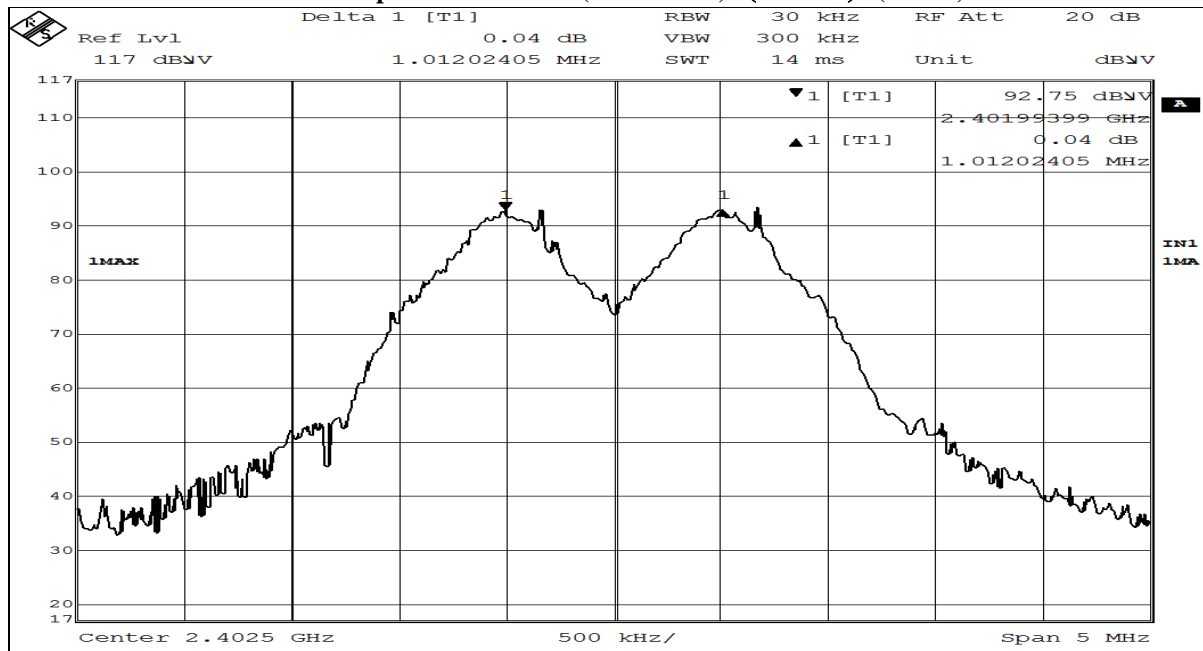
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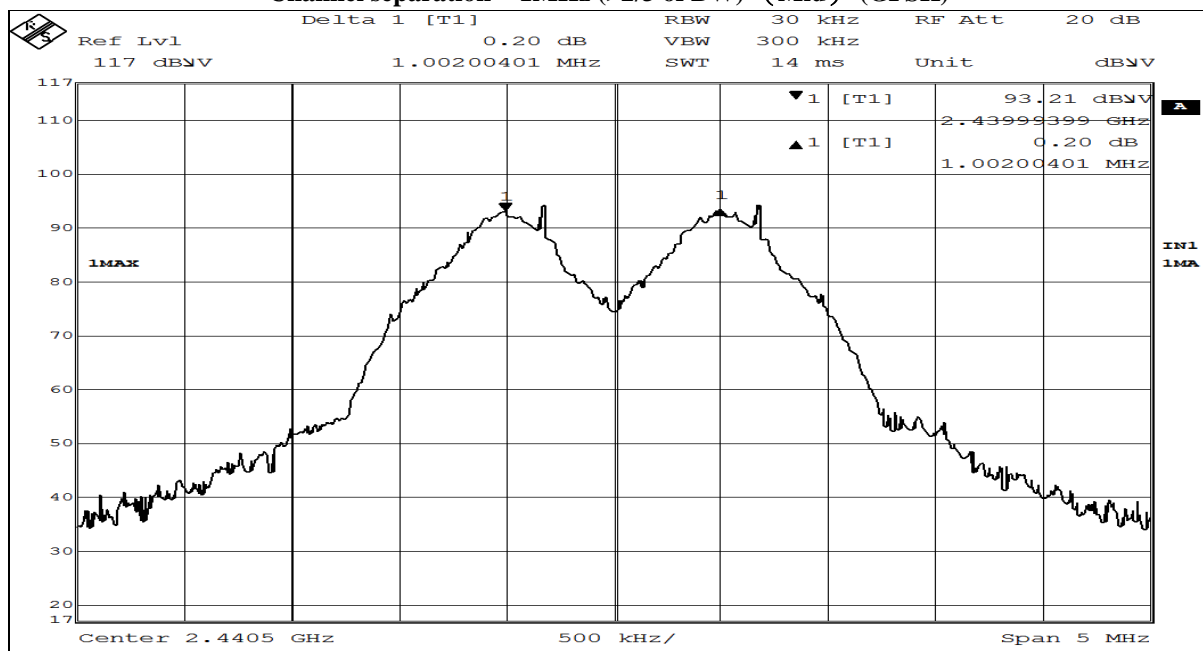
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No. : HM17120028 (Ref.: HM171018)

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



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



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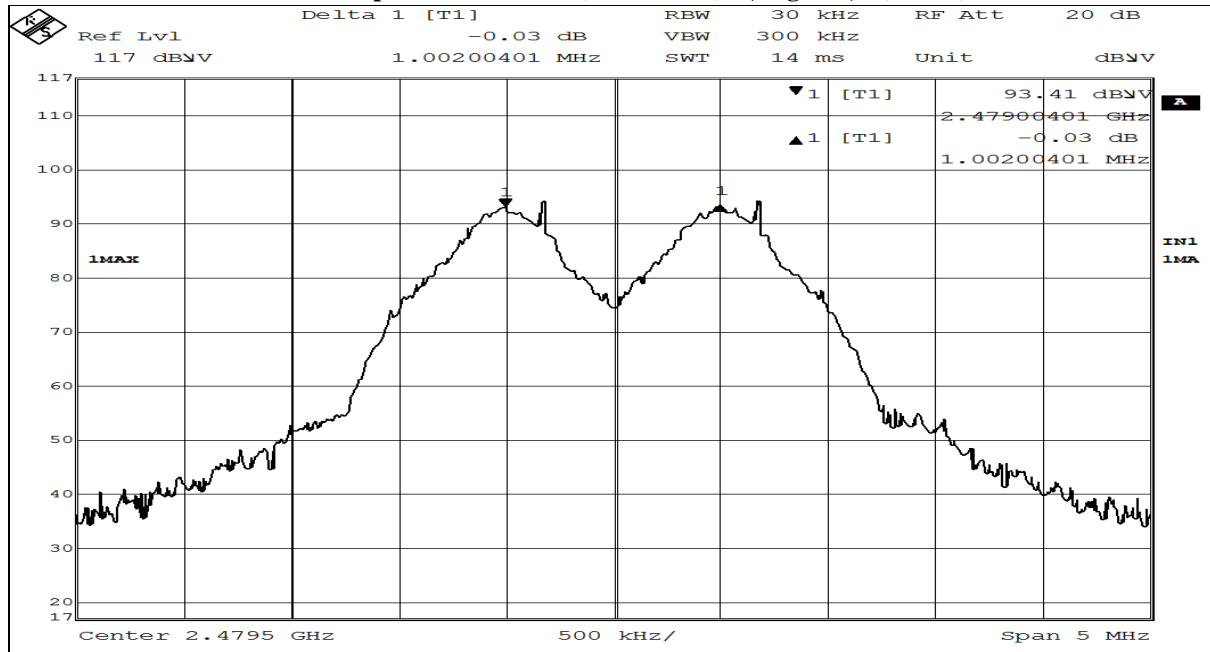
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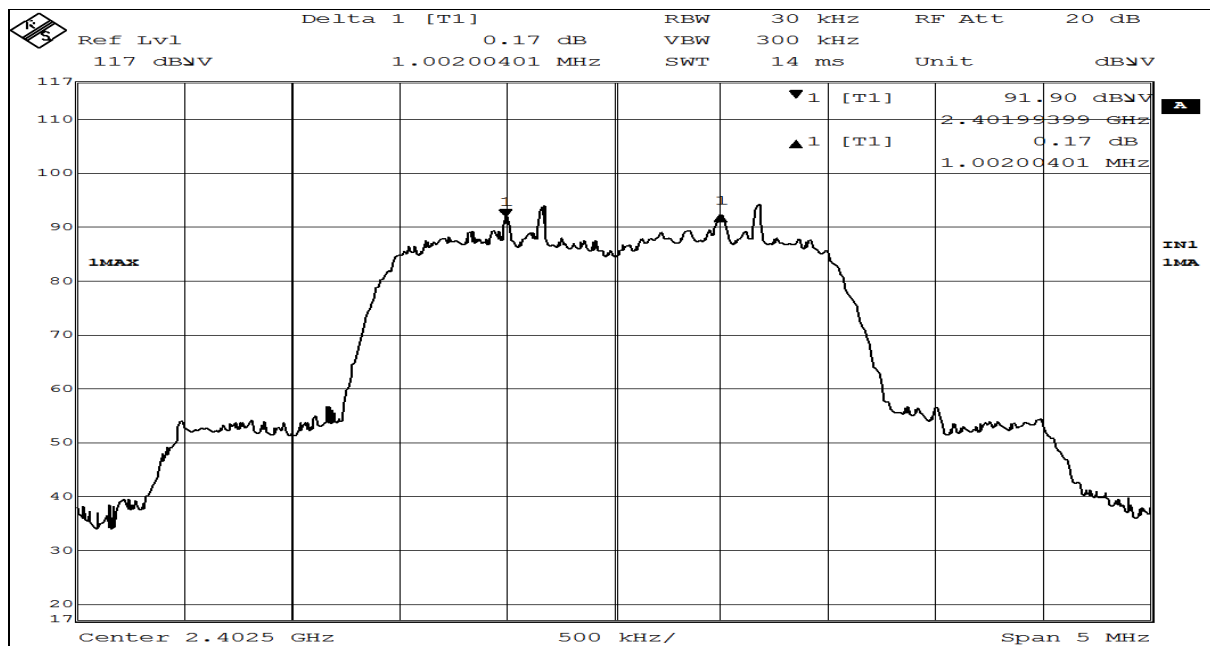
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No. : HM17120028 (Ref.: HM171018)

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



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



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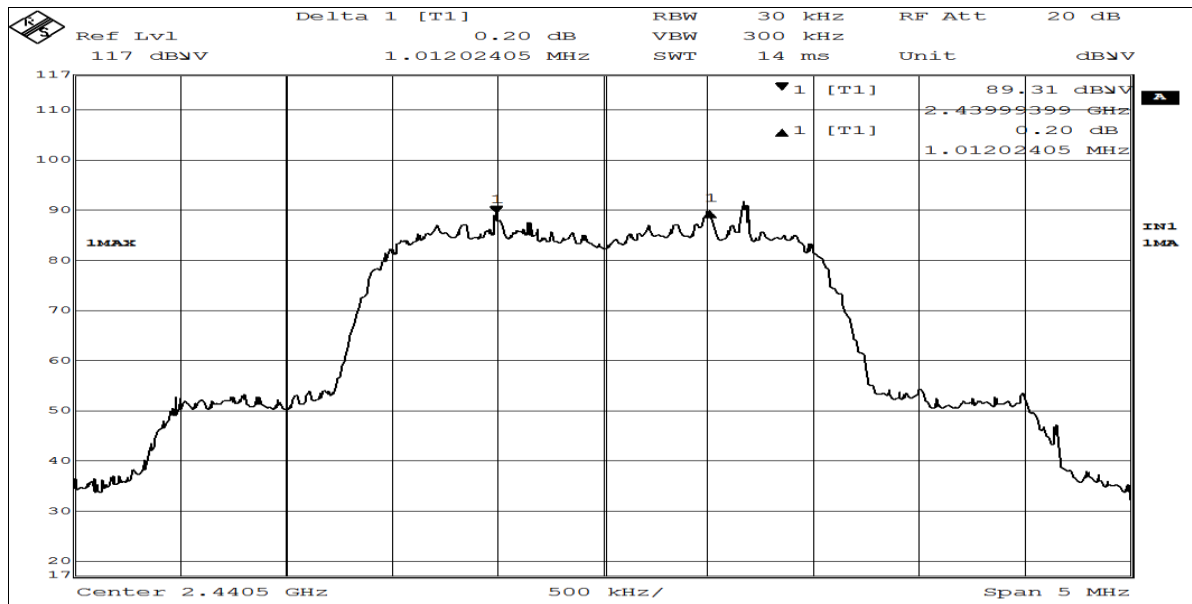
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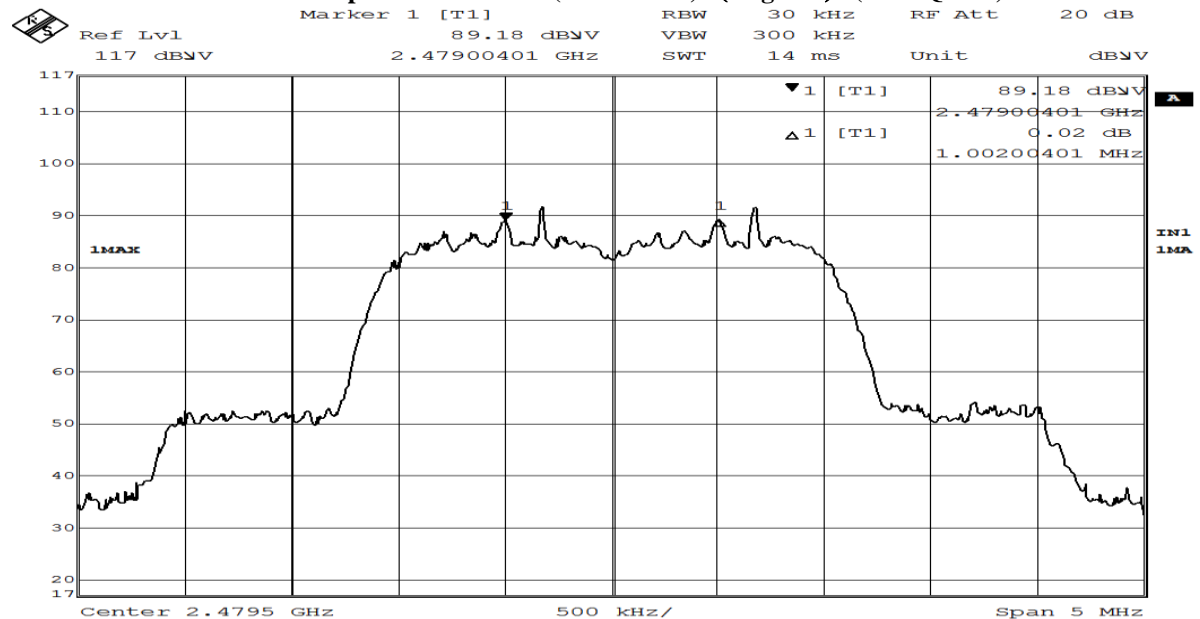
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No. : HM17120028 (Ref.: HM171018)

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



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



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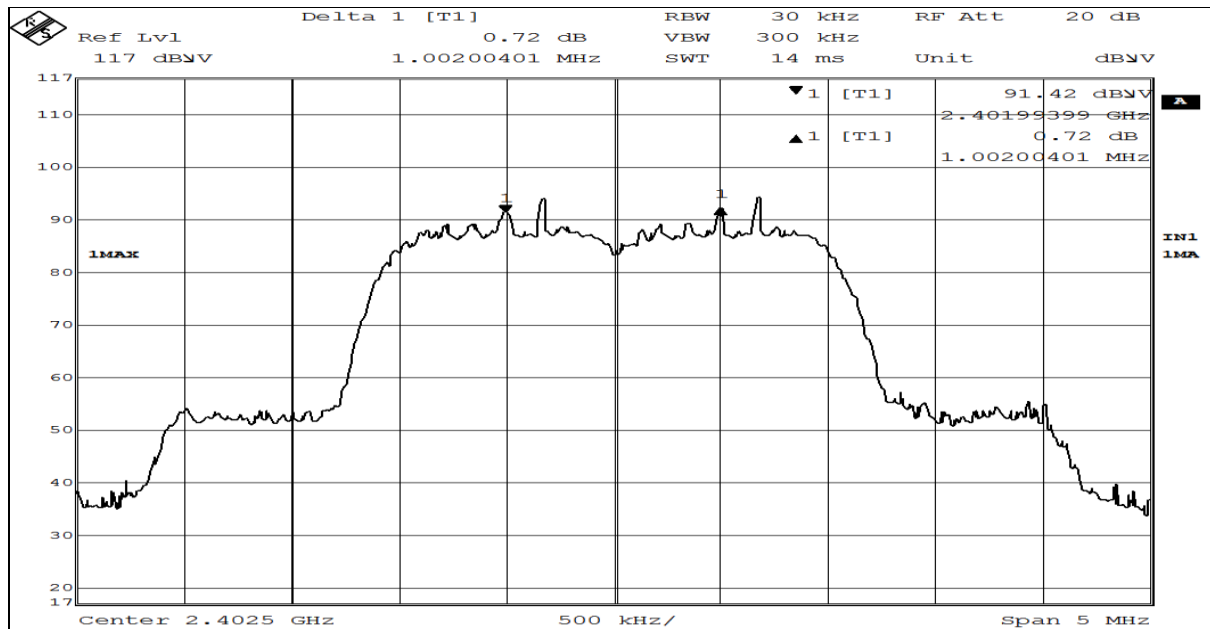
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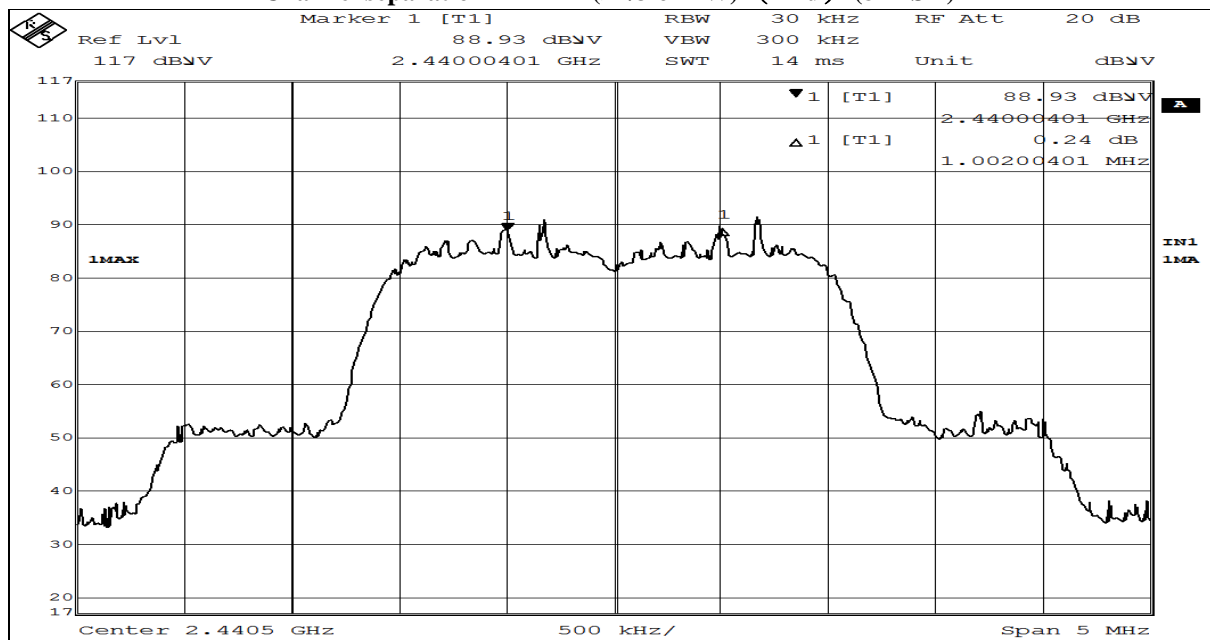
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No. : HM17120028 (Ref.: HM171018)

Channel separation = 1MHz (>2/3 of BW) (Lowest) (8DPSK)



Channel separation = 1MHz (>2/3 of BW) (Mid) (8DPSK)



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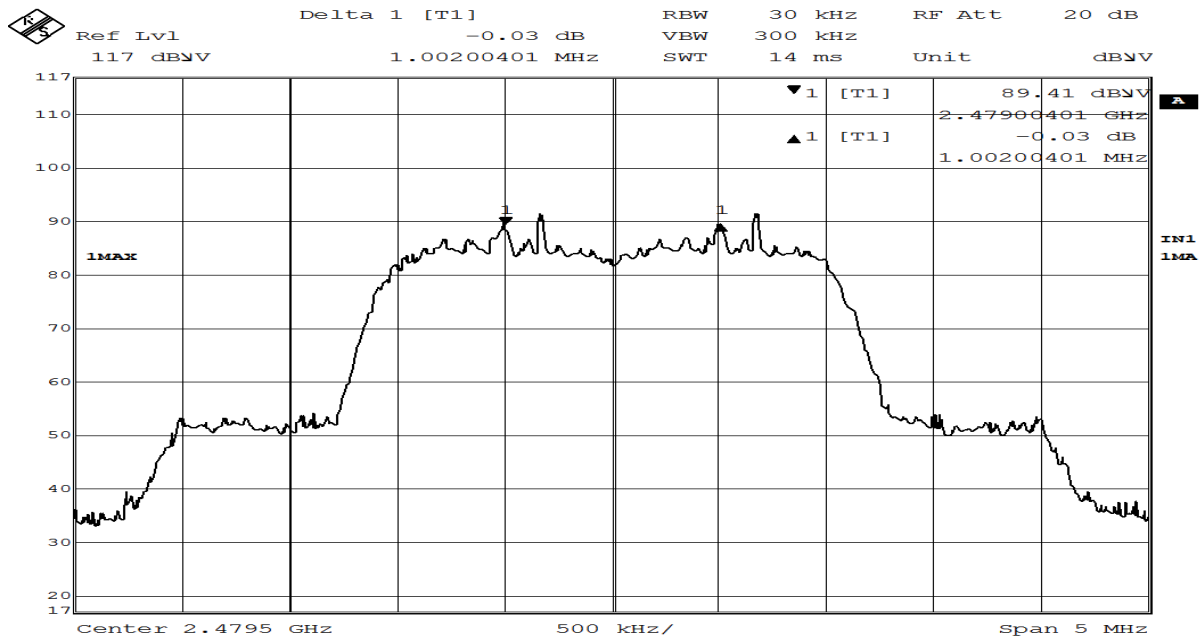
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Channel separation = 1MHz (>2/3 of BW) (Highest) (8DPSK)



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3.1.7 Band-edge Emissions 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.

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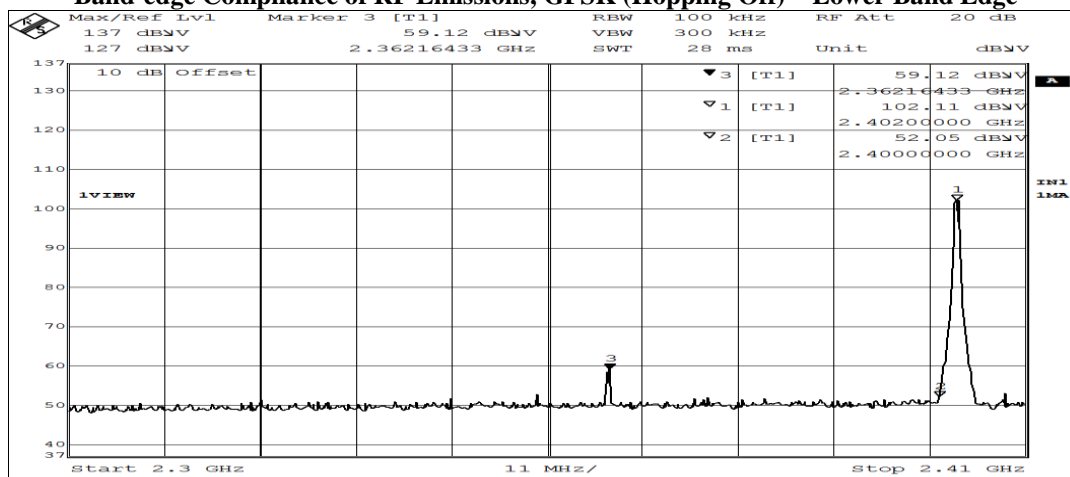
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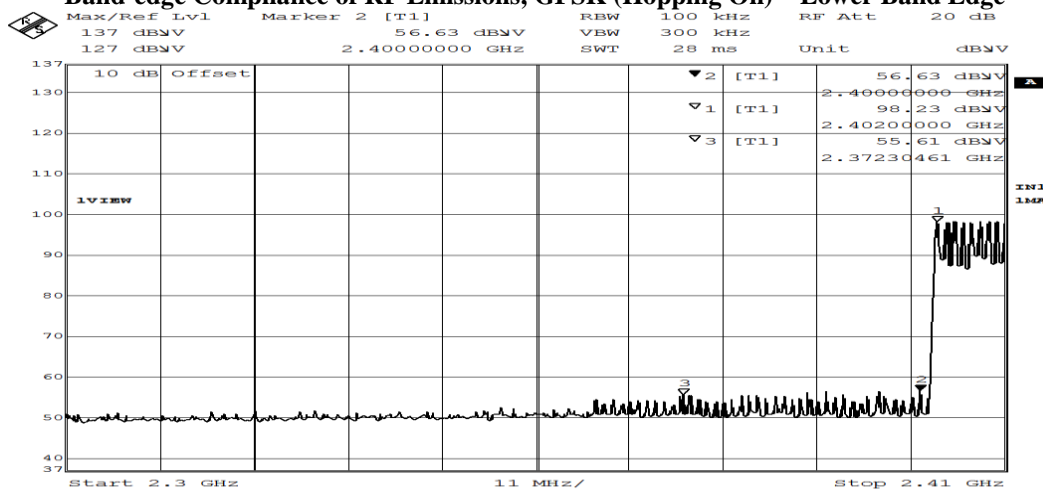
Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	50.0

Band-edge Compliance of RF Emissions, GFSK (Hopping Off) – Lower Band Edge



Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	41.6

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



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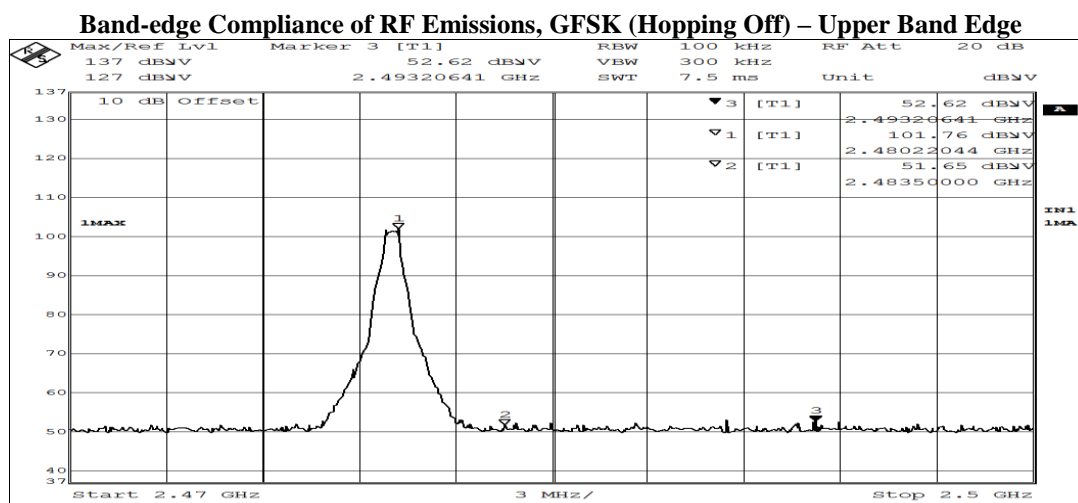
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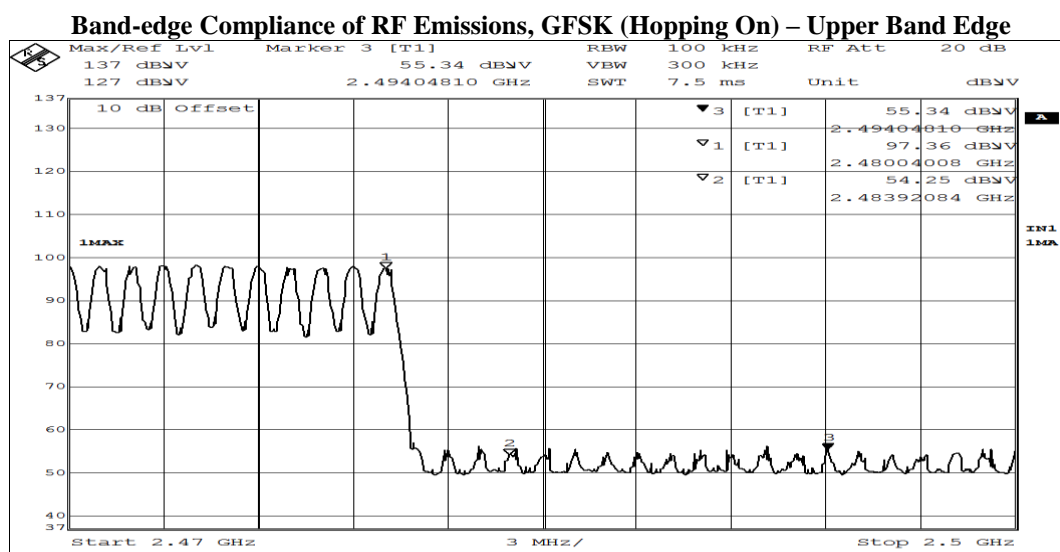
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	50.1



Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	46.2



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Band-edge Emissions Measurement:

Result: RF Radiated Emissions - GFSK

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 dB	E-Field Polarity
2362.2	22.3	36.8	59.1	74.0	14.9	Vertical
2372.3	19.5	36.8	56.3	74.0	17.7	Vertical
2493.2	15.7	36.9	52.6	74.0	21.4	Vertical
2494.0	18.6	36.9	55.5	74.0	18.5	Vertical

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 dB	E-Field Polarity
2362.2	5.7	36.8	42.5	54.0	11.5	Vertical
2372.3	3.1	36.8	39.9	54.0	14.1	Vertical
2493.2	3.7	36.9	40.6	54.0	13.4	Vertical
2494.0	-0.8	36.9	36.1	54.0	17.9	Vertical

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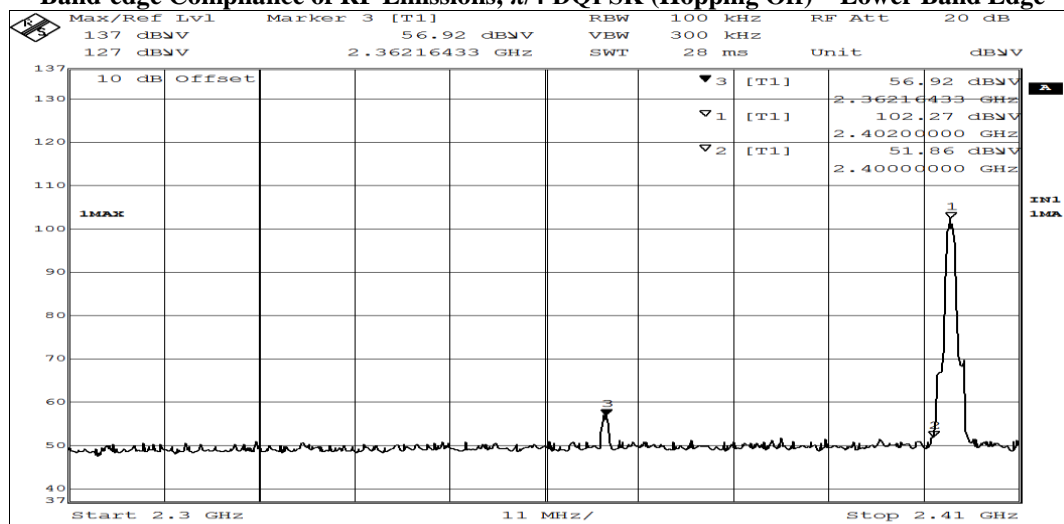
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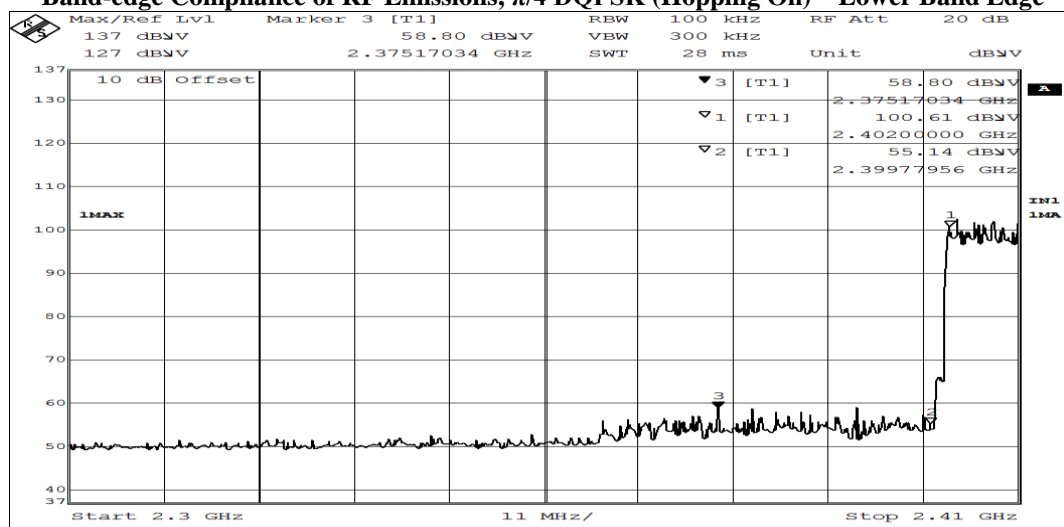
Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	50.4

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



Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	45.5

Band-edge Compliance of RF Emissions, $\pi/4$ DQPSK (Hopping On) – Lower Band Edge



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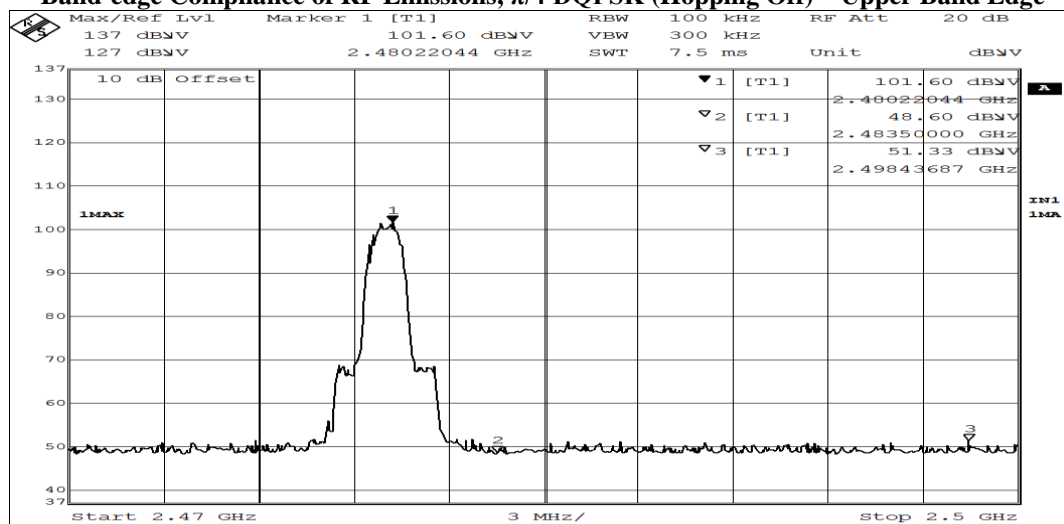
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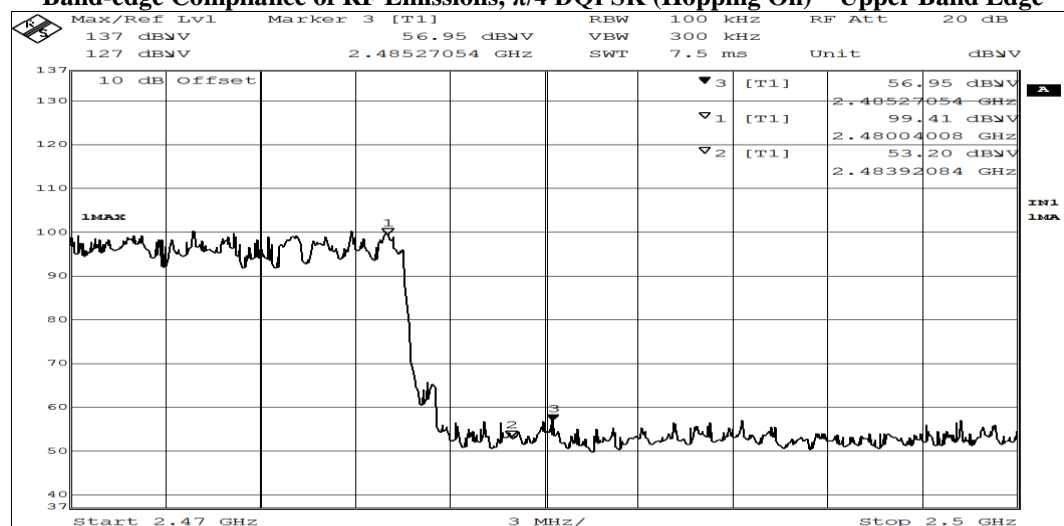
Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	53.0

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



Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	46.2

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



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Band-edge Emissions Measurement:

Result: RF Radiated Emissions $-\pi/4$ DQPSK

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 dB	E-Field Polarity
2362.2	19.4	36.8	56.2	74.0	17.8	Vertical
2375.2	22.0	36.8	58.8	74.0	15.2	Vertical
2498.4	16.3	36.9	53.2	74.0	20.8	Vertical
2485.3	20.1	36.9	57.0	74.0	17.0	Vertical

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 dB	E-Field Polarity
2362.2	3.7	36.8	40.5	54.0	13.5	Vertical
2375.2	3.1	36.8	39.9	54.0	14.1	Vertical
2498.4	2.6	36.9	39.5	54.0	14.5	Vertical
2485.3	-0.8	36.9	36.1	54.0	17.9	Vertical

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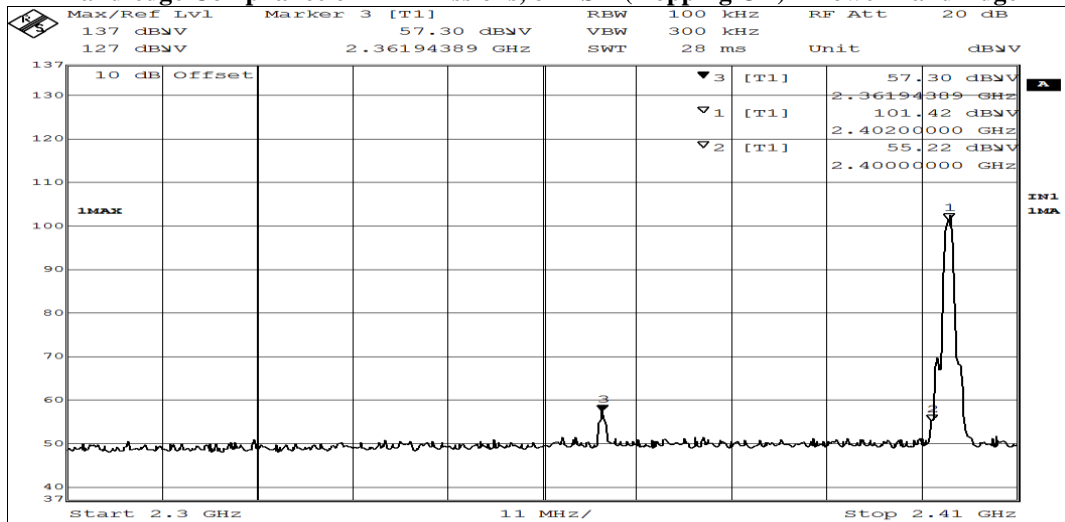
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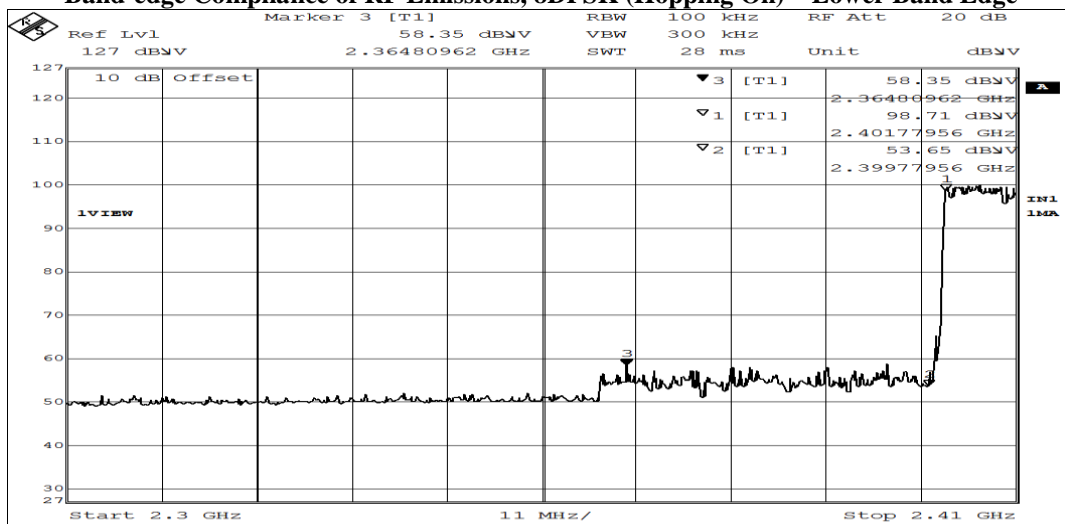
Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	46.2

Band-edge Compliance of RF Emissions, 8DPSK (Hopping Off) – Lower Band Edge



Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	45.0

Band-edge Compliance of RF Emissions, 8DPSK (Hopping On) – Lower Band Edge



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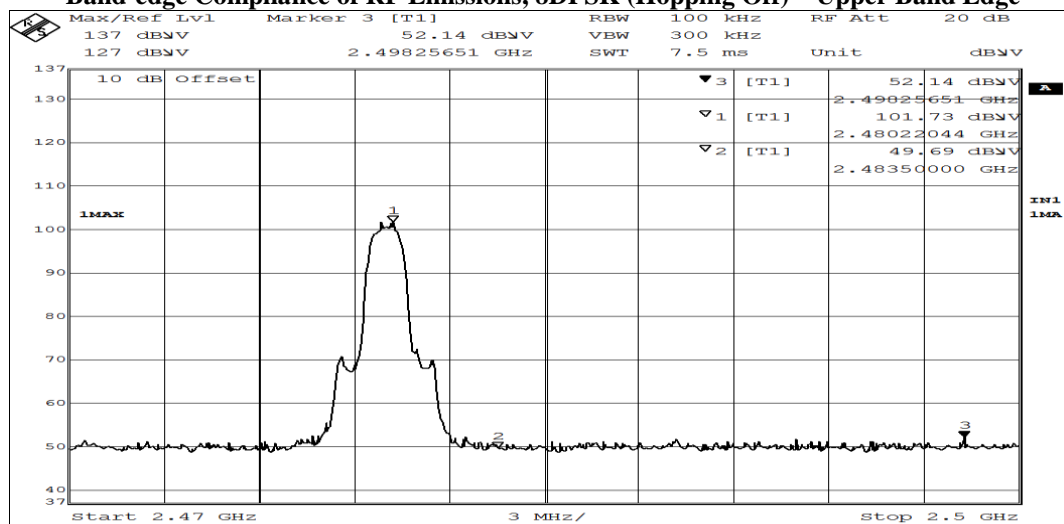
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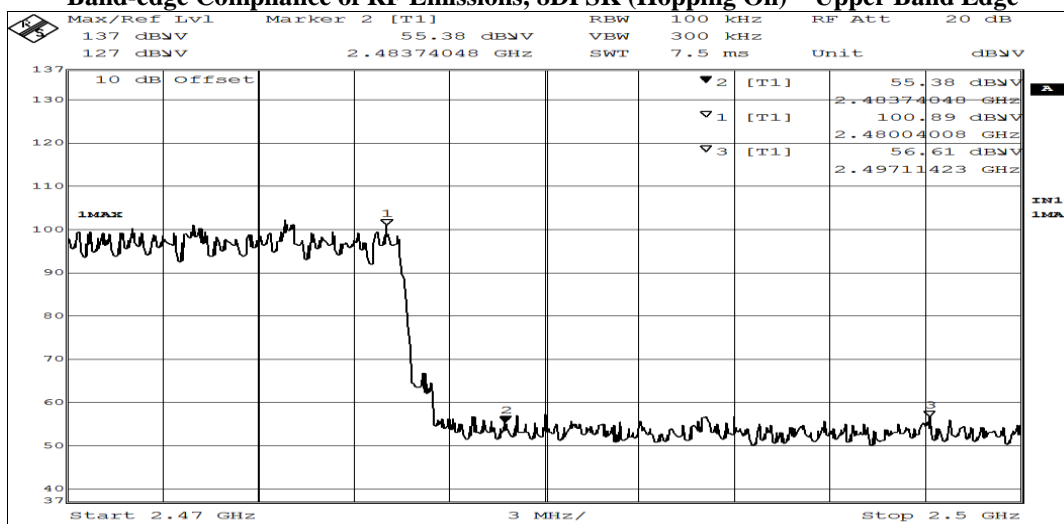
Frequency Range [MHz]	Radiated Emission Attenuate below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	52.0

Band-edge Compliance of RF Emissions, 8DPSK (Hopping Off) – Upper Band Edge



Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	45.5

Band-edge Compliance of RF Emissions, 8DPSK (Hopping On) – Upper Band Edge



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Band-edge Emissions Measurement:

Result: RF Radiated Emissions – 8DPSK

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 dB	E-Field Polarity
2361.9	20.5	36.8	57.3	74.0	16.7	Vertical
2364.9	21.6	36.8	58.4	74.0	15.6	Vertical
2490.3	15.2	36.9	52.1	74.0	21.9	Vertical
2497.1	19.7	36.9	56.6	74.0	17.4	Vertical

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 dB	E-Field Polarity
2361.9	5.9	36.8	42.7	54.0	11.3	Vertical
2364.9	3.1	36.8	39.9	54.0	14.1	Vertical
2490.3	4.3	36.9	41.2	54.0	12.8	Vertical
2497.1	0.8	36.9	37.7	54.0	16.3	Vertical

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3.1.8 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 ≥ RBW,

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

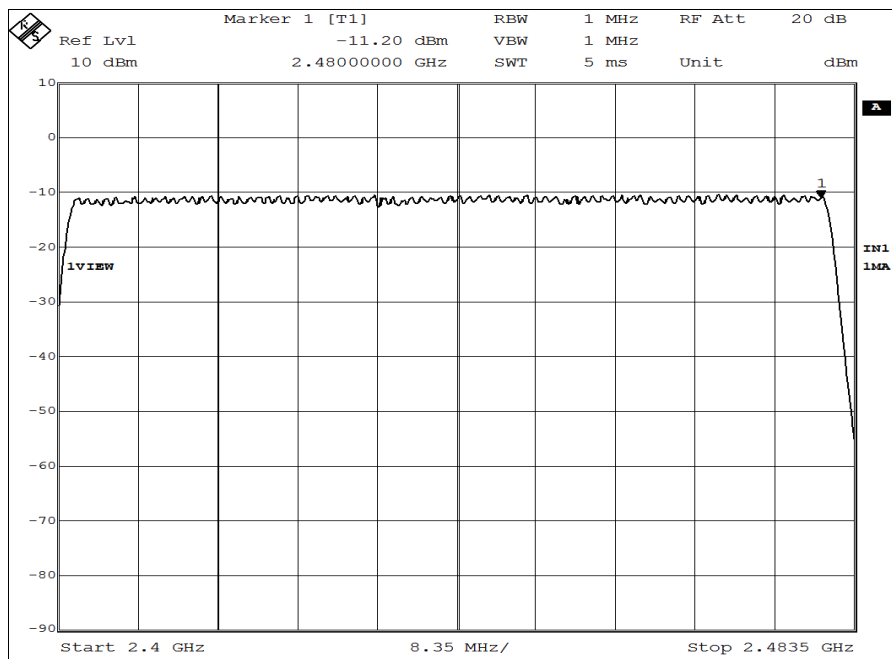
Span = Zero, Detector = Peak, Trace = Max. hold

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

Observed duration: 0.4s x 79 = 31.6s

Measurement Data:

Channel Occupied in 8DPSK: 79 of 79 Channel



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DH5 Packet:

DH5 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]

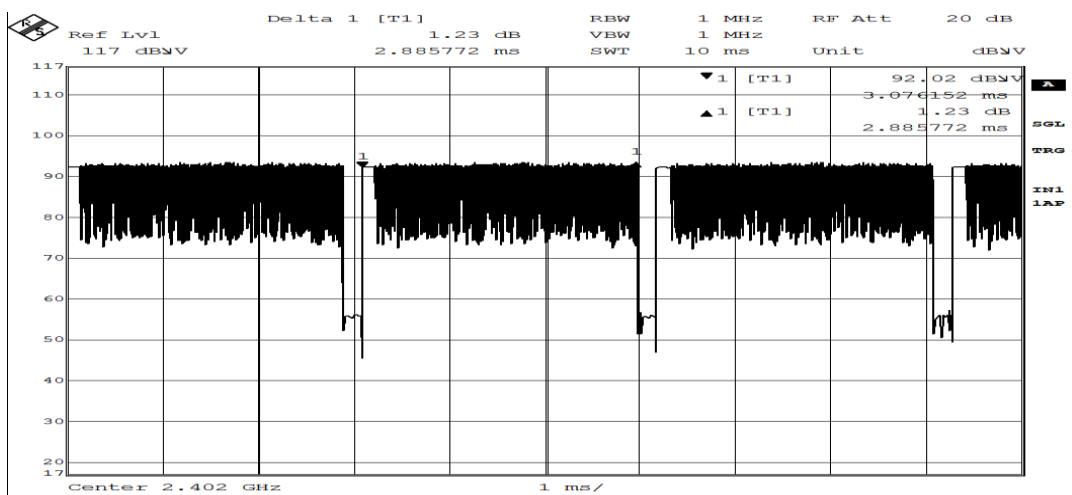
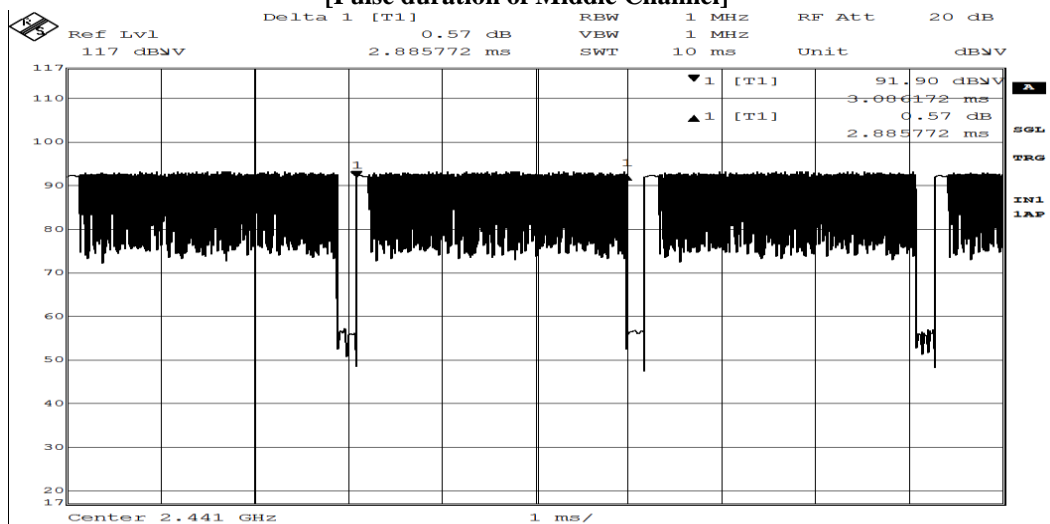


Fig. B
[Pulse duration of Middle Channel]



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DH3 Packet:

DH3 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]

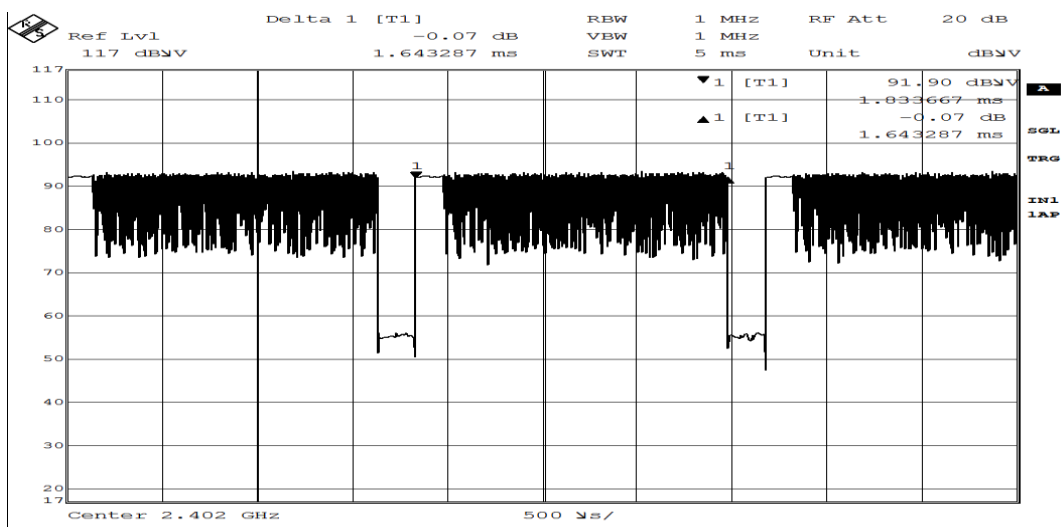
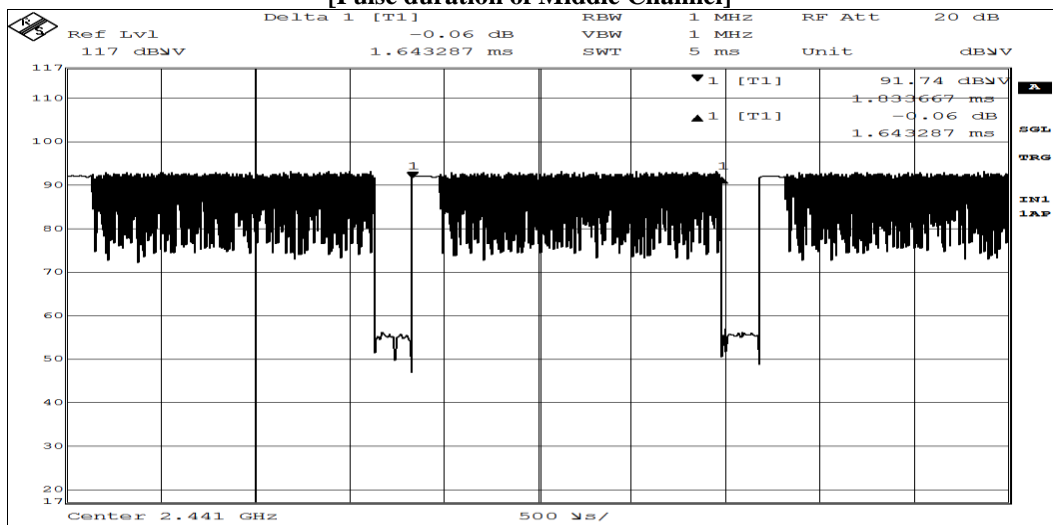


Fig. E
[Pulse duration of Middle Channel]



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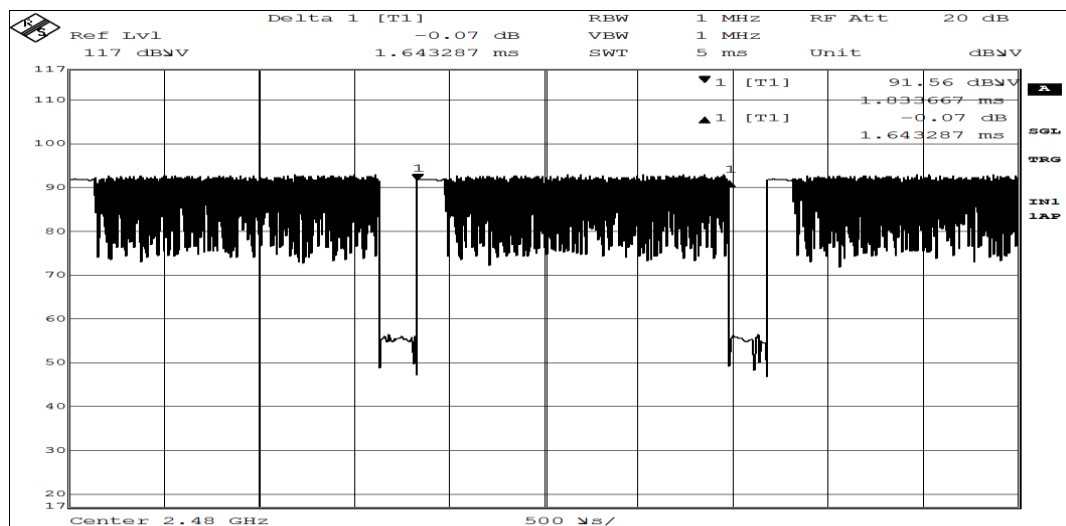
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Fig. F
[Pulse duration of Highest Channel]



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DH1 Packet:

DH1 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]

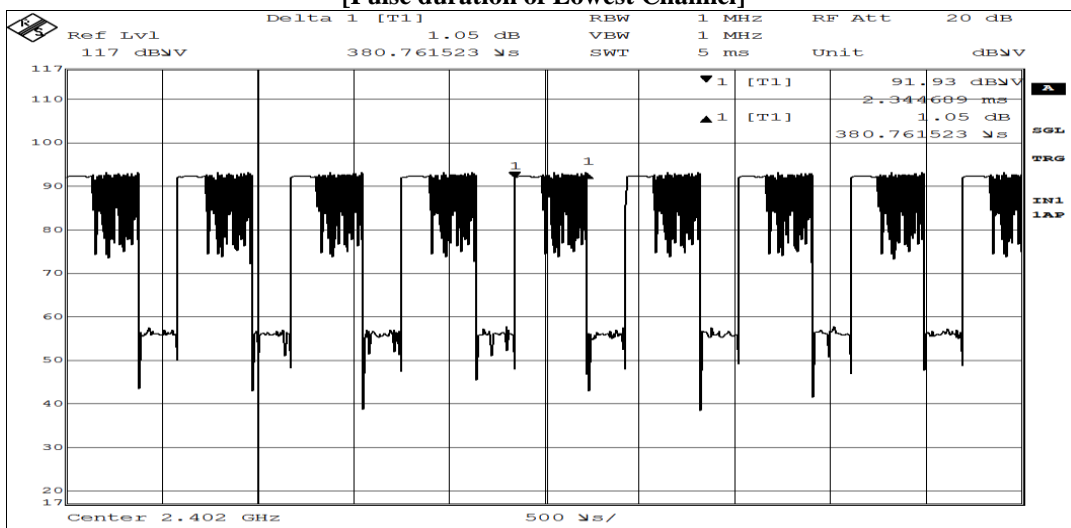
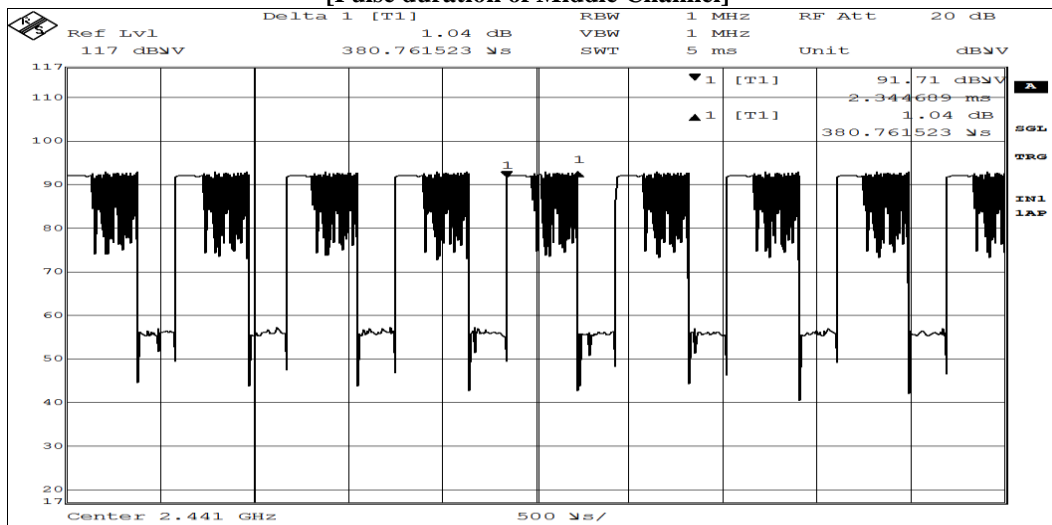


Fig. H
[Pulse duration of Middle Channel]



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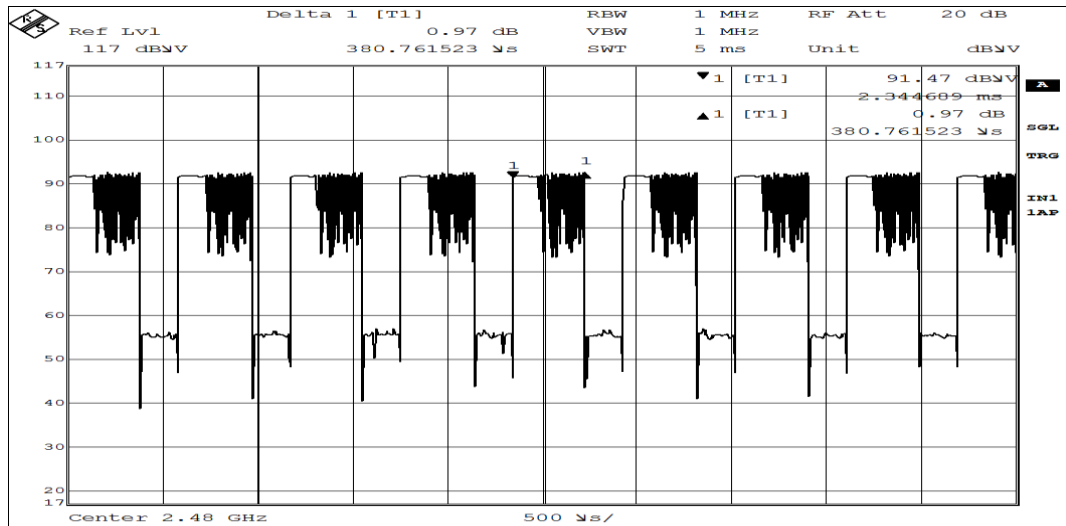
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Fig. I
[Pulse duration of Highest Channel]



Time of occupancy (Dwell Time):

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Results
DH5	2402	2.885	0.308	0.400	Complies
DH5	2441	2.885	0.308	0.400	Complies
DH5	2480	2.885	0.308	0.400	Complies
DH3	2402	1.643	0.263	0.400	Complies
DH3	2441	1.643	0.263	0.400	Complies
DH3	2480	1.643	0.263	0.400	Complies
DH1	2402	0.381	0.122	0.400	Complies
DH1	2441	0.381	0.122	0.400	Complies
DH1	2480	0.381	0.122	0.400	Complies

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3.1.9 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 according 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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3.1.10 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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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, the antenna gain = 0dBi. User is unable to remove or changed the Antenna.

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3.1.12 RF Exposure

Test Requirement: FCC 47CFR 15.247(i)
Test Date: 2017-11-08
Mode of Operation: Tx mode (GFSK)

Test Method:

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

Test Results:

N/A, exemption according to KDB 447498, peak power <1mW

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Appendix A

List of Measurement Equipment

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	--	2017/04/24	2018/04/24
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM354	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00142073	2016/02/29	2018/02/29
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2017/06/01	2018/06/01
EM299	DOUBLE-RIDGED WAVEGUIDE HORN ANTENNA	ETS-LINDGREN	3115	00114120	2016/04/27	2018/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2016/05/13	2018/05/13
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2016/05/13	2018/05/13
EM302	PRECISION OMNIDIRECTIONAL DIPOLE (1 – 6GHZ)	SEIBERSDORF LABORATORIES	POD 16	161806/L	2016/05/11	2018/05/11
EM303	PRECISION OMNIDIRECTIONAL DIPOLE (6 – 18GHZ)	SEIBERSDORF LABORATORIES	POD 618	6181908/L	2016/05/11	2018/05/11
EM318	USB WIDEBAND POWER SENSOR	AGILENT	U2022XA	MY53470001	2017/03/23	2019/03/23
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2016/03/16	2018/03/16

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2016/11/29	2017/11/29
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2017/06/01	2018/06/01
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2017/01/11	2018/01/11
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057- 99A	2017/02/02	2022/02/02
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	ESIB-K1	V1.20	N/A	N/A

Remarks:-

CM Corrective Maintenance

N/A Not Applicable or Not Available

TBD To Be Determined

The Hong Kong Standards and Testing Centre Limited

Head Office: 10 Dai Wang Street, Taipo Industrial Estate, Tai Po, N.T., Hong Kong

Unit B, 10/F, Block 1, Tai Ping Industrial Centre, No. 57 Ting Kok Road, Tai Po, N.T., Hong Kong

Tel: +852 2666 1888 Fax: +852 2664 4353 Email: hkstc@hkstc.org Website: www.stc-group.org

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Appendix B

Photographs of EUT

Front View of the product



Rear View of the product



Top View of the product



Bottom View of the product



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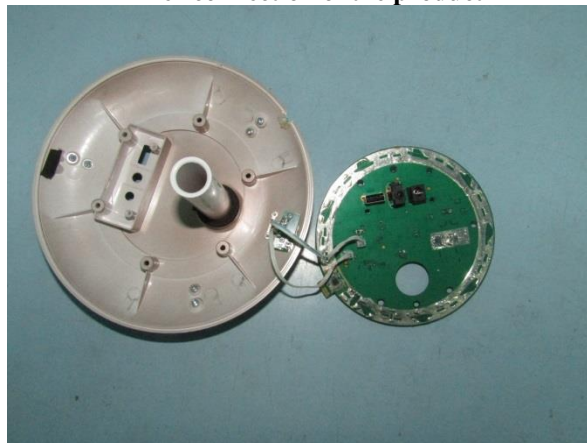
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Photographs of EUT

Inner connection of the product



Inner connection of the product



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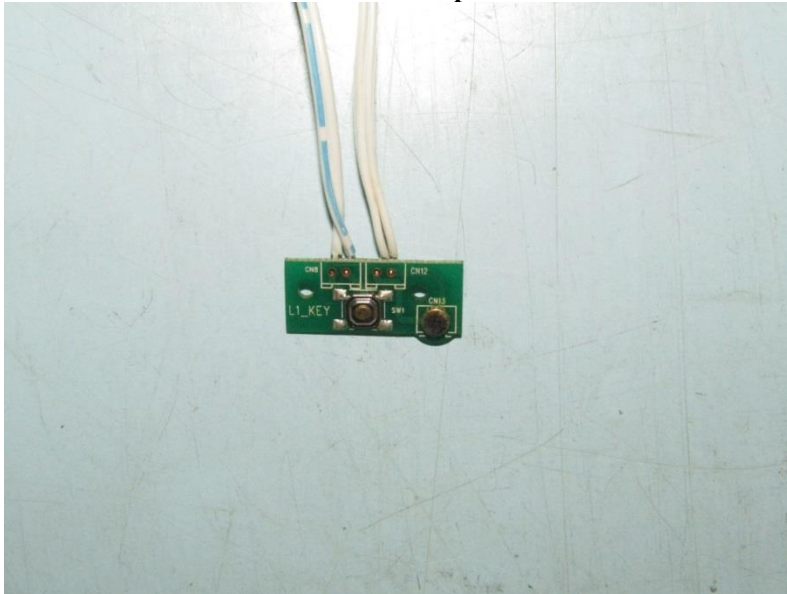
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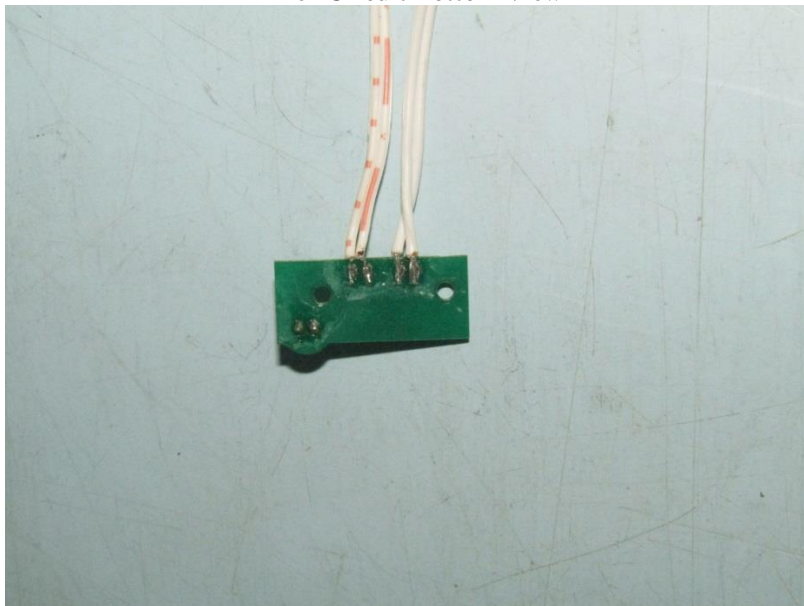
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Photographs of EUT

Inner Circuit Top View



Inner Circuit Bottom View



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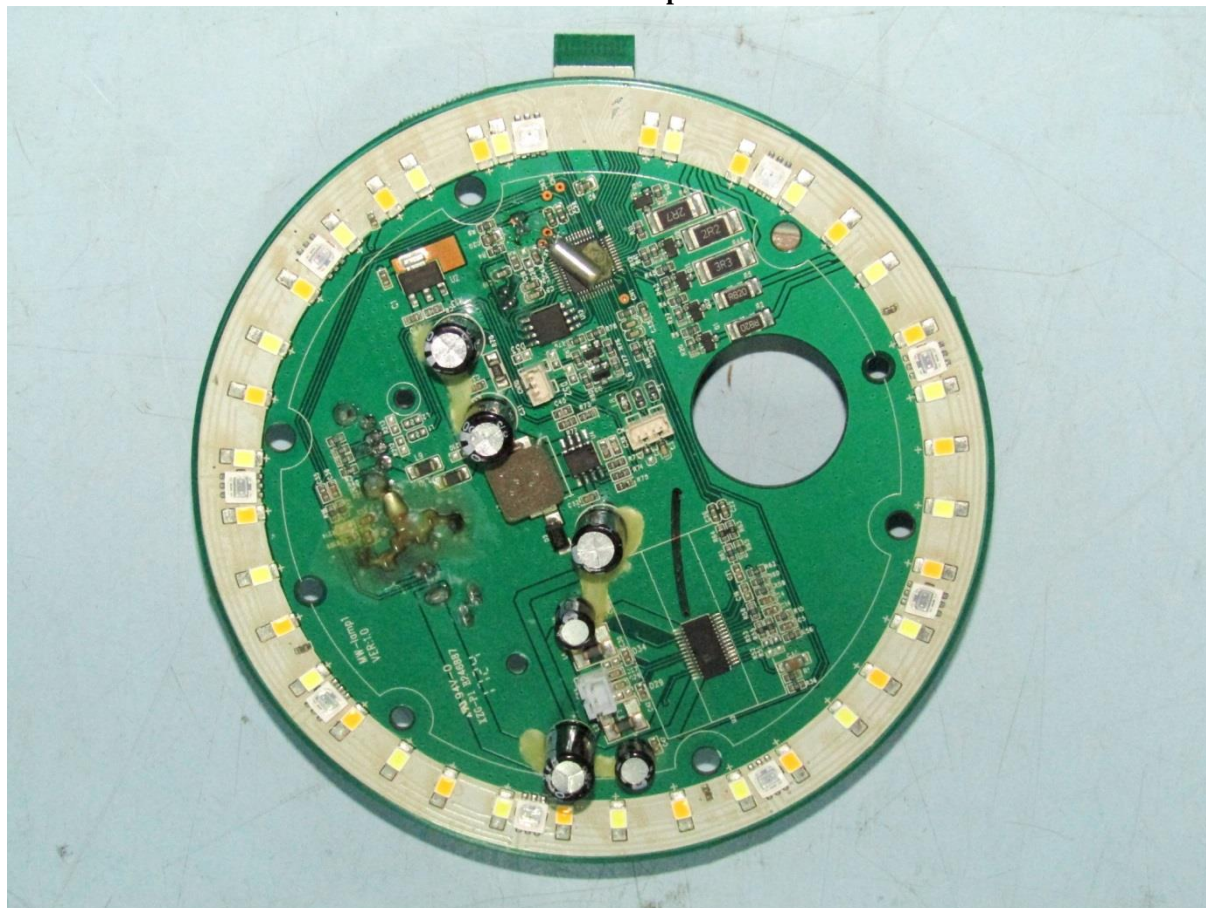
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Photographs of EUT

Inner Circuit Top View



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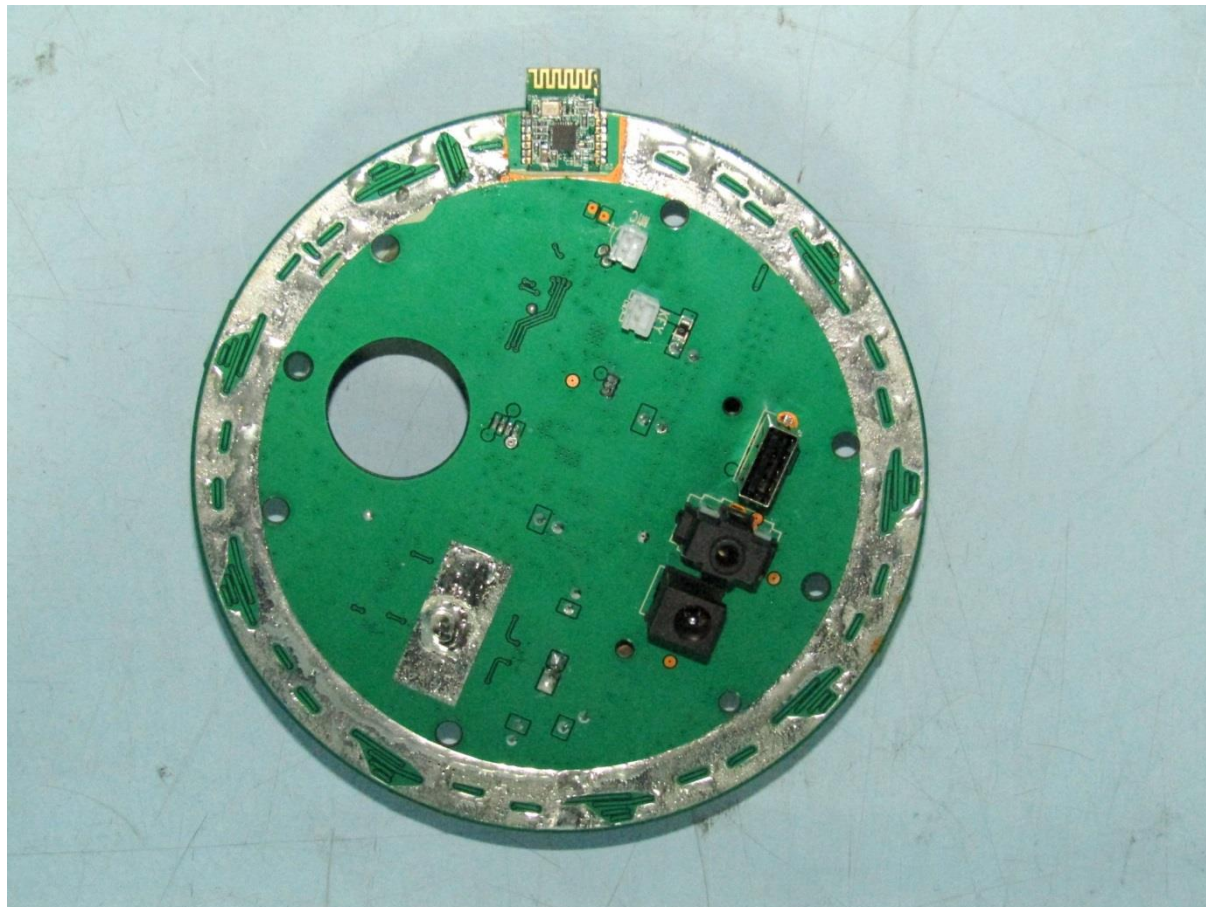
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Inner Circuit Bottom View



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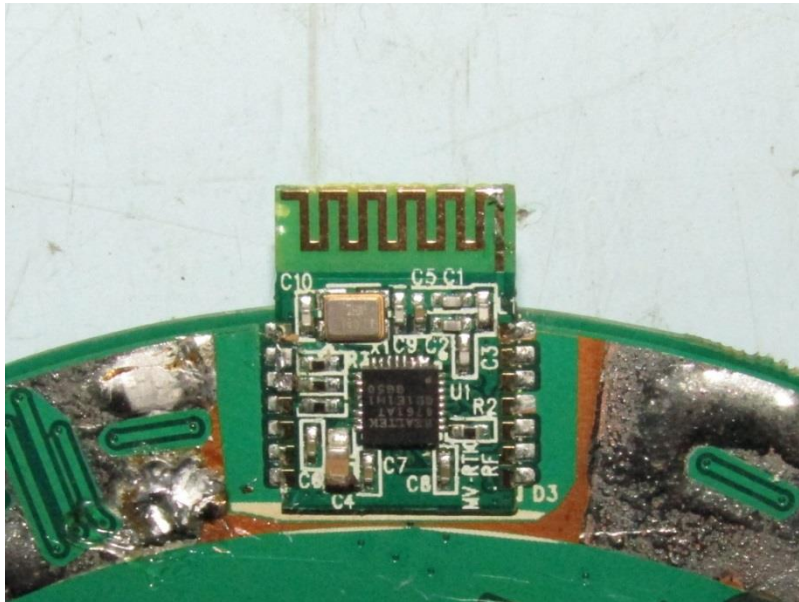
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Photographs of EUT

Inner Circuit Top View (RF Module)



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Unit B, 10/F, Block 1, Tai Ping Industrial Centre, No. 57 Ting Kok Road, Tai Po, N.T., Hong Kong

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Photographs of EUT

Measurement of Radiated Emission Test Set Up



Measurement of Radiated Emission Test Set Up



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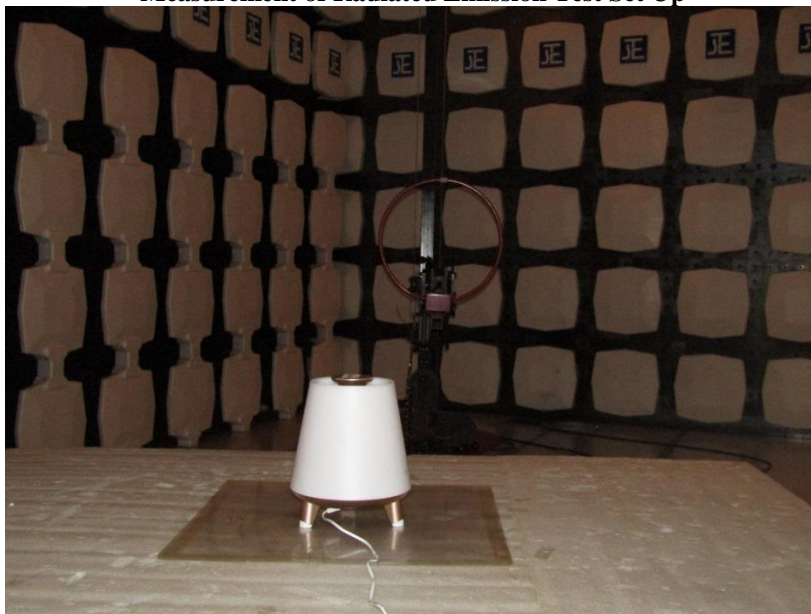
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Photographs of EUT

Measurement of Radiated Emission Test Set Up



Measurement of Conducted Emission Test Set Up



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

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