



Test Report

Date : 2017-11-30

No. : HM171058

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Applicant: Guangdong LEIYON Intelligence Technology Corp.
BBK Road of Wusha, Changan Town, Dongguan City Guangdong
Province, China

Manufacturer: Guangdong LEIYON Intelligence Technology Corp.
BBK Road of Wusha, Changan Town, Dongguan City Guangdong
Province, China

Description of Sample(s): Product: 2.1CH KARAOKE SYSTEM
Brand Name: LEIYON
Model Number: LY-BX32
FCC ID: 2AJA3LYBX32

Date Sample(s) Received: 2017-11-15

Date Tested: 2017-11-24 to 2017-11-28

Investigation Requested: Perform ElectroMagnetic Interference measurement in accordance with FCC 47 CFR [Codes of Federal Regulations] Part 15: 2016 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

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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: 2.1CH KARAOKE SYSTEM
Manufacturer: Guangdong LEIYON Intelligence Technology Corp.
BBK Road of Wusha, Changan Town, Dongguan City
Guangdong Province, China
Brand Name: LEIYON
Model Number: LY-BX25
Rating: 230Va.c. 50Hz

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is 2.1 Ch. Karaoke System. 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

2017-11-15

1.4 Submitted Sample(s):

2 Samples

1.5 Test Duration

2017-11-24 to 2017-11-28

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):

1.7dBi

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: 2016 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 Conducted Output Power	FCC 47CFR 15.247(b)(1)	ANSI C63.10:2013	N/A	☒	☐	☐
Radiated Spurious Emissions	FCC 47CFR 15.209	ANSI C63.10:2013	N/A	☒	☐	☐
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10:2013	N/A	☒	☐	☐
Number of Hopping Frequency	FCC 47CFR 15.247 (b)(1)	ANSI C63.10:2013	N/A	☒	☐	☐
20dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	☒	☐	☐
Hopping Channel Separation	FCC 47CFR 15.247(a)(1)	ANSI C63.10: 2013	N/A	☒	☐	☐
Band-edge measurement (Radiated)	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	☒	☐	☐
Pseudorandom Hopping Algorithm	FCC 47CFR 15.247(a)(1)	N/A	N/A	☒	☐	☐
Time of Occupancy (Dwell Time)	FCC 47CFR 15.247(a)(1)(iii)	ANSI C63.10: 2013	N/A	☒	☐	☐
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	☒	☐	☐
RF Exposure	FCC 47CFR 15.247(i)	N/A	N/A	☐	☐	☒

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 Conducted Output Power	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

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3.1 Emission

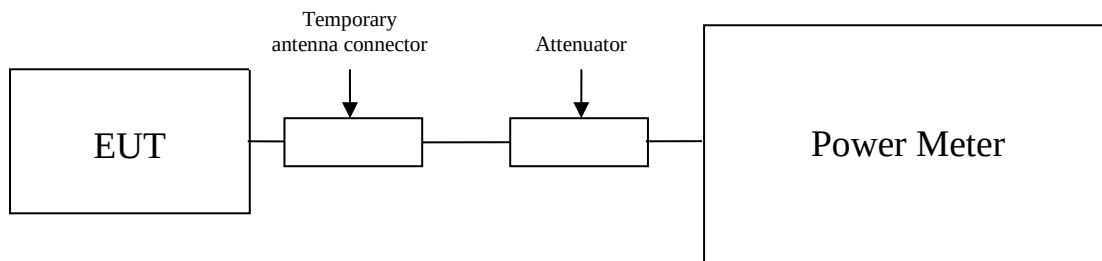
3.1.1 Maximum Peak Conducted Output Power

Test Requirement: FCC 47CFR 15.247(b)(2)
Test Method: ANSI C63.10:2013
Test Date: 2017-11-24
Mode of Operation: Tx mode :GFSK/ π /4-DQPSK/ 8DPSK

Test Method:

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

Test Setup:



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Limits for Maximum Peak Conducted 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 conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000827
39	2441	0.000753
78	2480	0.000784

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

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000541
39	2441	0.000513
78	2480	0.000498

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

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000571
39	2441	0.000533
78	2480	0.000519

:

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

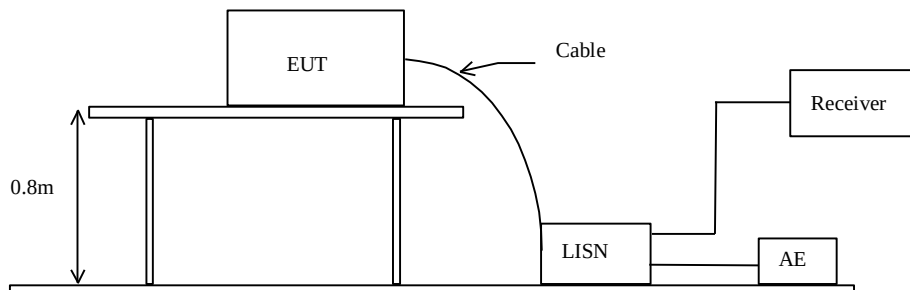
Test Date: 2017-11-27

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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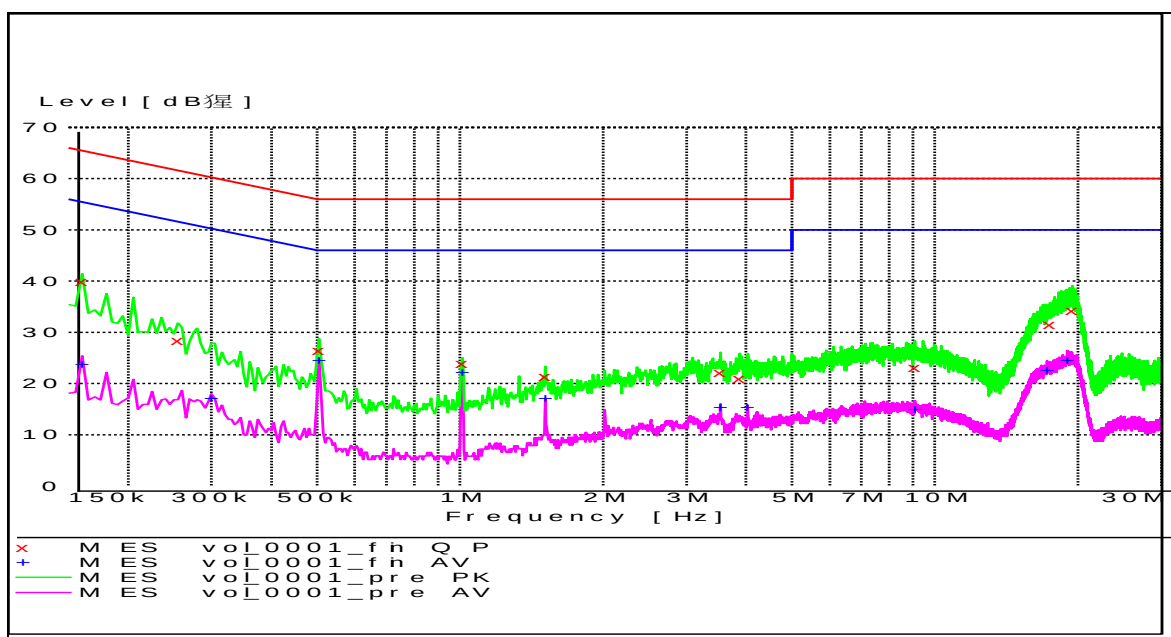
Limit for Conducted Emissions (FCC 47CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
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
0.160000	40.00	9.9	66	25.5	N	GND
0.255000	28.40	9.9	62	33.1	L1	GND
0.505000	26.40	10.0	56	29.6	N	GND
1.010000	24.00	9.8	56	32.0	L1	GND
1.515000	21.40	10.0	56	34.6	L1	GND
3.540000	22.10	10.4	56	33.9	N	GND
3.890000	21.00	10.5	56	35.0	N	GND
9.080000	23.20	10.4	60	36.8	L1	GND
17.470000	31.50	10.7	60	28.5	L1	GND
19.450000	34.30	10.7	60	25.7	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.160000	23.70	9.9	56	31.7	L1	GND
0.300000	17.00	10.0	50	33.2	L1	GND
0.505000	24.50	10.0	46	21.5	L1	GND
1.010000	22.20	9.8	46	23.8	L1	GND
1.515000	17.20	10.0	46	28.8	N	GND
3.540000	15.30	10.4	46	30.7	N	GND
4.035000	15.30	10.5	46	30.7	L1	GND
9.080000	14.90	10.4	50	35.1	N	GND
17.215000	22.50	10.7	50	27.5	L1	GND
19.015000	24.50	10.7	50	25.5	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:	2017-11-28
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.

* Semi-anechoic chamber located on the G/F of “The Hong Kong Standards and Testing Centre Ltd.” with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Designation Number: HK0001.

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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

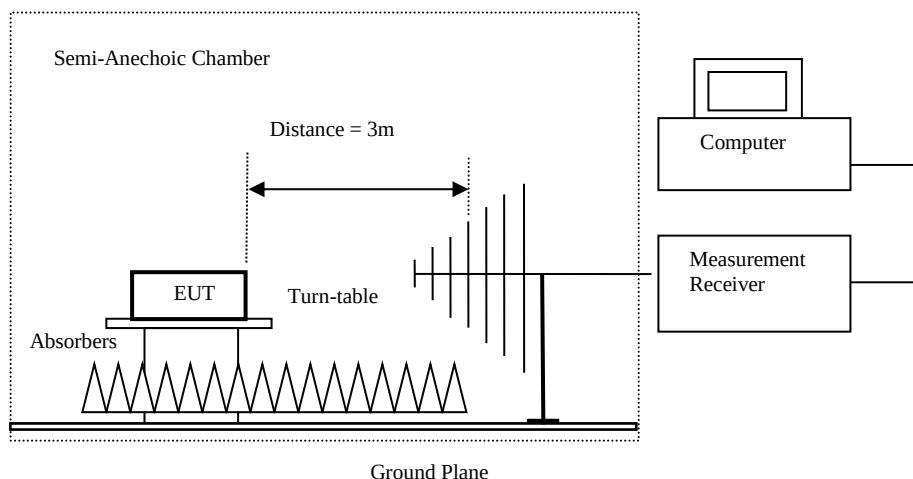
30MHz – 1GHz (QP)

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
4804.0	5.3	42.4	47.7	74.0	26.3	Vertical
7206.0	2.7	46.7	49.4	74.0	24.6	Vertical
9608.0	2.1	48.4	50.5	74.0	23.5	Vertical
12010.0	0.7	53.1	53.8	74.0	20.2	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
4804.0	-7.3	42.4	35.1	54.0	18.9	Vertical
7206.0	-10.7	46.7	36.0	54.0	18.0	Vertical
9608.0	-11.3	48.4	37.1	54.0	16.9	Vertical
12010.0	-11.9	53.1	41.2	54.0	12.8	Vertical

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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
4882.0	4.7	42.5	47.2	74.0	26.8	Vertical
7323.0	2.3	47.1	49.4	74.0	24.6	Vertical
9764.0	1.9	49.3	51.2	74.0	22.8	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
4882.0	-7.8	42.5	34.7	54.0	19.3	Vertical
7323.0	-9.9	47.1	37.2	54.0	16.8	Vertical
9764.0	-11.7	49.3	37.6	54.0	16.4	Vertical
12205.0	-12.4	53.1	40.7	54.0	13.3	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
4960.0	5.3	43.2	48.5	74.0	25.5	Vertical
7440.0	2.9	46.2	49.1	74.0	24.9	Vertical
9920.0	1.9	50.9	52.8	74.0	21.2	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
4960.0	-8.1	43.2	35.1	54.0	18.9	Vertical
7440.0	-11.3	46.2	34.9	54.0	19.1	Vertical
9920.0	-12.3	50.9	38.6	54.0	15.4	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	4.9	42.4	47.3	74.0	26.7	Vertical
7206.0	2.5	46.7	49.2	74.0	24.8	Vertical
9608.0	1.9	48.4	50.3	74.0	23.7	Vertical
12010.0	0.6	53.1	53.7	74.0	20.3	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	-7.8	42.4	34.6	54.0	19.4	Vertical
7206.0	-11.7	46.7	35.0	54.0	19.0	Vertical
9608.0	-11.9	48.4	36.5	54.0	17.5	Vertical
12010.0	-12.3	53.1	40.8	54.0	13.2	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
4882.0	5.4	42.5	47.9	74.0	26.1	Vertical
7323.0	2.3	47.1	49.4	74.0	24.6	Vertical
9764.0	2.1	49.3	51.4	74.0	22.6	Vertical
12205.0	0.8	53.1	53.9	74.0	20.1	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
4882.0	-8.1	42.5	34.4	54.0	19.6	Vertical
7323.0	-10.7	47.1	36.4	54.0	17.6	Vertical
9764.0	-11.9	49.3	37.4	54.0	16.6	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
4960.0	5.4	43.2	48.6	74.0	25.4	Vertical
7440.0	2.1	46.2	48.3	74.0	25.7	Vertical
9920.0	1.9	50.9	52.8	74.0	21.2	Vertical
12400.0	0.6	54.3	54.9	74.0	19.1	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
4960.0	-7.8	43.2	35.4	54.0	18.6	Vertical
7440.0	-10.9	46.2	35.3	54.0	18.7	Vertical
9920.0	-11.9	50.9	39.0	54.0	15.0	Vertical
12400.0	-12.7	54.3	41.6	54.0	12.4	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
4804.0	5.4	42.4	47.8	74.0	26.2	Vertical
7206.0	2.6	46.7	49.3	74.0	24.7	Vertical
9608.0	1.9	48.4	50.3	74.0	23.7	Vertical
12010.0	0.5	53.1	53.6	74.0	20.4	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
4804.0	-8.3	42.4	34.1	54.0	19.9	Vertical
7206.0	-10.9	46.7	35.8	54.0	18.2	Vertical
9608.0	-11.2	48.4	37.2	54.0	16.8	Vertical
12010.0	-12.7	53.1	40.4	54.0	13.6	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
4882.0	4.7	42.5	47.2	74.0	26.8	Vertical
7323.0	2.1	47.1	49.2	74.0	24.8	Vertical
9764.0	1.7	49.3	51.0	74.0	23.0	Vertical
12205.0	0.7	53.1	53.8	74.0	20.2	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
4882.0	-8.1	42.5	34.4	54.0	19.6	Vertical
7323.0	-10.3	47.1	36.8	54.0	17.2	Vertical
9764.0	-11.8	49.3	37.5	54.0	16.5	Vertical
12205.0	-12.7	53.1	40.4	54.0	13.6	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
4960.0	4.9	43.2	48.1	74.0	25.9	Vertical
7440.0	2.4	46.2	48.6	74.0	25.4	Vertical
9920.0	1.9	50.9	52.8	74.0	21.2	Vertical
12400.0	0.9	54.3	55.2	74.0	18.8	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
4960.0	-7.8	43.2	35.4	54.0	18.6	Vertical
7440.0	-10.7	46.2	35.5	54.0	18.5	Vertical
9920.0	-11.9	50.9	39.0	54.0	15.0	Vertical
12400.0	12.4	54.3	66.7	54.0	-12.7	Vertical

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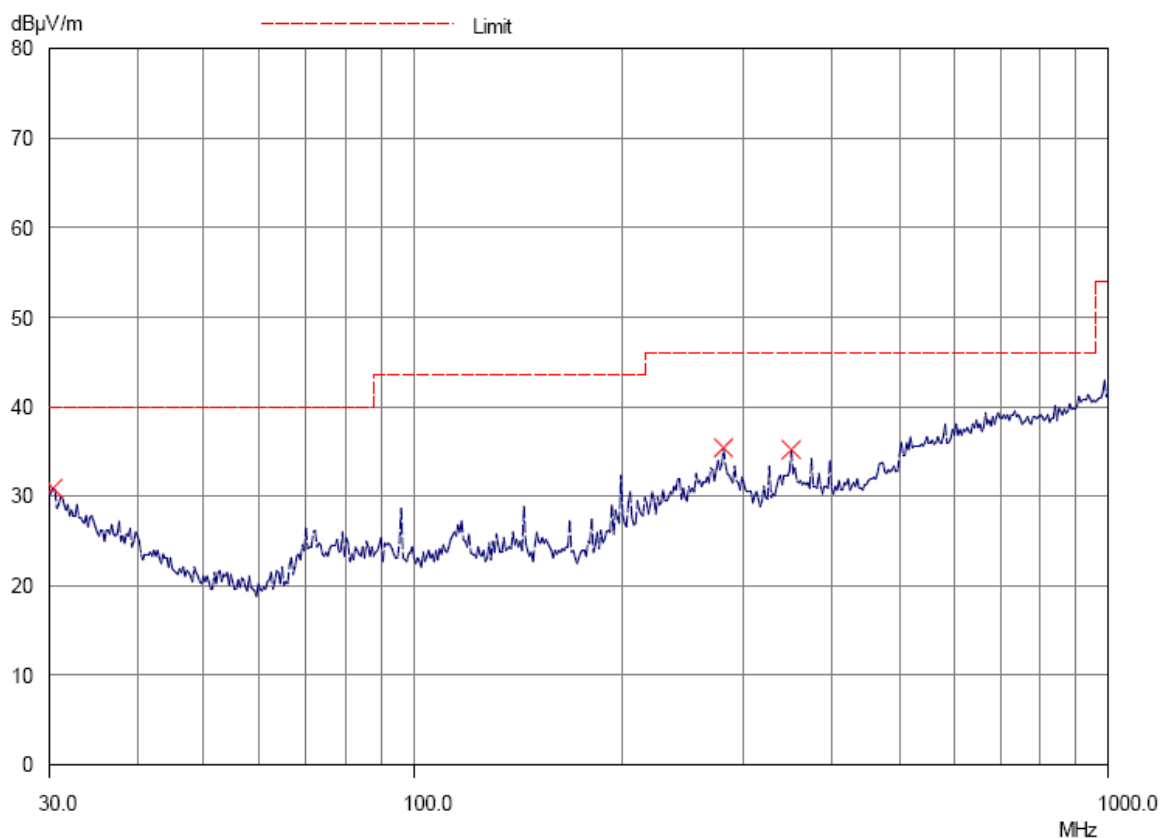
Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

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
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.

Result of Bluetooth communication mode, (30MHz – 1GHz): PASS

Horizontal



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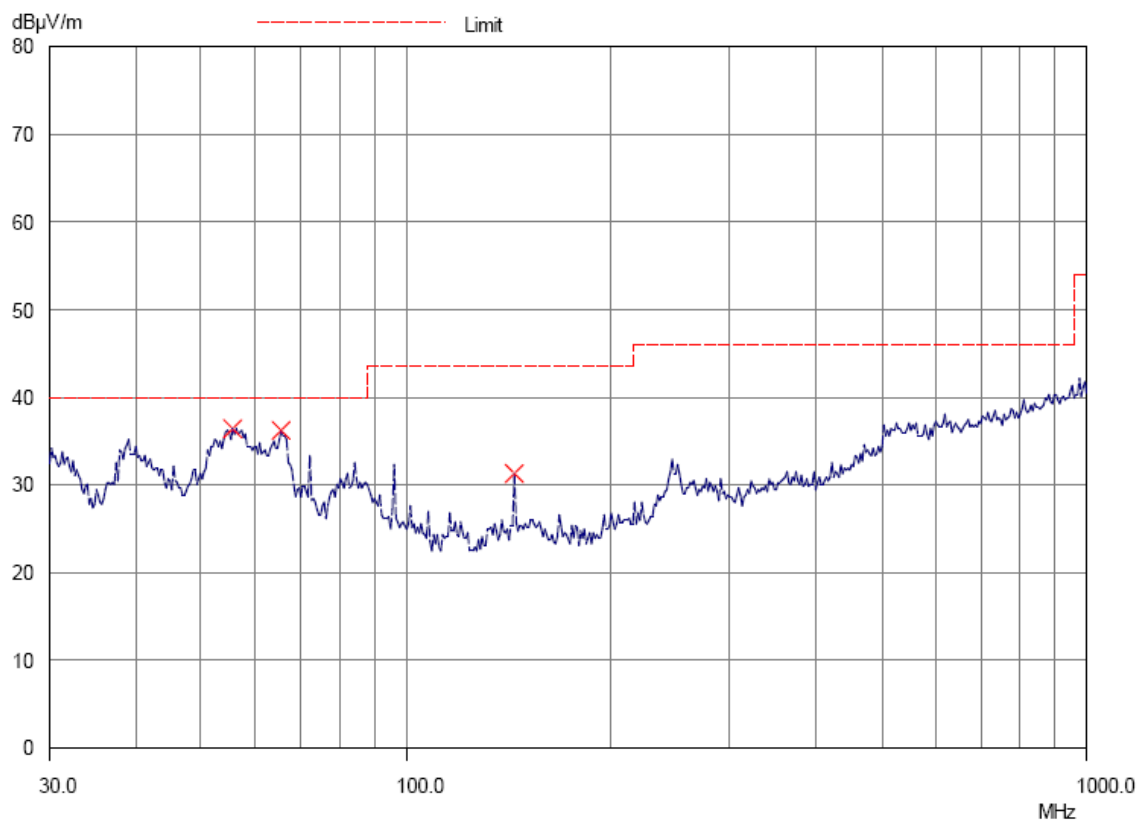
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Result of Bluetooth communication mode, (30MHz – 1GHz): PASS

Vertical



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Result of Bluetooth communication 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
55.4	27.6	6.8	34.4	52.5	100	Vertical
65.3	27.4	6.9	34.3	51.9	150	Vertical
144.0	21.4	8.9	30.3	32.9	150	Vertical
30.3	18.6	15.2	33.8	49.0	200	Horizontal
278.1	19.4	13.6	33.0	44.8	200	Horizontal
347.9	13.2	15.8	29.0	28.1	200	Horizontal

Result of Bluetooth communication mode, (9kHz – 30MHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

Result of Bluetooth communication mode, (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:

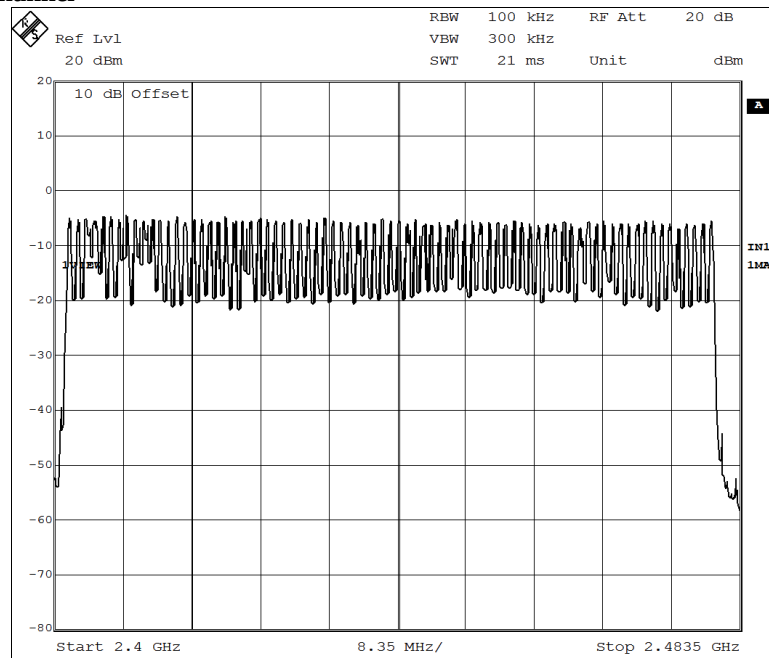
RBW = 100kHz, VBW $\geq$ RBW, Sweep = Auto, Span = the frequency band of operation
Detector = Peak, Trace = Max. hold

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Measurement Data:

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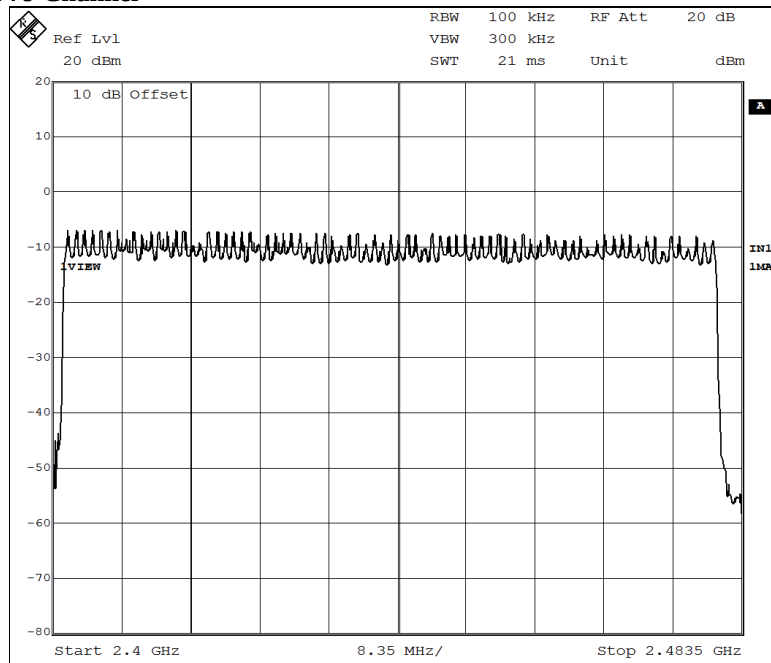
Test Report

Date : 2017-11-30

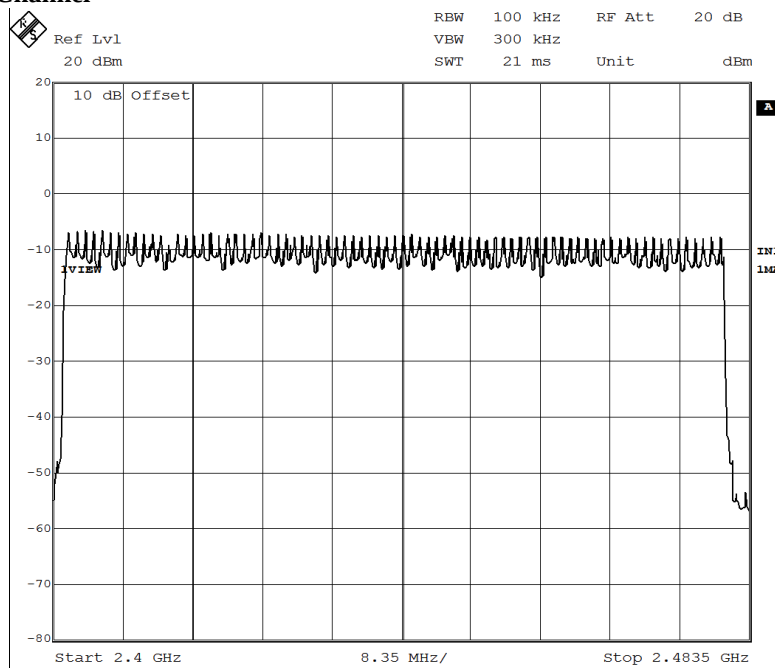
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$\pi/4$ -DQPSK: 79 of 79 Channel

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8DPSK: 79 of 79 Channel



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Test Report

Date : 2017-11-30

No. : HM171058

3.1.5 20dB Bandwidth

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Test Requirement:	FCC 47CFR 15.247(a)(1)
Test Method:	ANSI C63.10:2013
Test Date:	2017-11-24
Mode of Operation:	Tx mode :GFSK/ π /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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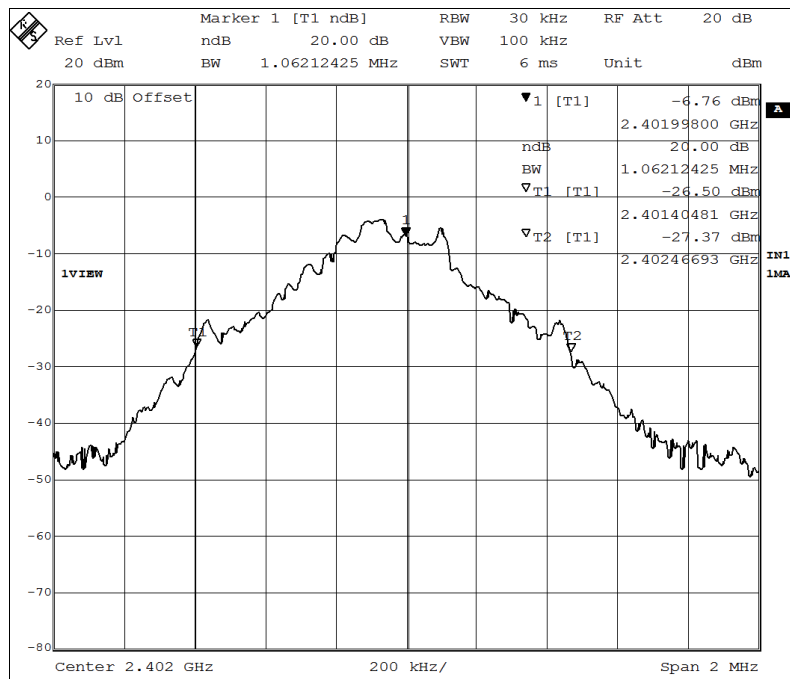
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.06	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)



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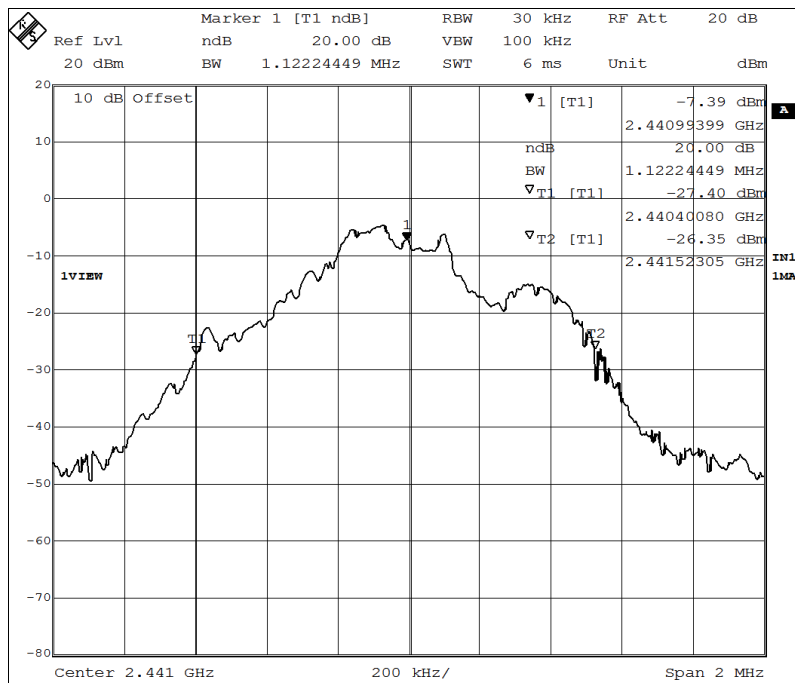
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.12	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



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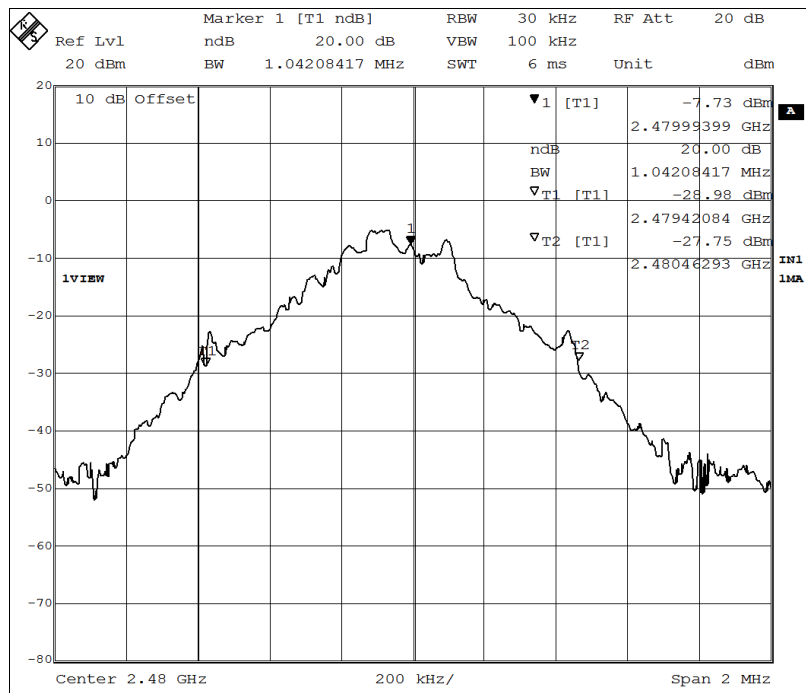
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Fundamental Frequency [MHz]	20dB Bandwidth [KHz]	FCC Limits [MHz]
2480	1.04	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)



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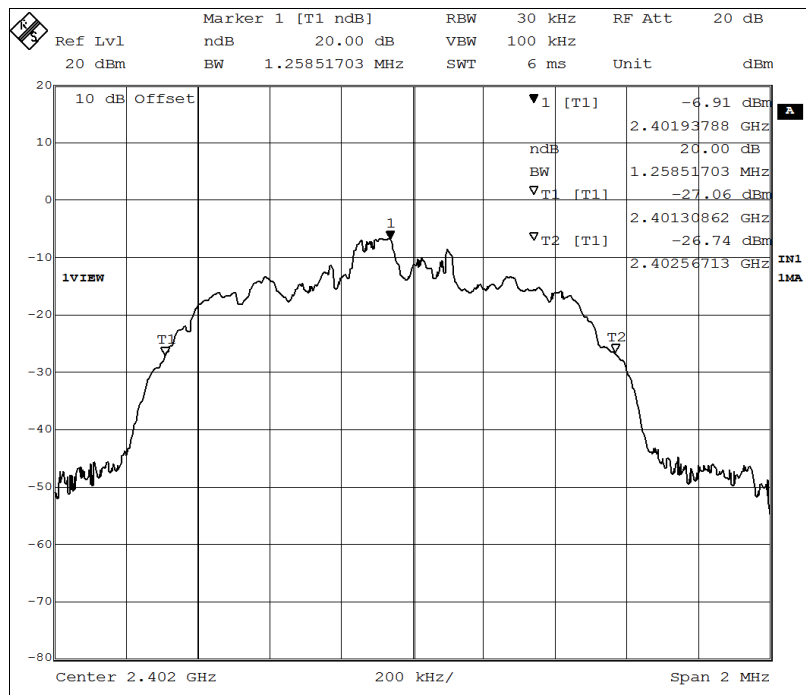
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.26	Within 2400-2483.5

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



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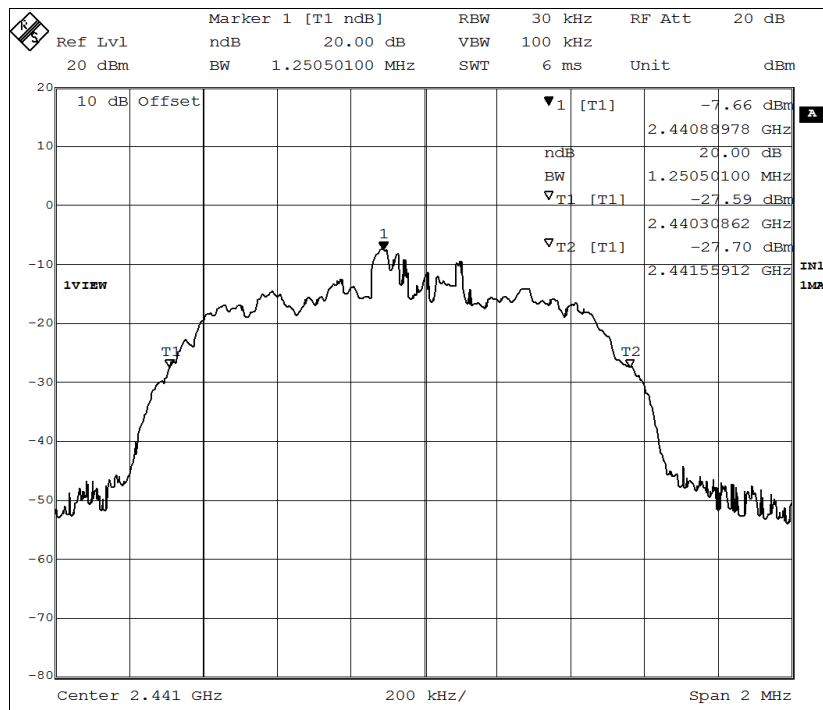
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No. : HM171058

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.25	Within 2400-2483.5

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



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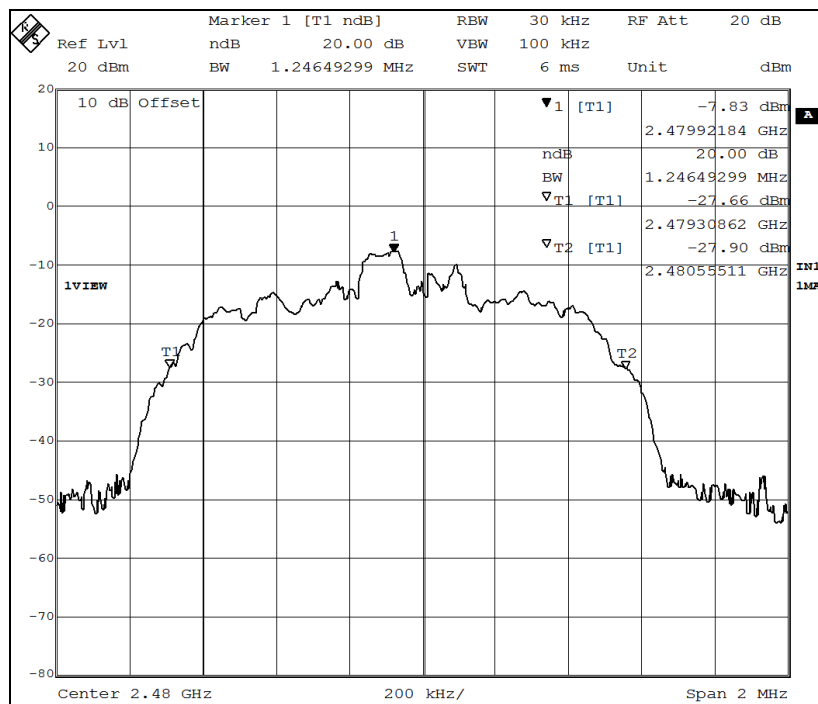
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.25	Within 2400-2483.5

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



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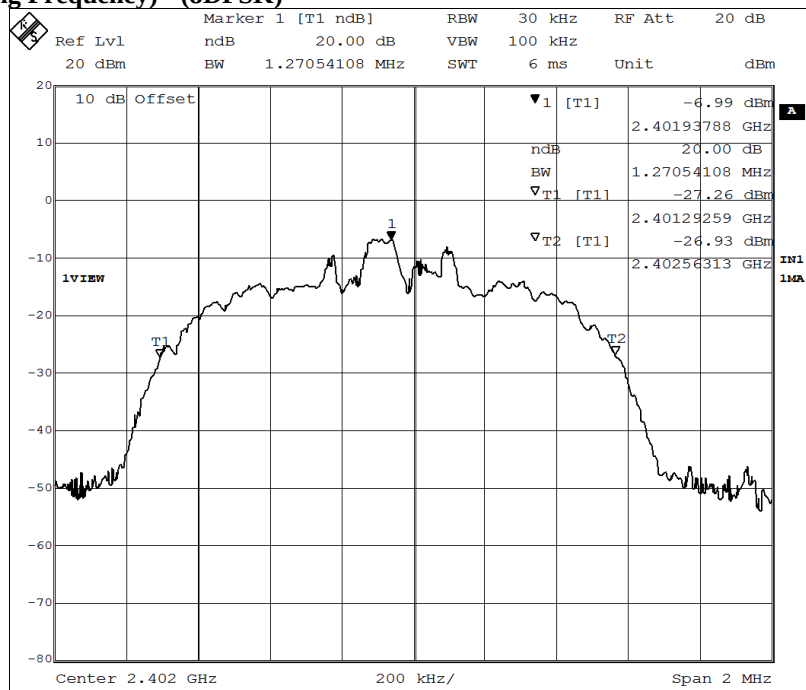
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.27	Within 2400-2483.5

(Lowest Operating Frequency) - (8DPSK)



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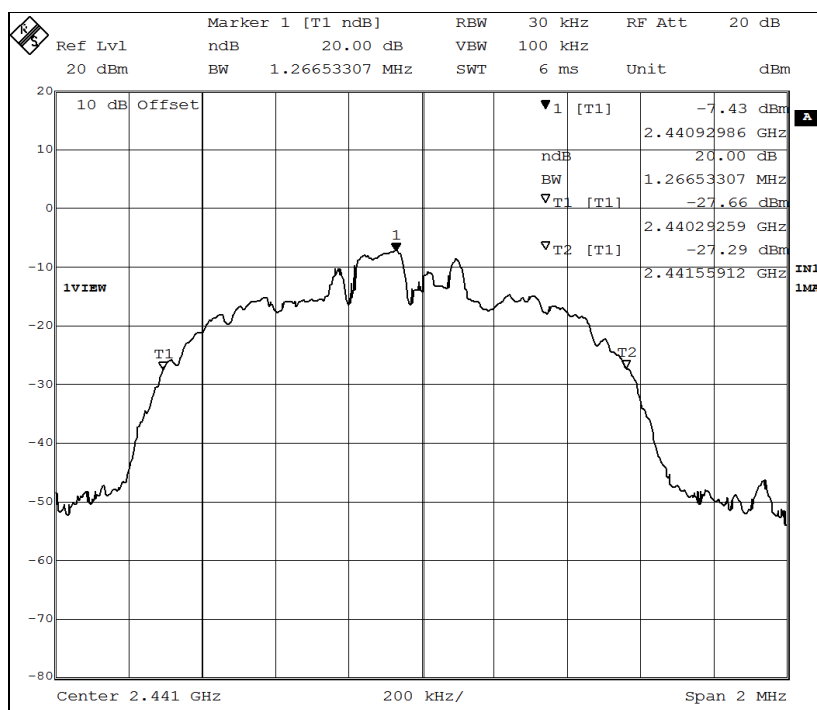
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No. : HM171058

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.27	Within 2400-2483.5

(Middle Operating Frequency) - (8DPSK)



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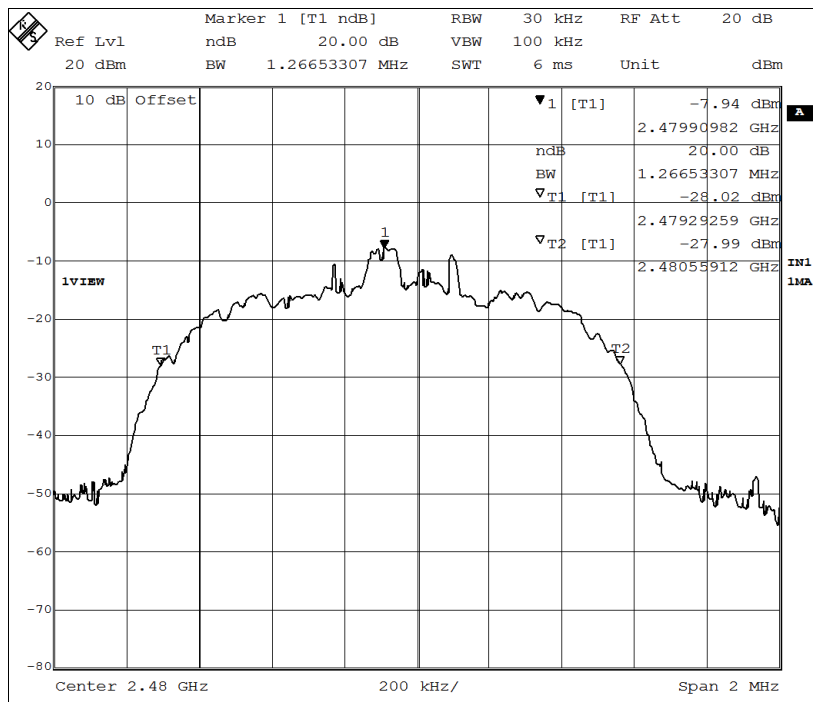
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.27	Within 2400-2483.5

(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 = 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 * $\frac{2}{3}$ = 1.12MHz * $\frac{2}{3}$ = 746.7kHz

$\pi/4$ DQPSK: The measured maximum bandwidth * $\frac{2}{3}$ = 1.26MHz * $\frac{2}{3}$ = 840.0kHz

8DPSK: The measured maximum bandwidth * $\frac{2}{3}$ = 1.27MHz * $\frac{2}{3}$ = 847.7MHz

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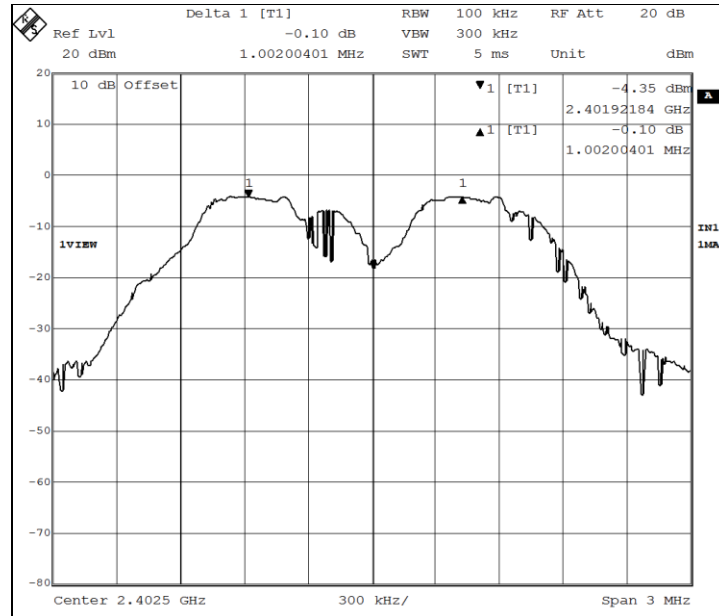
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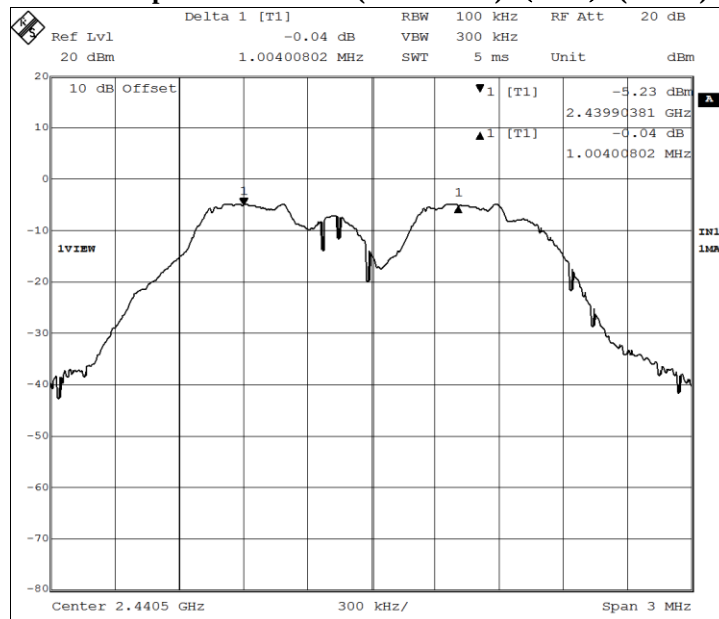
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Channel separation = 1MHz (>2/3 of BW) (Lowest) (GFSK)



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



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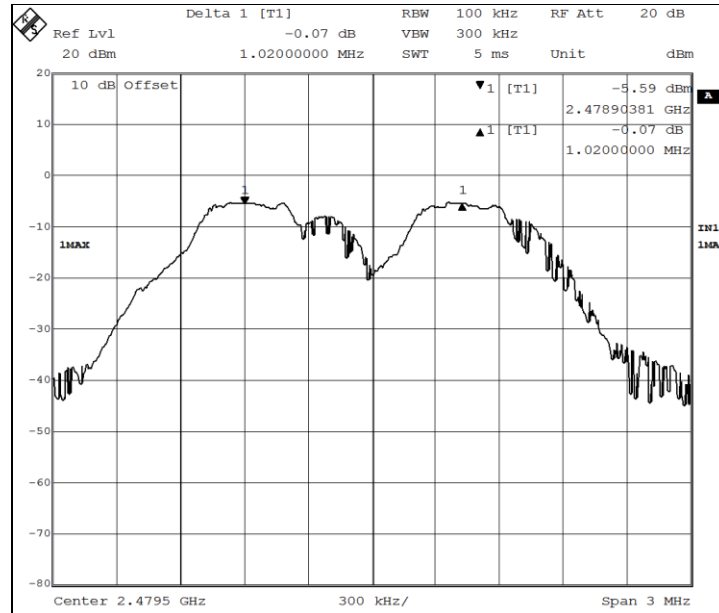
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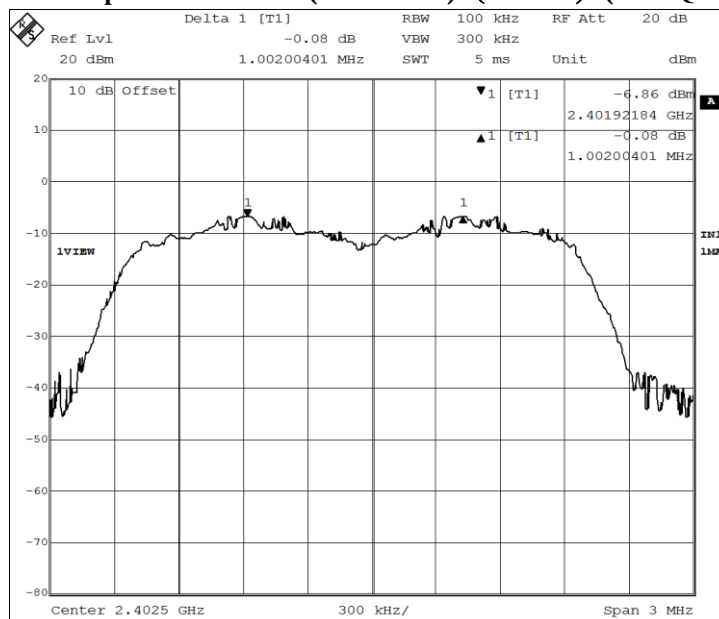
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Channel separation = 1MHz (>2/3 of BW) (Highest) (GFSK)



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



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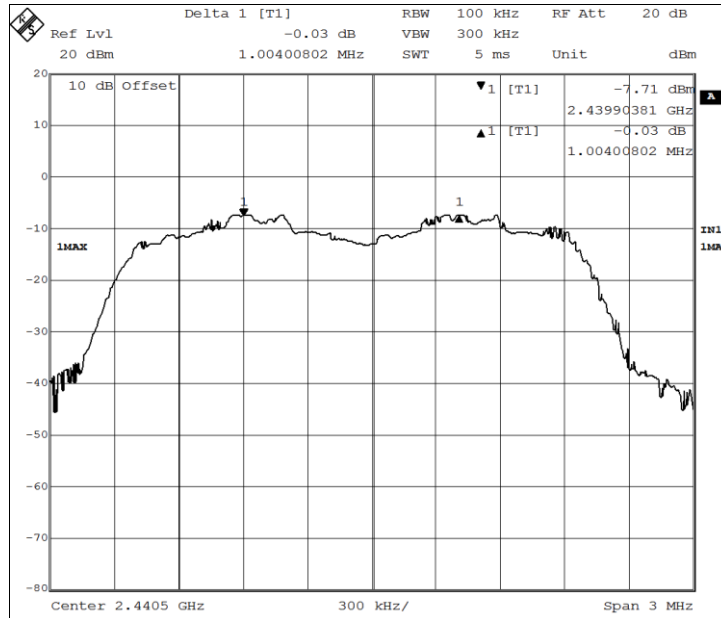
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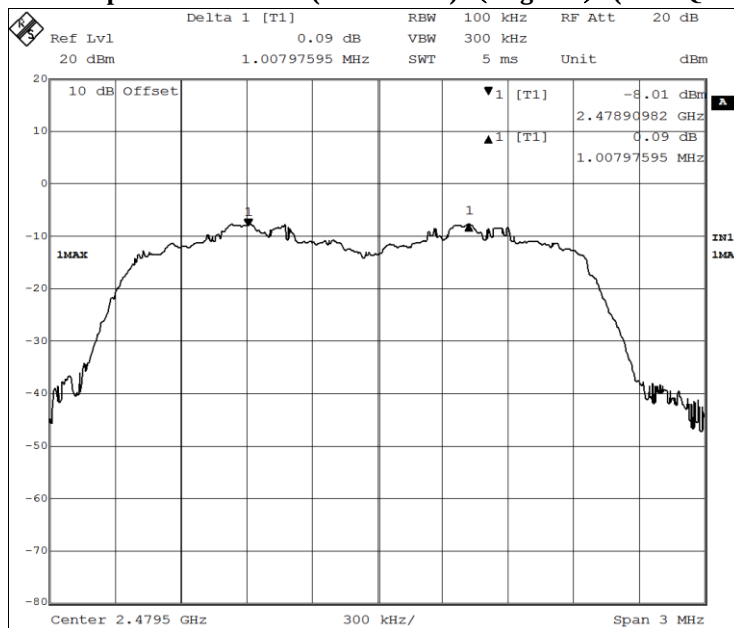
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Channel separation = 1MHz (>2/3 of BW) (Mid) ($\pi/4$ DQPSK)



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



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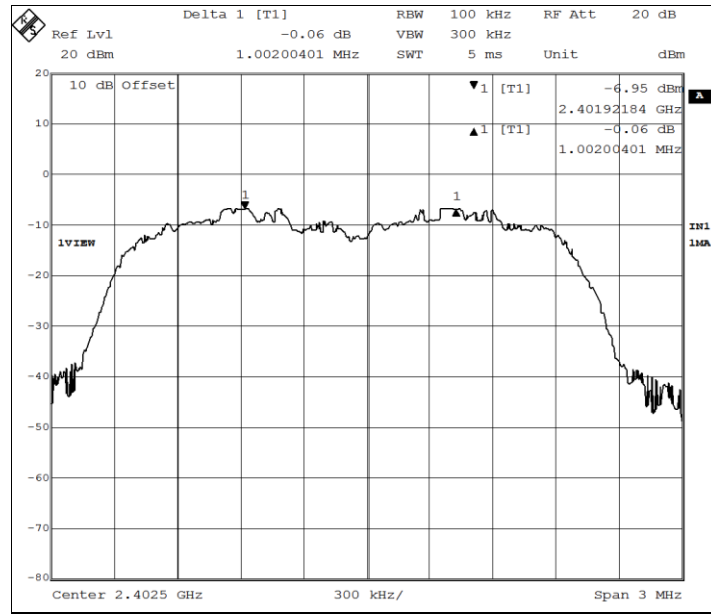
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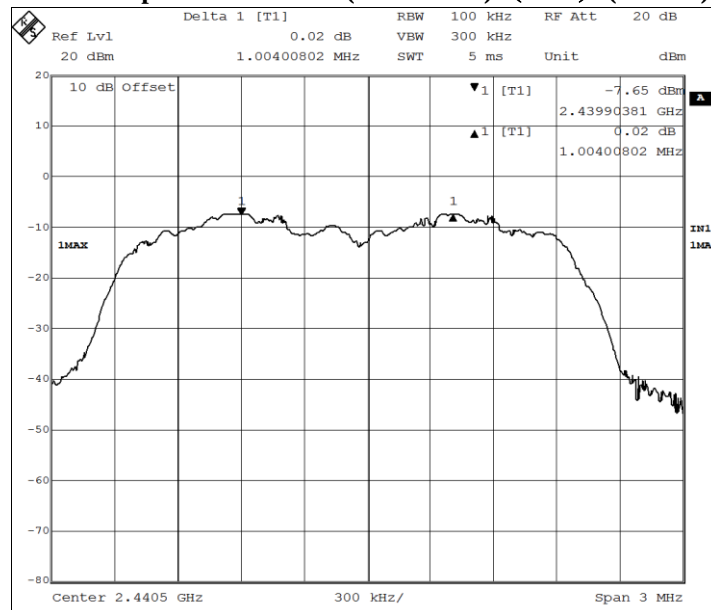
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Channel separation = 1MHz ($>2/3$ of BW) (Lowest) (8DPSK)



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



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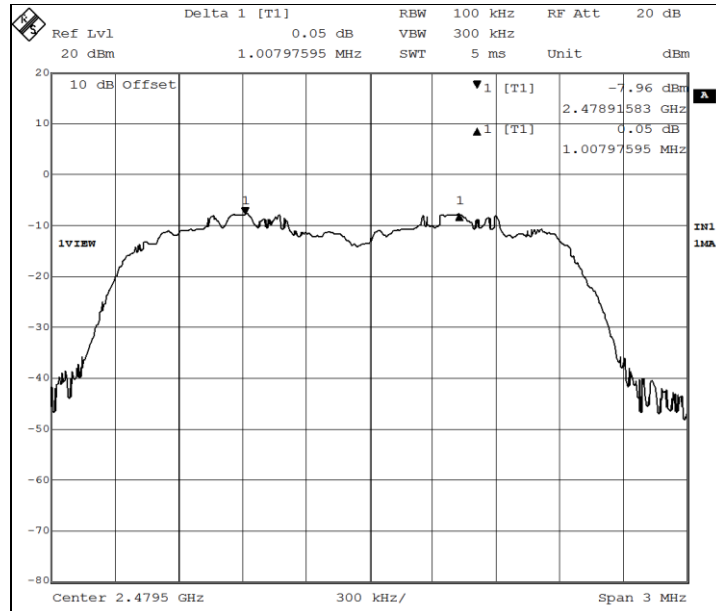
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Channel separation = 1MHz (>2/3 of BW) (Highest) (8DPSK)



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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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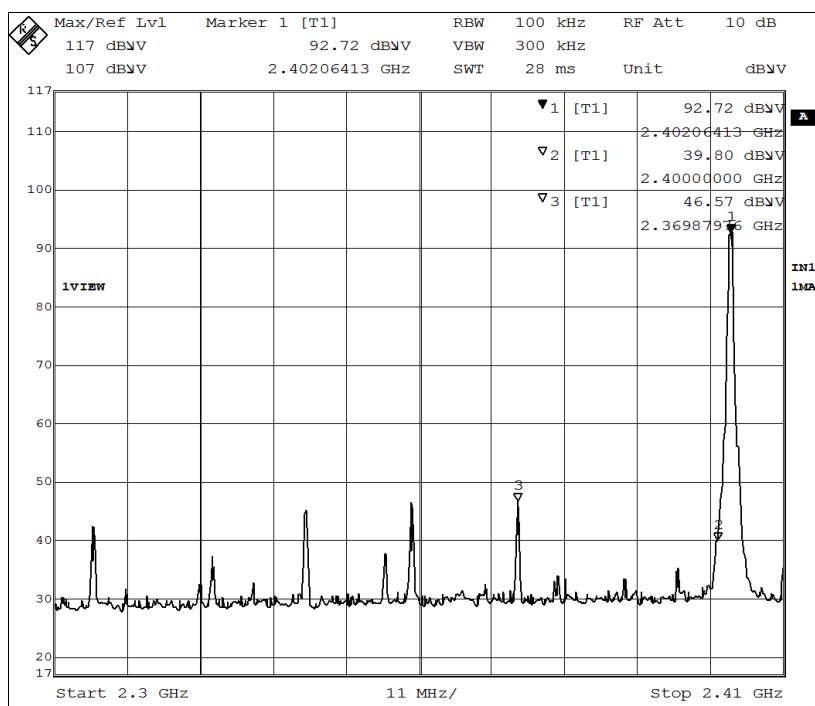
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	52.9

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



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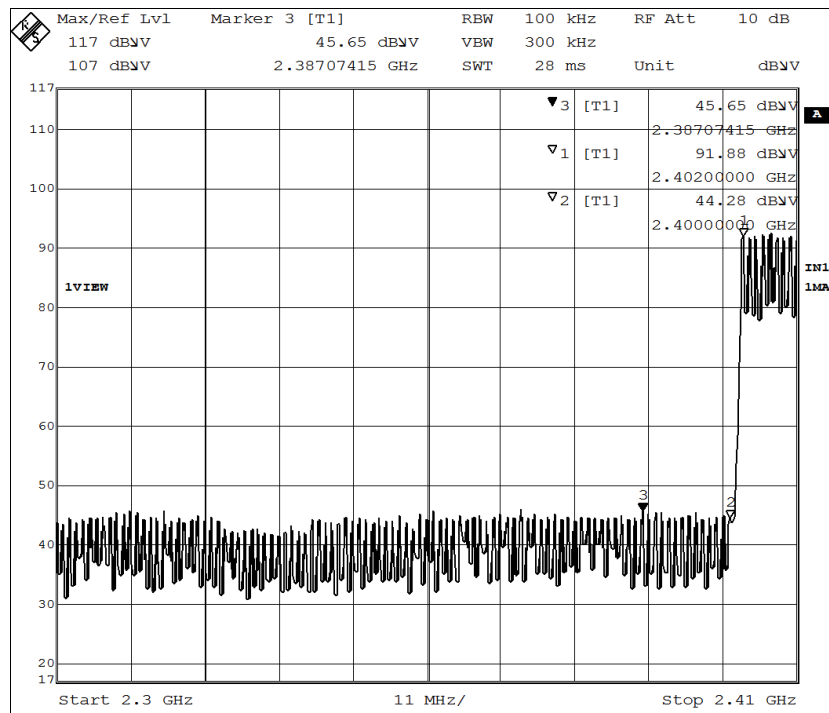
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	47.6

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



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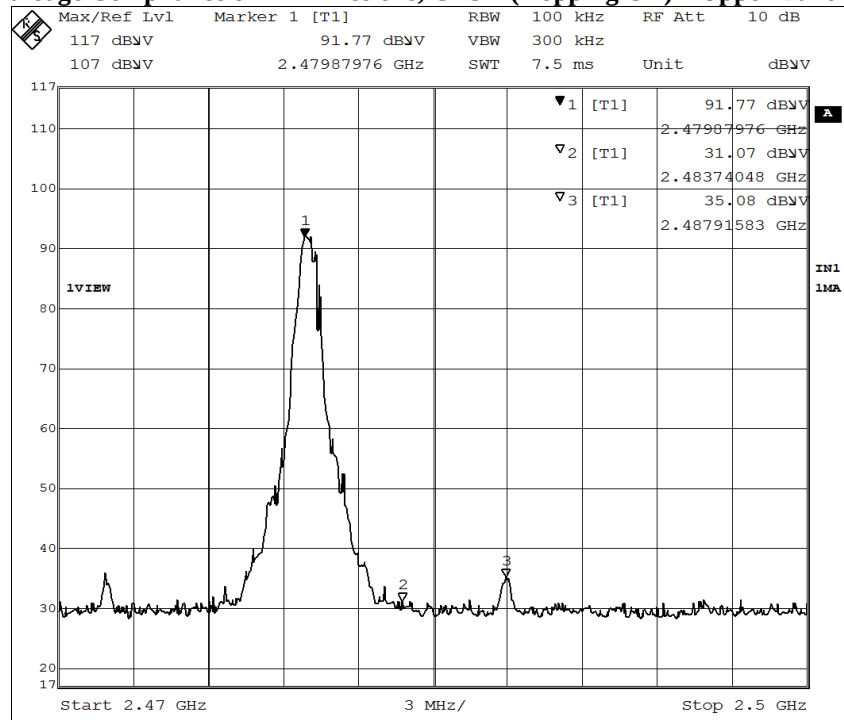
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	60.7

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



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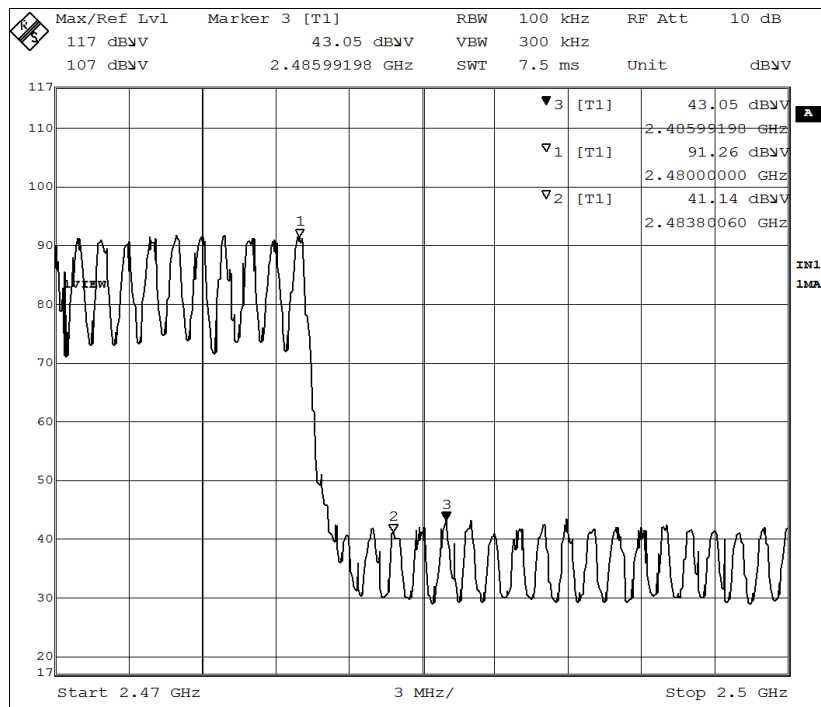
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	50.1

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



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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
2369.9	11.5	36.8	48.3	74.0	25.7	Vertical
2387.0	13.1	36.8	49.9	74.0	24.1	Vertical
2487.9	2.8	36.9	39.7	74.0	34.3	Vertical
2486.0	7.3	36.9	44.2	74.0	29.8	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
2369.9	4.1	36.8	40.9	54.0	13.1	Vertical
2387.0	3.2	36.8	40.0	54.0	14.0	Vertical
2487.9	-3.1	36.9	33.8	54.0	20.2	Vertical
2486.0	2.9	36.9	39.8	54.0	14.2	Vertical

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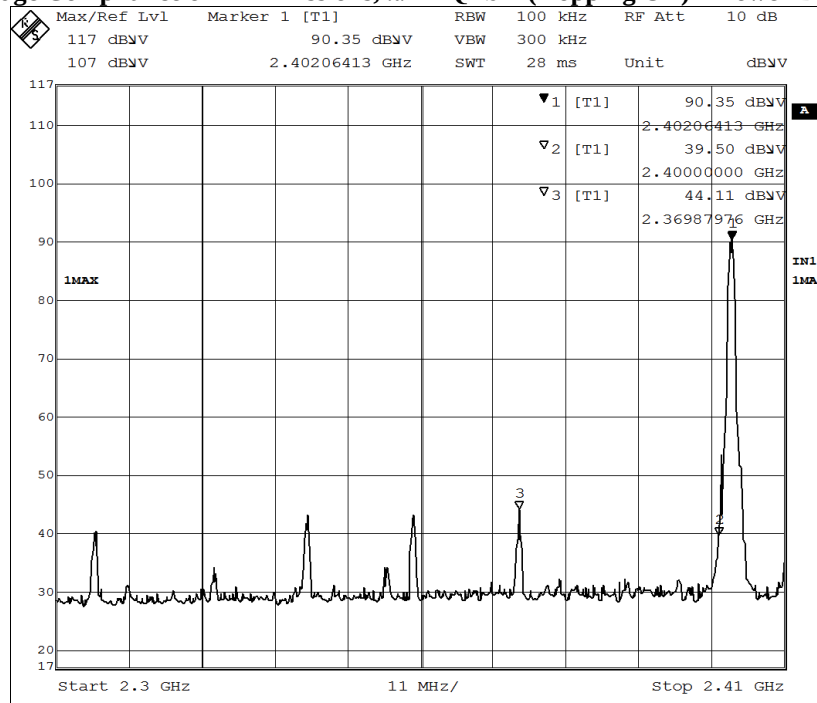
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	50.9

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



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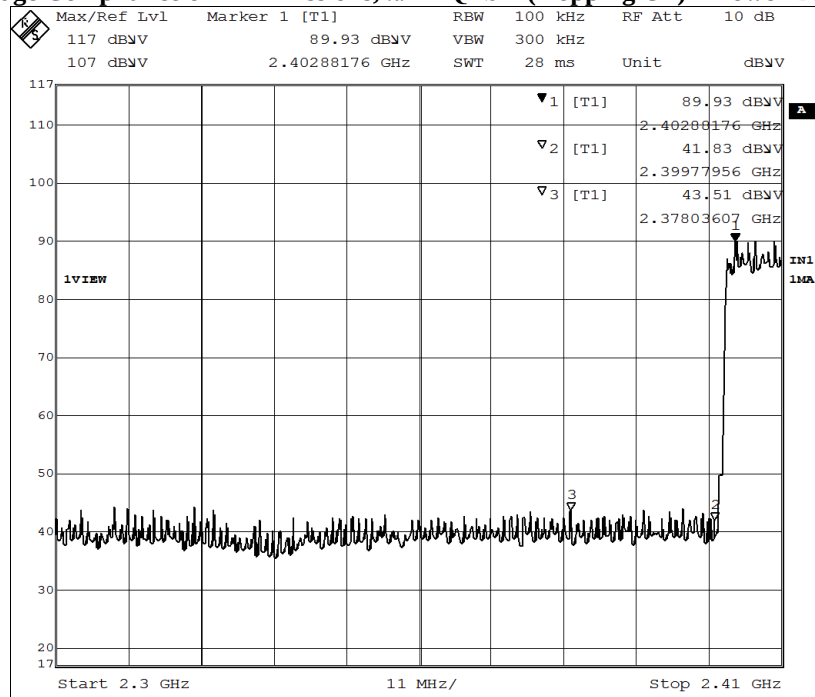
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	48.1

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



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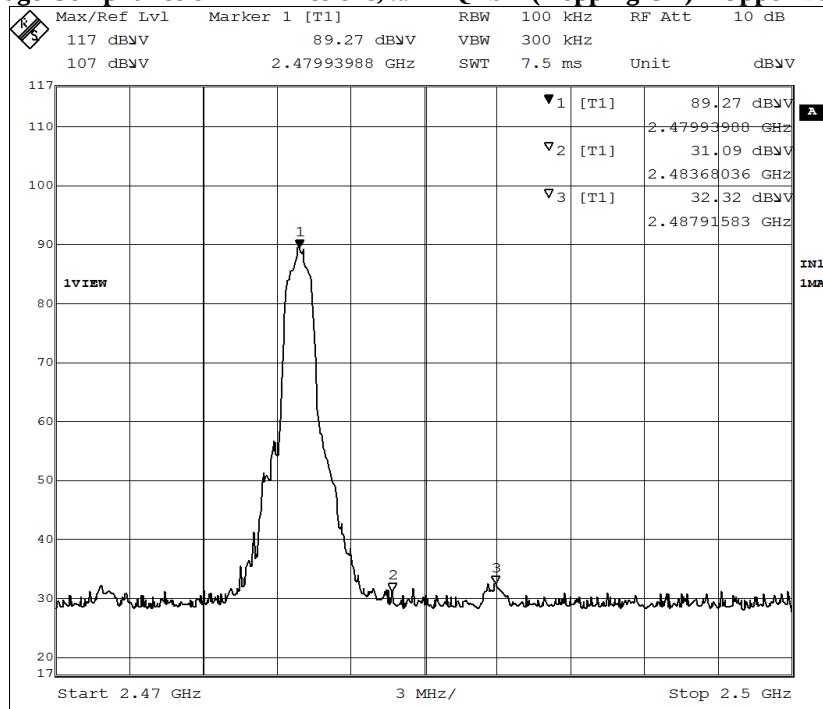
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	58.2

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



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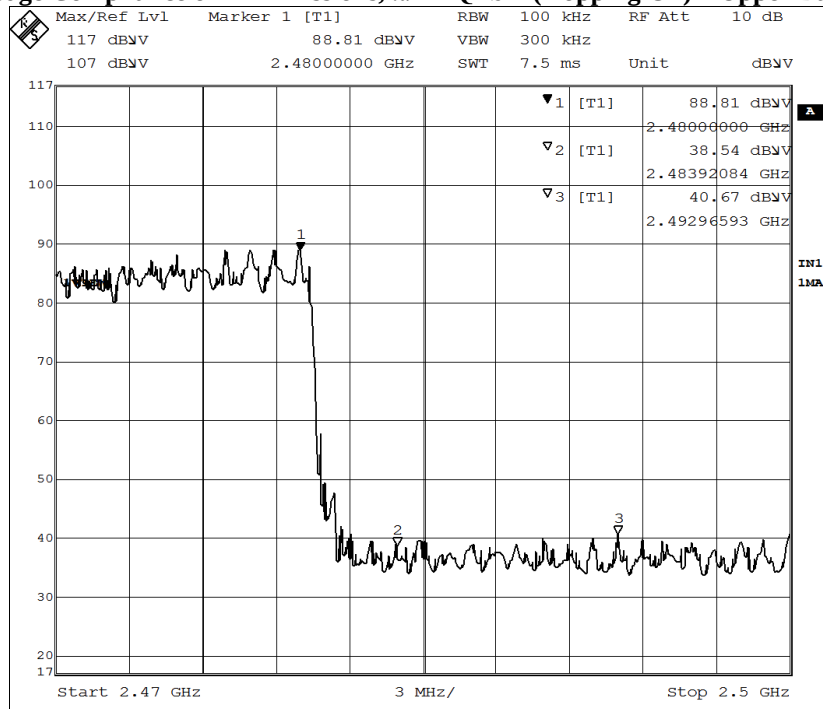
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	50.3

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
2369.9	10.8	36.8	47.6	74.0	26.4	Vertical
2378.0	11.4	36.8	48.2	74.0	25.8	Vertical
2487.9	2.7	36.9	39.6	74.0	34.4	Vertical
2493.0	7.7	36.9	44.6	74.0	29.4	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
2369.9	3.7	36.8	40.5	54.0	13.5	Vertical
2378.0	3.4	36.8	40.2	54.0	13.8	Vertical
2487.9	-3.4	36.9	33.5	54.0	20.5	Vertical
2493.0	1.1	36.9	38.0	54.0	16.0	Vertical

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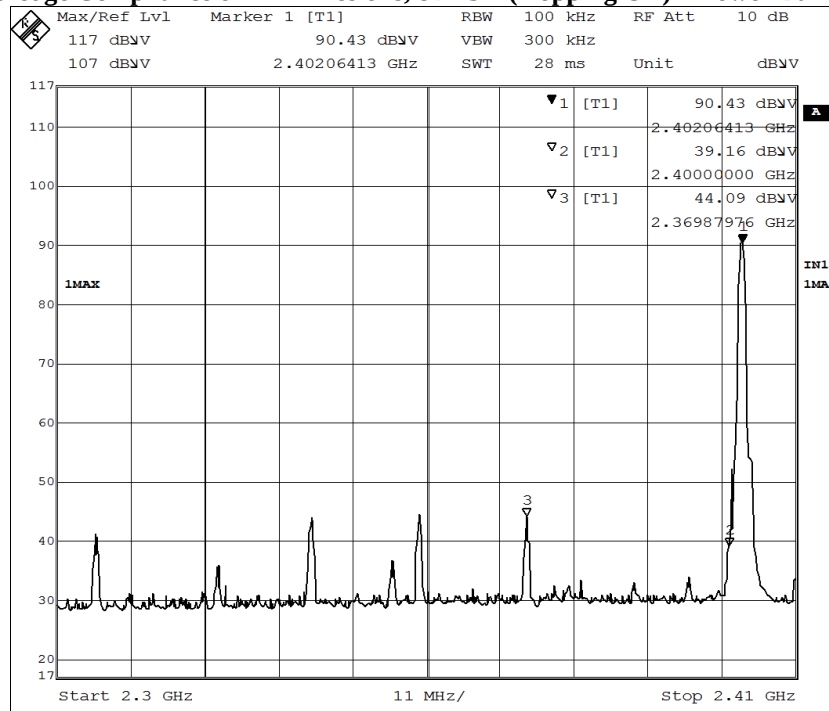
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	51.3

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



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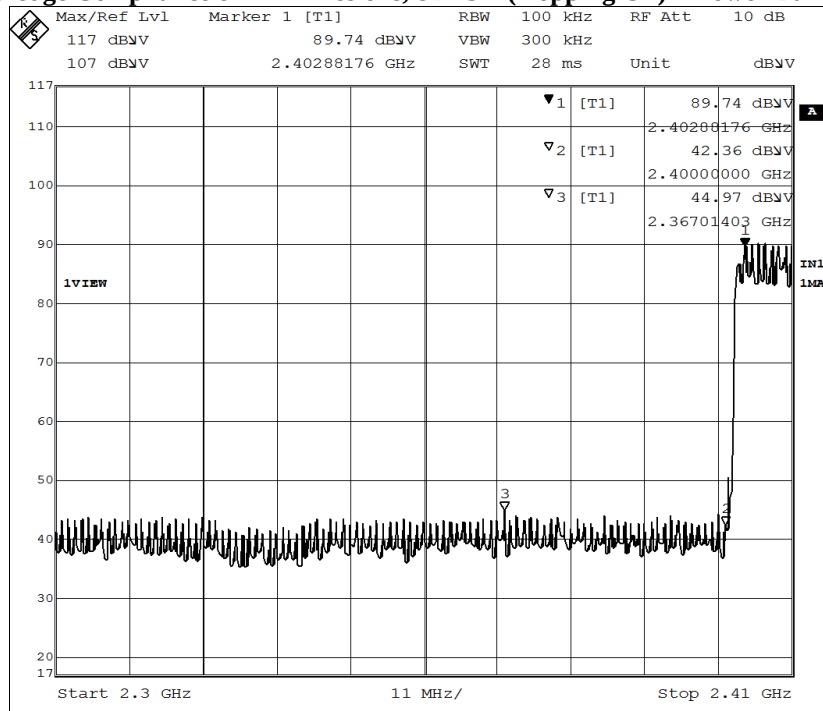
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	47.4

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



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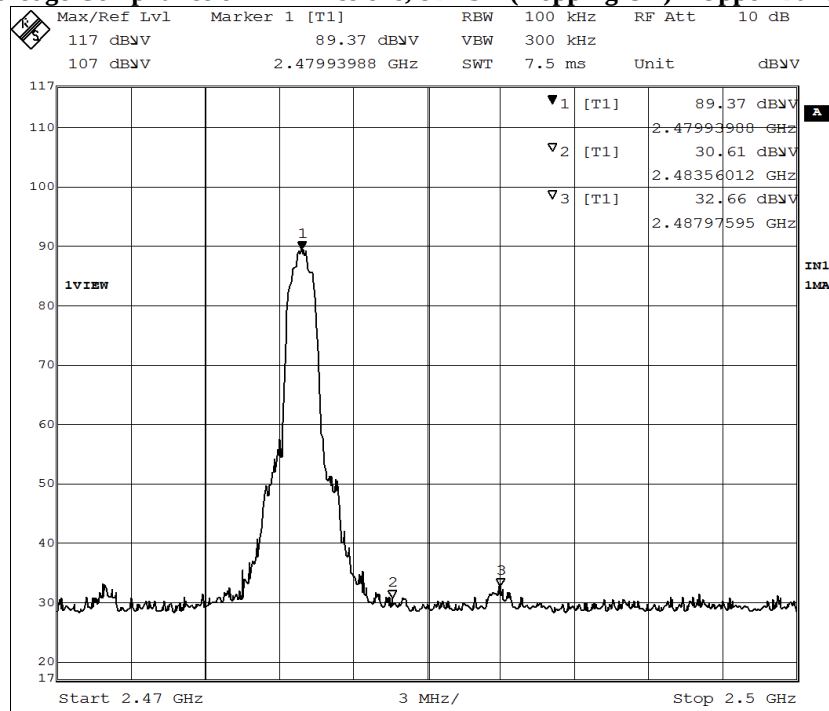
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Frequency Range [MHz]	Radiated Emission Attenuate below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	58.8

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



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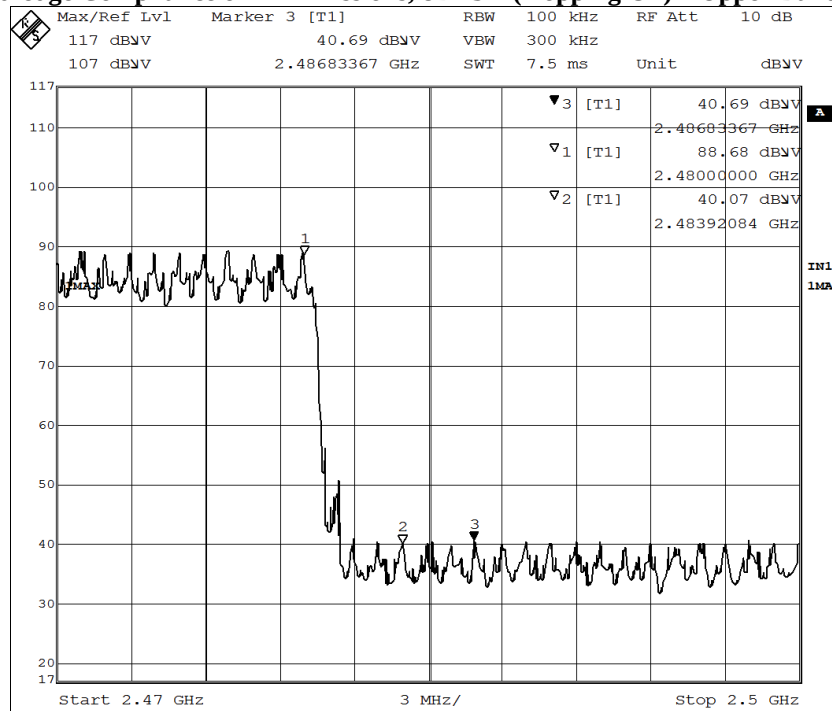
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Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	48.6

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
2369.8	10.3	36.8	47.1	74.0	26.9	Vertical
2367.0	11.5	36.8	48.3	74.0	25.7	Vertical
2487.9	3.1	36.9	40.0	74.0	34.0	Vertical
2483.9	8.9	36.9	45.8	74.0	28.2	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
2369.8	3.2	36.8	40.0	54.0	14.0	Vertical
2367.0	2.7	36.8	39.5	54.0	14.5	Vertical
2487.9	0.7	36.9	37.6	54.0	16.4	Vertical
2483.9	0.9	36.9	37.8	54.0	16.2	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 $\geq$ RBW,

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

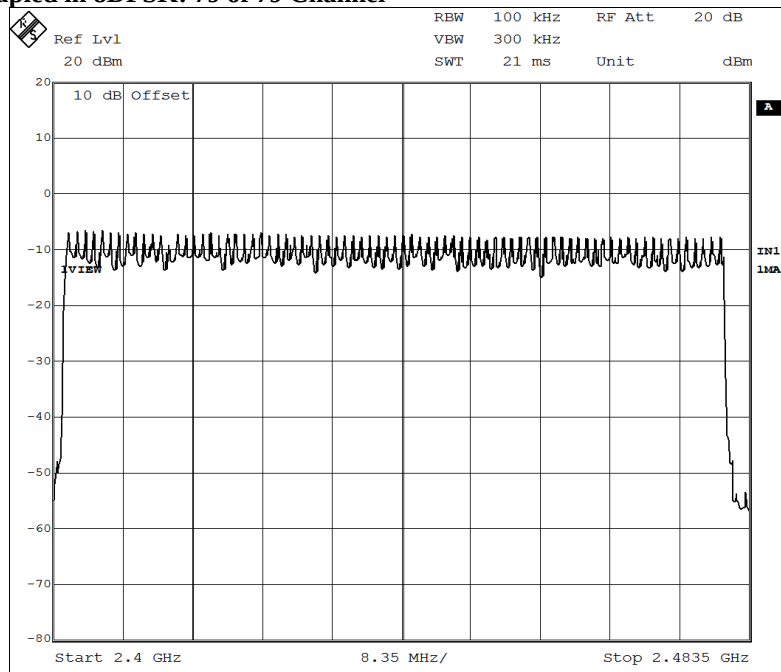
Span = Zero, Detector = Peak, Trace = Max. hold

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

Observed duration: 0.4s x 79 = 31.6s

Measurement Data:

Channel Occupied in 8DPSK: 79 of 79 Channel



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DH5 Packet:

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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]

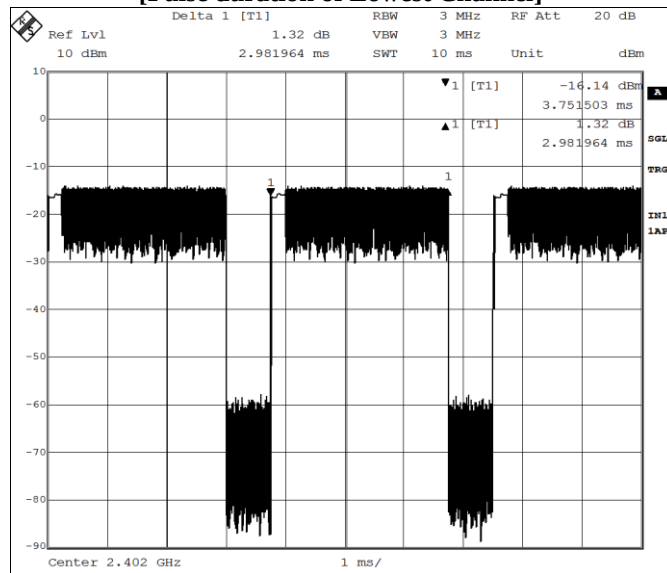
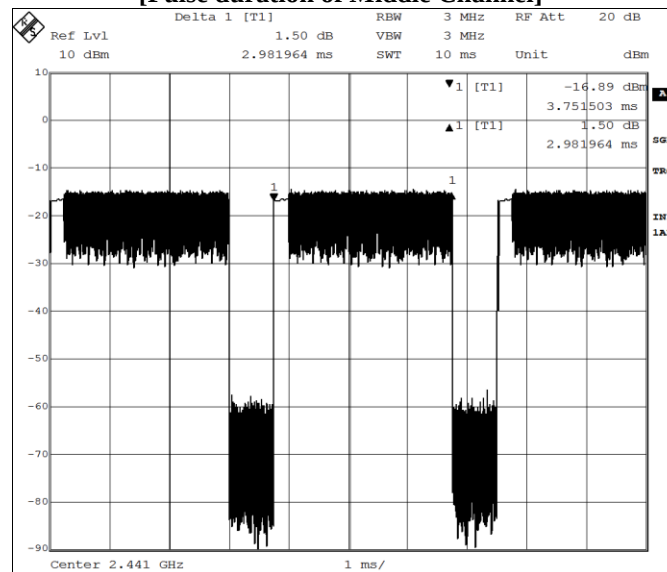


Fig. B

[Pulse duration of Middle Channel]



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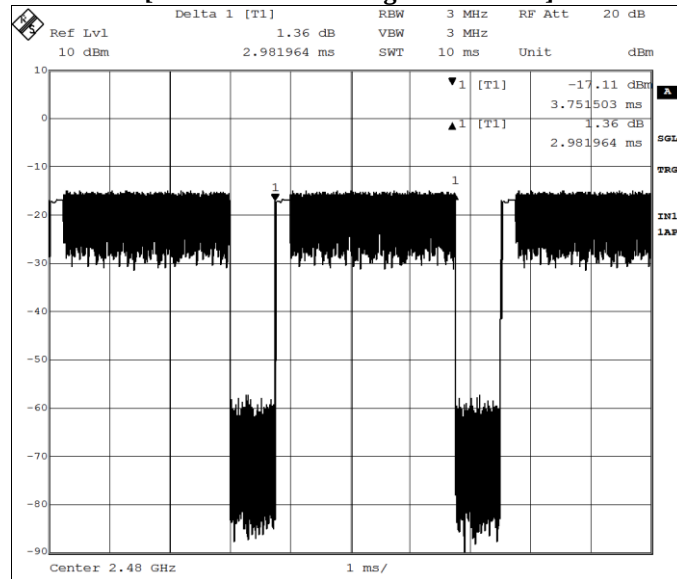
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Fig. C
[Pulse duration of Highest Channel]



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DH3 Packet:

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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]

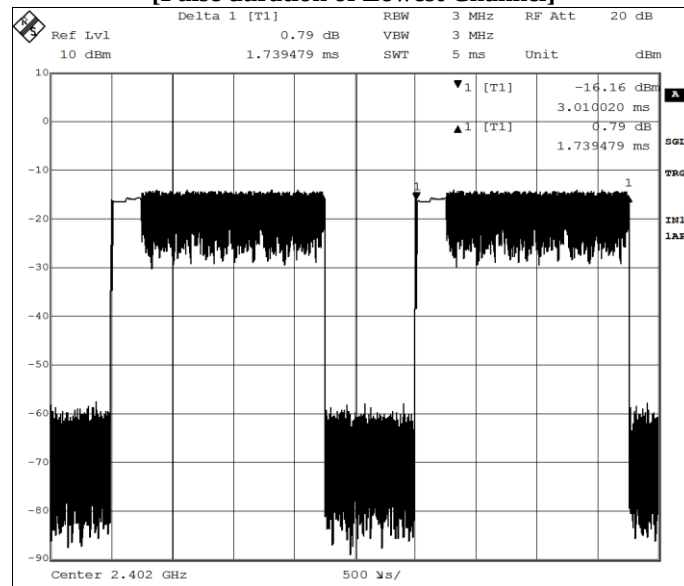
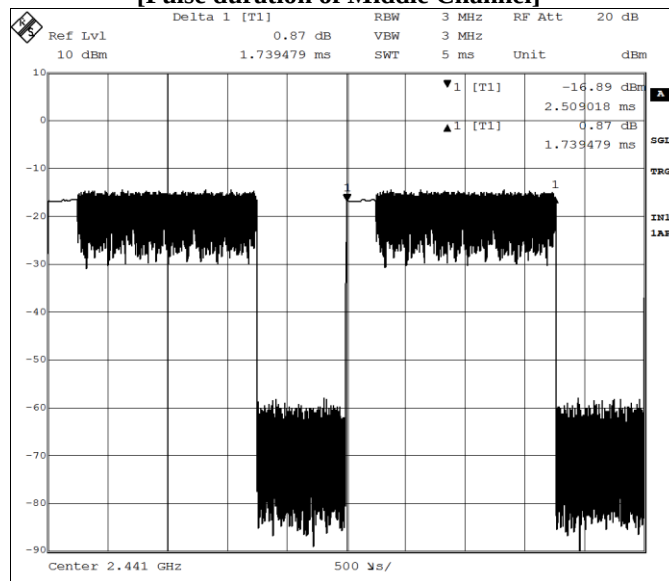


Fig. E
[Pulse duration of Middle Channel]



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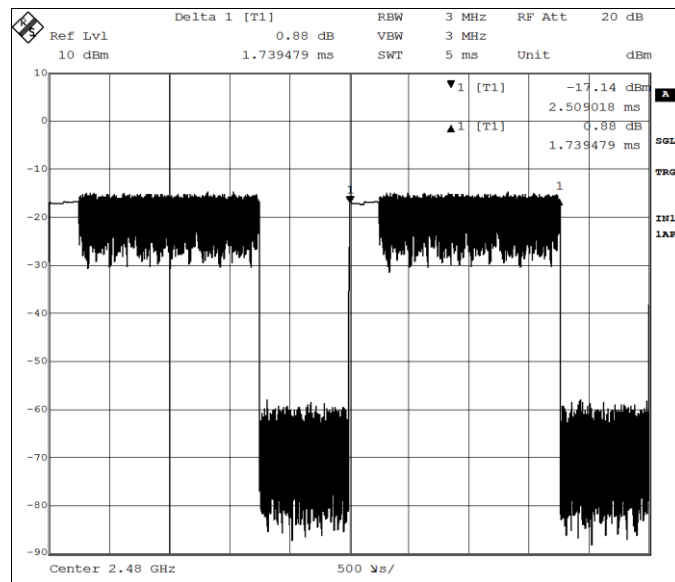
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Fig. F
[Pulse duration of Highest Channel]



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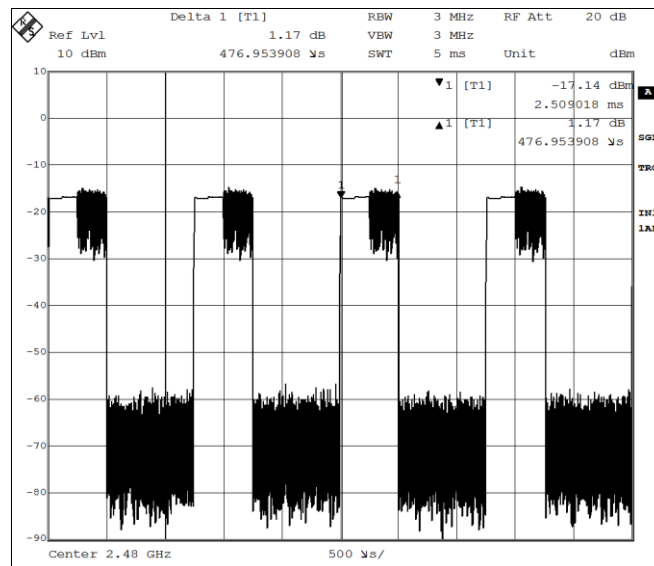
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Fig. I
[Pulse duration of Highest Channel]



Time of occupancy (Dwell Time):

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Results
DH5	2402	2.982	0.318	0.400	Complies
DH5	2441	2.982	0.318	0.400	Complies
DH5	2480	2.982	0.318	0.400	Complies
DH3	2402	1.739	0.278	0.400	Complies
DH3	2441	1.739	0.278	0.400	Complies
DH3	2480	1.739	0.278	0.400	Complies
DH1	2402	0.477	0.153	0.400	Complies
DH1	2441	0.477	0.153	0.400	Complies
DH1	2480	0.477	0.153	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 = 1.7dBi. User is unable to remove or changed the Antenna.

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Test Report

Date : 2017-11-30
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3.1.12 RF Exposure

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Test Requirement: FCC 47CFR 15.247(i)
Test Date: 2017-11-24
Mode of Operation: On mode

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:

The EUT complied with the requirement(s) of this section.
EUT meets the requirements of these sections as proven through MPE calculation
The MPE calculation for EUT @ 20cm
Based on the highest P = 0.827 mW@2442MHz

$$\begin{aligned} P_d &= PG / 4\pi R^2 = (0.827 \times 1.48) / 12.566 \times (20)^2 \\ &= (1.223) / 12.566 \times 400 = 1.223 / 5026.4 \\ &= 0.000243 \text{ mW/cm}^2 \end{aligned}$$

where:

- *Pd = power density in mW/cm²
- * G = Antenna numeric gain (1.48); Log G = g/10 (g = 1.7dBi).
- * P = Conducted RF power to antenna (0.827mW@2442MHz).
- * R = Minimum allowable distance.(20 cm)

- *The power density Pd = 0.000243mW/cm² is less than 1 mW/cm² (listed MPE limit)
- *The SAR evaluation is not needed (this is a desk top device, R> 20 cm)
- * The EUT(antenna) must be 0.2 meters away from the General Population.

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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

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Appendix B

Photographs of EUT

Front View of the product



Rear View of the product



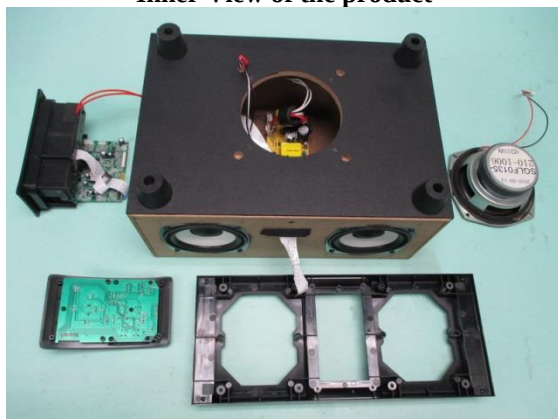
Rear View of the product



Rear View of the product



Inner View of the product



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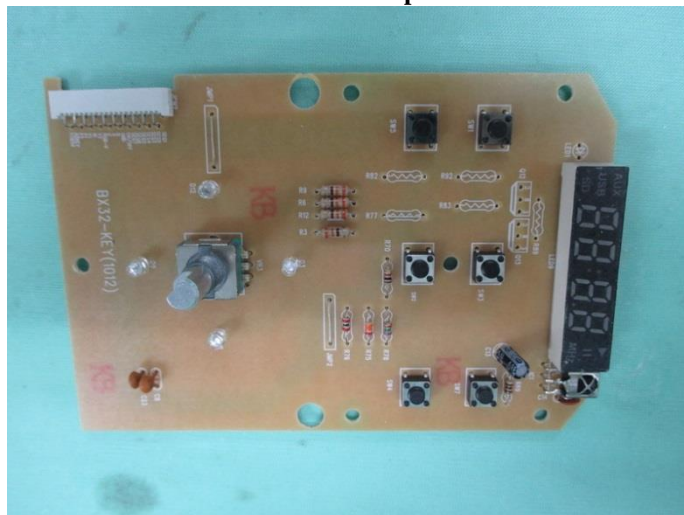
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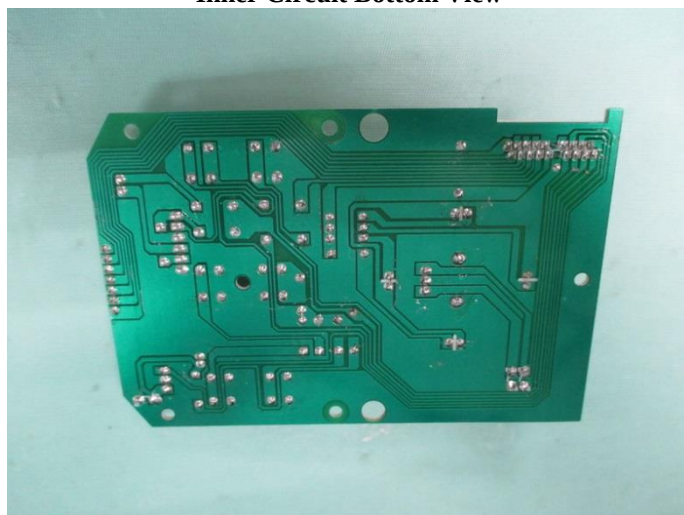
Date : 2017-11-30
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Photographs of EUT

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Inner Circuit Top View



Inner Circuit Bottom View



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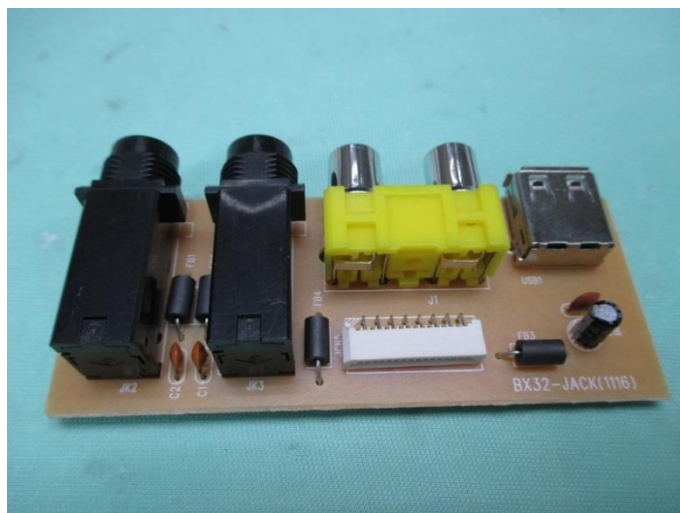
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Photographs of EUT

Inner Circuit Top View



Inner Circuit Bottom View



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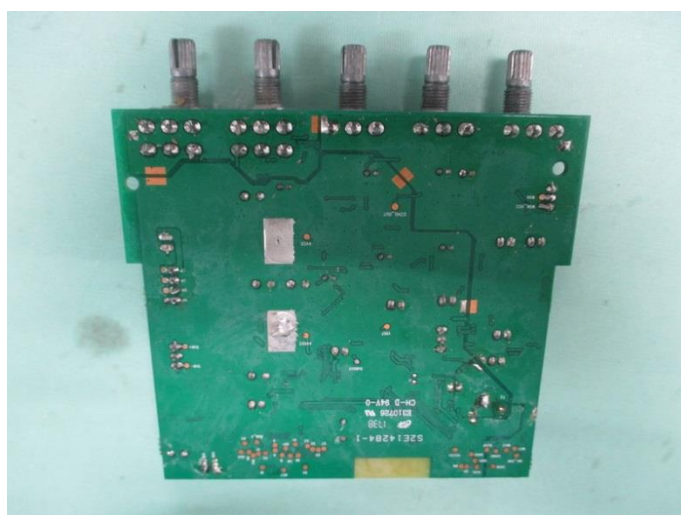
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Photographs of EUT

Inner Circuit Top View



Inner Circuit Bottom View



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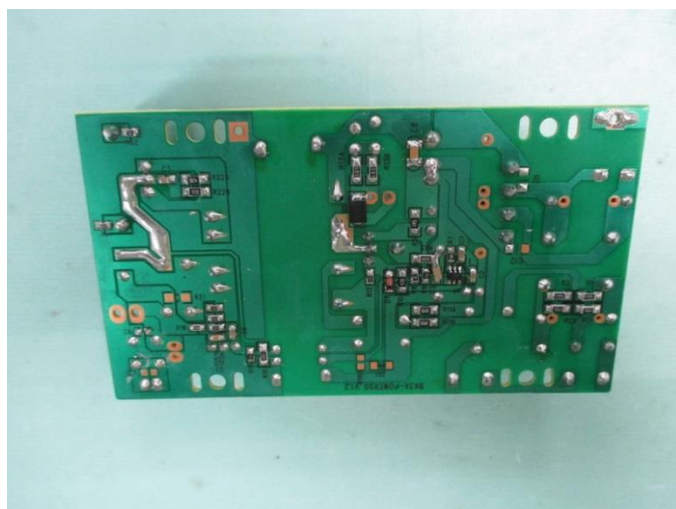
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Inner Circuit Top View



Inner Circuit Bottom View



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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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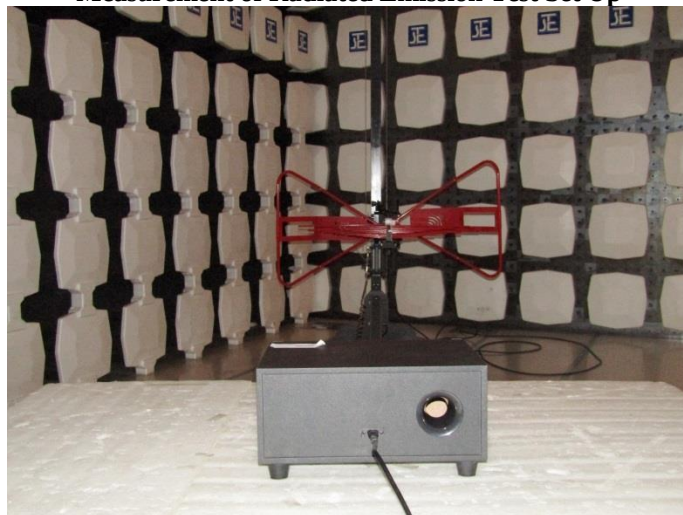
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Photographs of EUT

Measurement of Radiated Emission Test Set Up



Measurement of Radiated Emission Test Set Up



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