




Test Report

Date : 2016-10-17

No. : MH193094

Page 1 of 93

- Applicant** : Ewig Industries Macao Commercial Offshore Limited
Avenida Da Praia Grande No.619, EDF. Comercial Si Toi L6, Macau
- Supplier / Manufacturer** : Dong Guan Q&S Electronic Manufacturing Company Limited
Yin Shan Industrial District, Fu Gang Village, Xiang Mang West Road, Qing Xi Town, Dongguan City, Guang Dong Province, China
- Description of Sample(s)** : Submitted sample(s) said to be
Product: App Wake Up Light
Brand Name: Beurer
Model No.: WL90
FCC ID: N9ZWL90
- Date Samples Received** : 2016-09-29
- Date Tested** : 2016-09-26 to 2016-10-17
- Investigation Requested** : Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2015 and ANSI C63.10:2013 for FCC Certification.
- Conclusions** : The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.
- Remarks** : Bluetooth FHSS (GFSK, 4-DQPSK and 8DPSK)
For additional model(s) details, please page 3



Dr. LEE Kam Chuen
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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Test Report

Date : 2016-10-17

No. : MH193094

Page 2 of 93

CONTENT:

Cover	Page 1 of 93
Content	Page 2 of 93
<u>1.0 General Details</u>	
1.1 Test Laboratory	Page 3 of 93
1.2 Equipment Under Test [EUT] Description of EUT operation	Page 3 of 93
1.3 Date of Order	Page 3 of 93
1.4 Submitted Sample(s)	Page 3 of 93
1.5 Test Duration	Page 3 of 93
1.6 Country of Origin	Page 3 of 93
1.7 RF Module Details	Page 4 of 93
1.8 Antenna Details	Page 4 of 93
<u>2.0 Technical Details</u>	
2.1 Investigations Requested	Page 5 of 93
2.2 Test Standards and Results Summary	Page 5 of 93
2.3 Table for Test Modes	Page 6 of 93
<u>3.0 Test Results</u>	
3.1 Emission	Page 7-88 of 93
<u>Appendix A</u>	
List of Measurement Equipment	Page 89 of 93
<u>Appendix B</u>	
Photograph(s) of Product	Page 90-93 of 93

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Test Report

Date : 2016-10-17

No. : MH193094

Page 3 of 93

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, New Territories, Hong Kong

Telephone: 852 2666 1888

Fax: 852 2664 4353

1.2 Equipment Under Test [EUT]

Description of Sample(s)

Product: App Wake Up Light

Manufacturer: Dong Guan Q&S Electronic Manufacturing Company Limited
Yin Shan Industrial District, Fu Gang Village, Xiang Mang West
Road, Qing Xi Town, Dongguan City, Guang Dong Province,
China

Brand Name: Beurer

Model Number: WL90

Additional Model Number: BEG003

Rating: Input: 100-240V a.c. 50/60Hz 0.5A;
Output: 5.0V d.c. 3.0A.

The AC/DC adaptor was provided by the applicant with following details:

Brand name: Ktec; Model no.: KSAS0180500300HU

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is an App Wake Up Light. 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

2016-09-29

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2016-09-26 to 2016-10-17

1.6 Country of Origin

China

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Test Report

Date : 2016-10-17

No. : MH193094

Page 4 of 93

1.7 RF Module Details

Module Model Number: WLT2564M
Module FCC ID: N/A
Module Transmission Type: Bluetooth 4.0+EDR
Modulation: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK)
Data Rates:
1Mbps: GFSK
2 Mbps: $\pi/4$ -DQPSK
3 Mbps: 8DPSK
Frequency Range: 2400-2483.5MHz
Carrier Frequencies: 2402MHz – 2480MHz

Module Specification (specification provided by manufacturer)

1.8 Antenna Details

Antenna Type: Chip antenna
Antenna Gain: 2.5dBi

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Test Report

Date : 2016-10-17

No. : MH193094

Page 5 of 93

2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2015 Regulations and ANSI C63.10:2013 for FCC Certification.

According FCC KDB 558074 DTS Measurement Guidance, Duty cycle $\geq 98\%$.

The device was realized by test software.

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Maximum Peak Conducted Output Power	FCC 47CFR 15.247(b)(1)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Radiated Spurious Emissions	FCC 47CFR 15.209	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)(1)	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 checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: N/A - Not Applicable

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Test Report

Date : 2016-10-17

No. : MH193094

Page 6 of 93

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 device was realized by test software.

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

Test Items	Mode	Data Rate
Maximum Peak Conducted Output Power	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps
Hopping Channel Separation	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps
Number of Hopping Frequency	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps
Time of Occupancy(Dwell Time)	8DPSK (DH1 / DH3 / DH5)	3MBps
Radiated Spurious Emissions	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps
Band-edge compliance of Conducted Emission	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps

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Test Report

Date : 2016-10-17

No. : MH193094

Page 7 of 93

3.0 Test Results

3.1 Emission

3.1.1 Maximum Peak Conducted Output Power

Test Requirement:	FCC 47CFR 15.247(b) (1)
Test Method:	ANSI C63.10: 2013
Test Date:	2016-09-26
Mode of Operation:	Tx mode

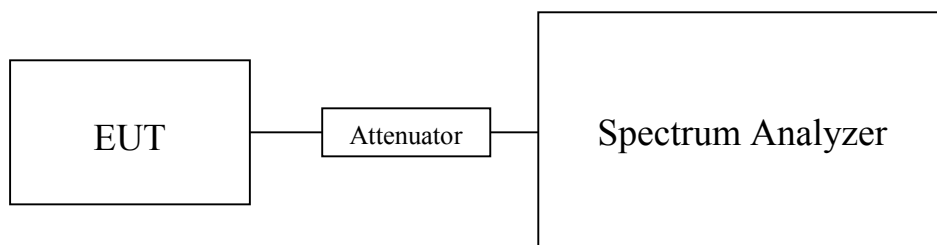
Test Method:

A temporary antenna connector was soldered to the RF output. The RF output of the EUT was connected to the spectrum analyzer. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

Spectrum Analyzer Setting:

RBW = 3 MHz, VBW = 3MHz, Sweep = Auto, Span: Approximately five times the 20 dB bandwidth
Detector = Peak, Trace = Max. hold

Test Setup:



Note: a temporary antenna connector was soldered to the RF output.

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Test Report

Date : 2016-10-17

Page 8 of 93

No. : MH193094

Limits for Maximum Peak Conducted Output Power [FCC 47CFR 15.247]:

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000350

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000264

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000232

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000342

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000252

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000216

Results of Bluetooth Communication mode (8DPSK) (Fundamental Power): Pass

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000351

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000243

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000214

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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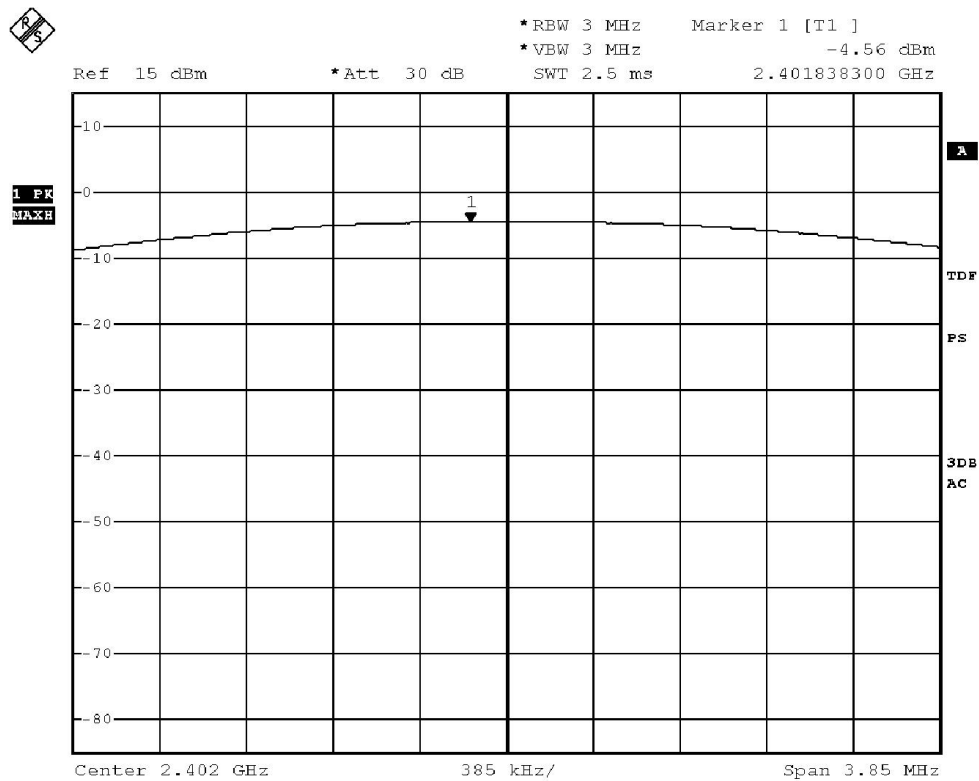
Date : 2016-10-17

Page 9 of 93

No. : MH193094

Test plot of Maximum Peak Conducted Output Power :

Bluetooth Communication mode (GFSK, 2402MHz)



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Date: 26.SEP.2016 17:39:24

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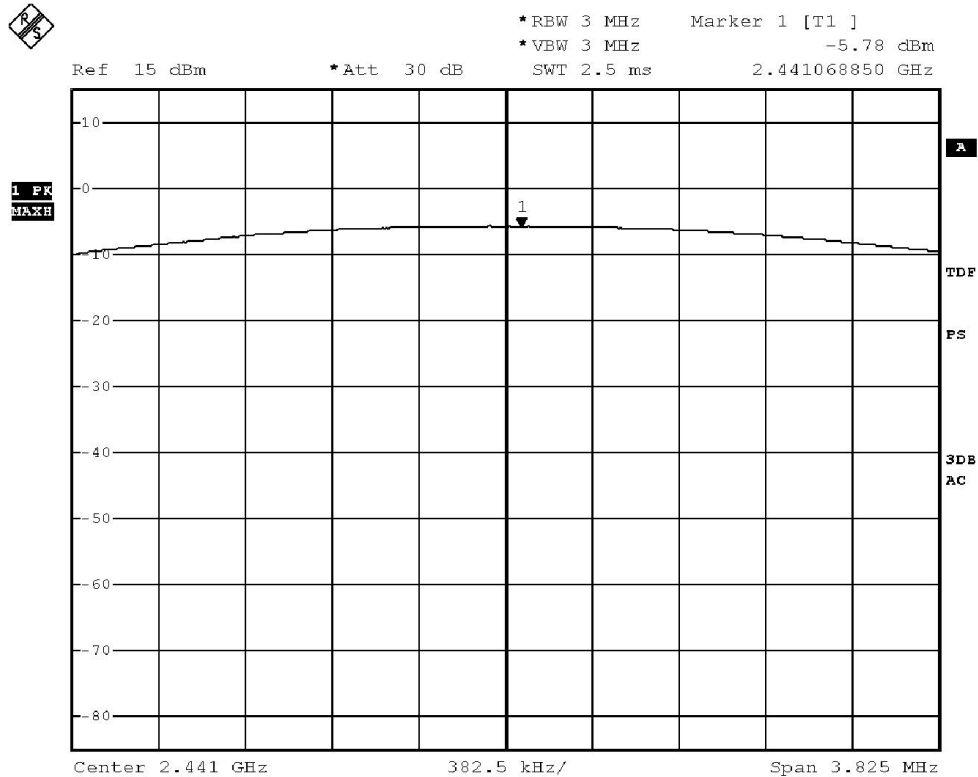
Test Report

Date : 2016-10-17

No. : MH193094

Page 10 of 93

Bluetooth Communication mode (GFSK, 2441MHz)



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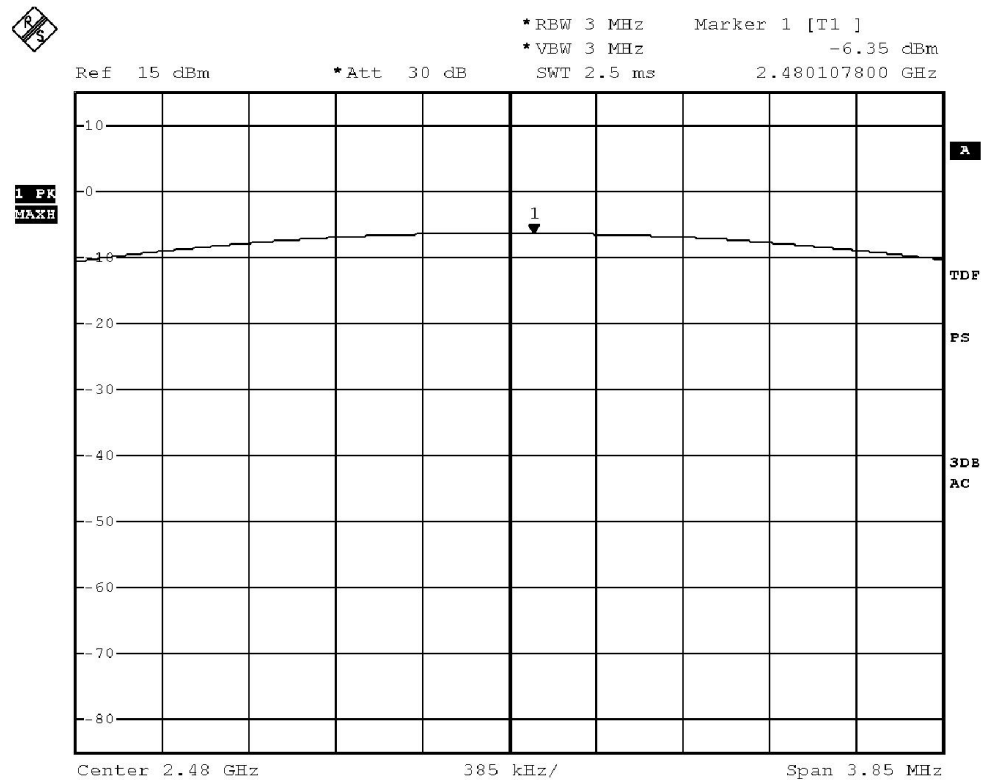
Test Report

Date : 2016-10-17

No. : MH193094

Page 11 of 93

Bluetooth Communication mode (GFSK, 2480MHz)



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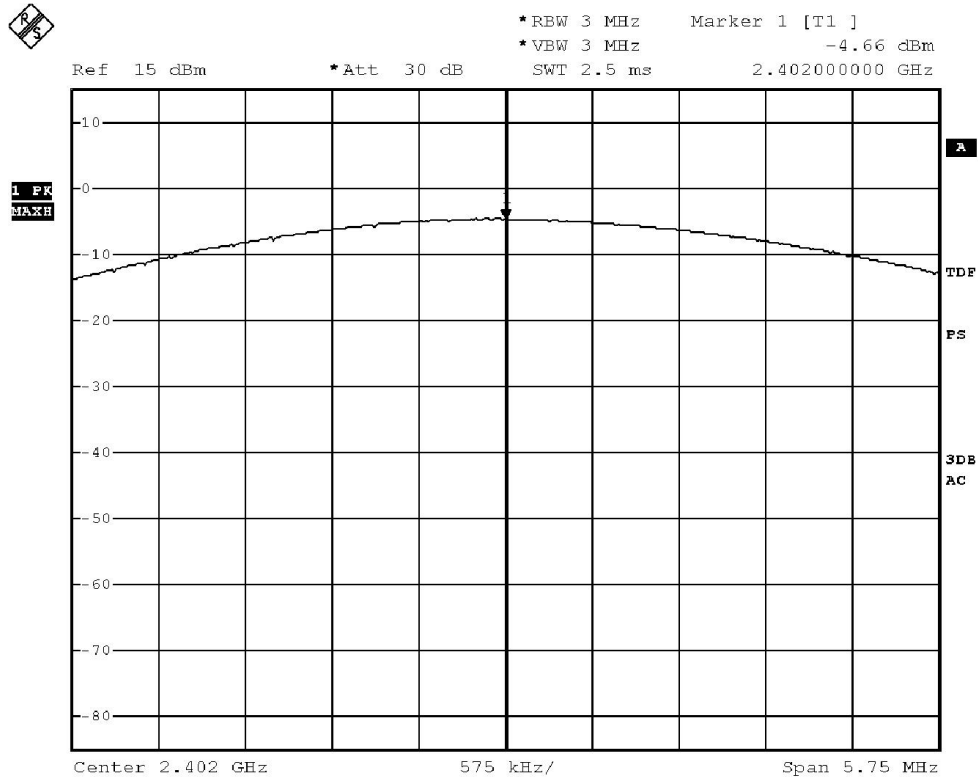
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Date : 2016-10-17

No. : MH193094

Page 12 of 93

Bluetooth Communication mode ($\pi/4$ DQPSK, 2402MHz)



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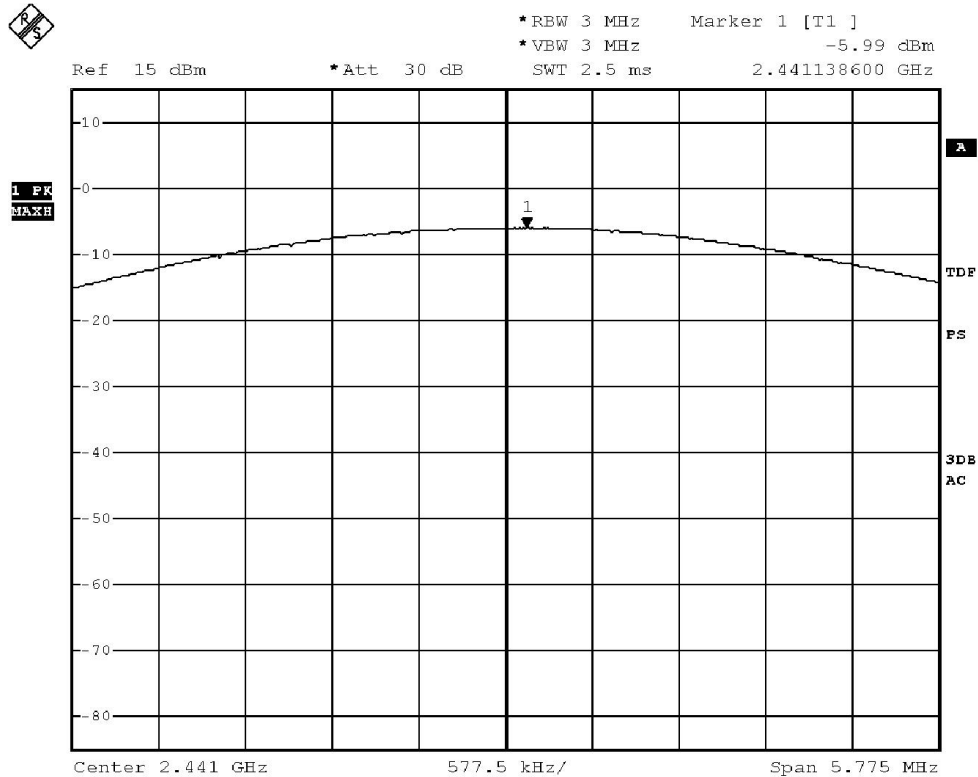
Test Report

Date : 2016-10-17

Page 13 of 93

No. : MH193094

Bluetooth Communication mode ($\pi/4$ DQPSK, 2441MHz)



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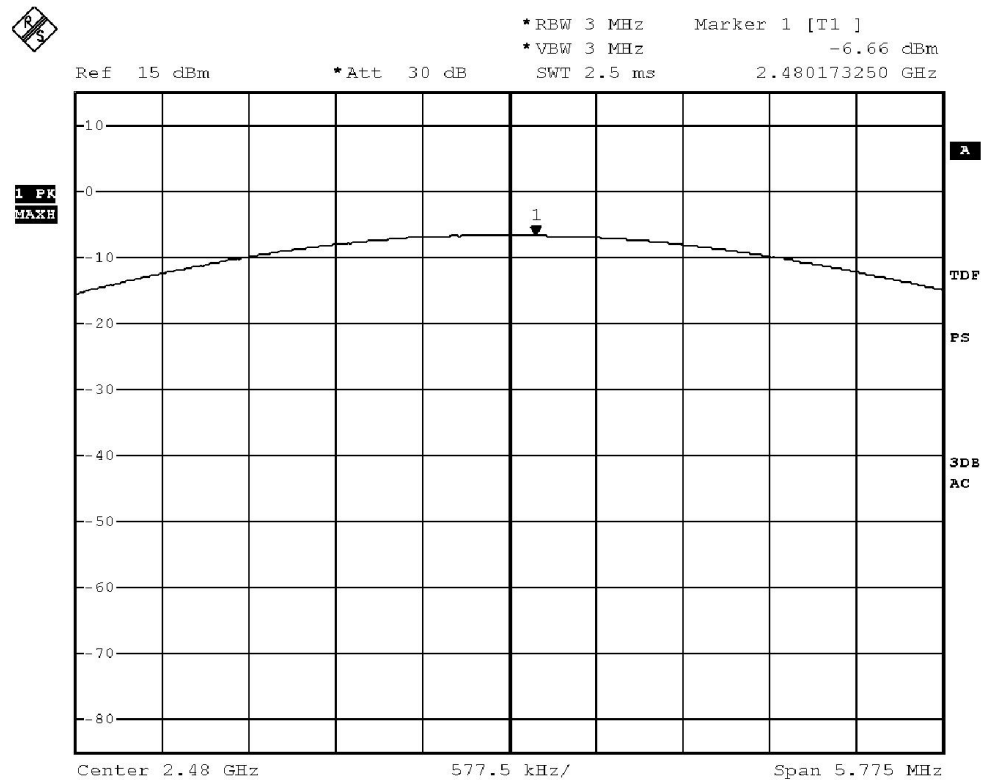
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Date : 2016-10-17

No. : MH193094

Page 14 of 93

Bluetooth Communication mode ($\pi/4$ DQPSK, 2480MHz)



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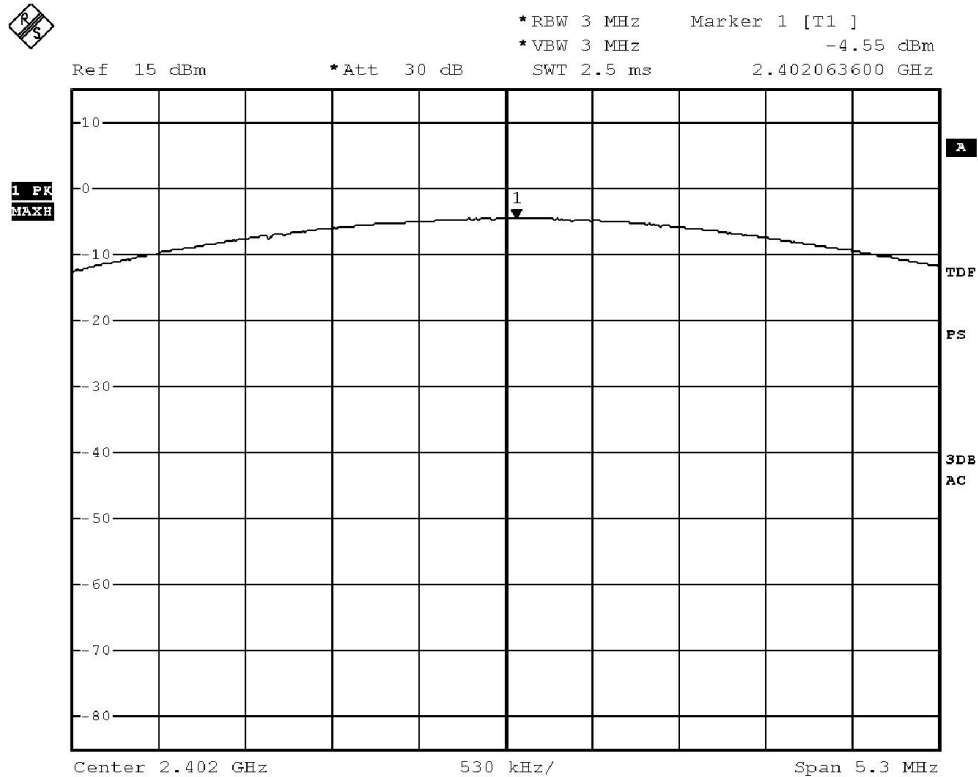
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Date : 2016-10-17

No. : MH193094

Page 15 of 93

Bluetooth Communication mode (8DPSK, 2402MHz)



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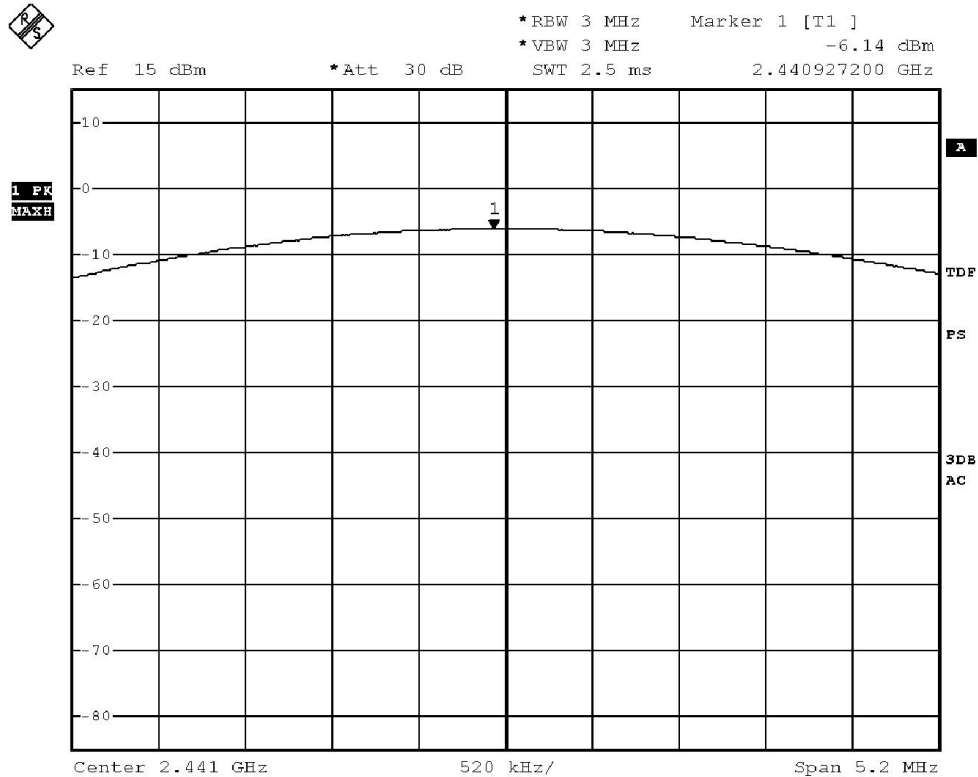
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Date : 2016-10-17

No. : MH193094

Page 16 of 93

Bluetooth Communication mode (8DPSK, 2441MHz)



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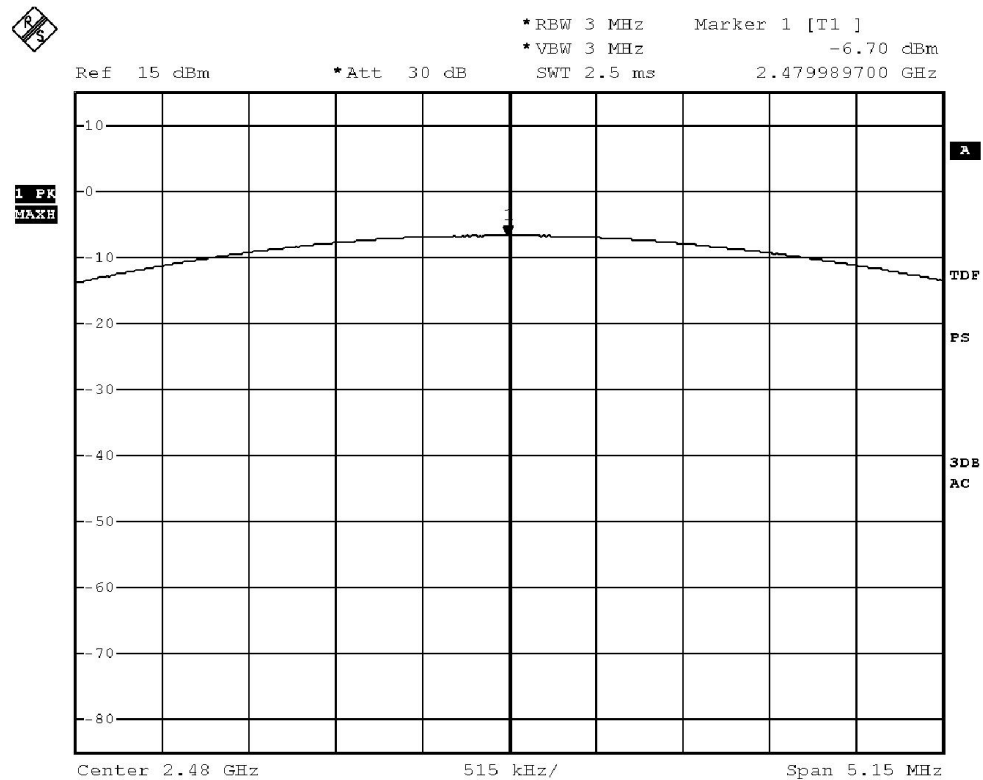
Test Report

Date : 2016-10-17

No. : MH193094

Page 17 of 93

Bluetooth Communication mode (8DPSK, 2480MHz)



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Test Report

Date : 2016-10-17

Page 18 of 93

No. : MH193094

3.1.2 Radiated Spurious Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2016-09-28
Mode of Operation:	Tx mode / Bluetooth Communication mode (GFSK)

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, rotated about all 3 axis (X, Y & Z) and 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 Registration Number: 607756.

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Test Report

Date : 2016-10-17

No. : MH193094

Page 19 of 93

Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)

RBW: 10kHz
VBW: 30kHz
Sweep: Auto
Span: Fully capture the emissions being measured
Trace: Max. hold

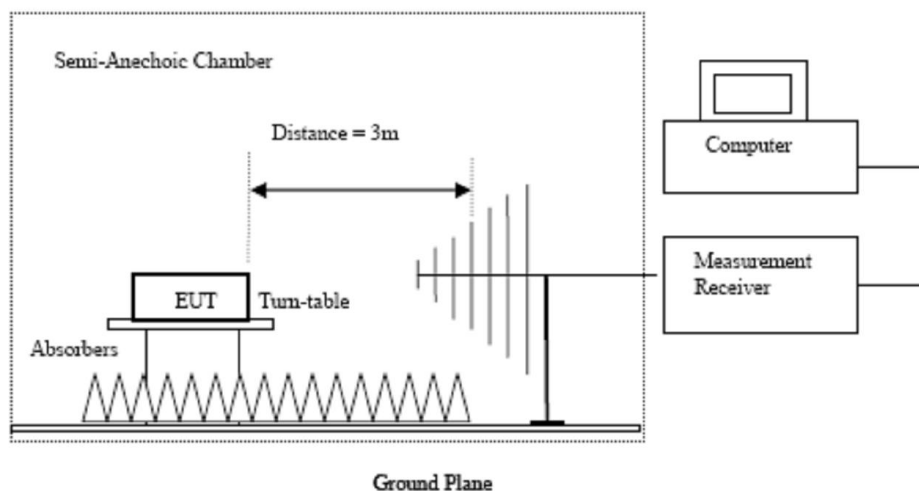
30MHz – 1GHz (QP)

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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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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Test Report

Date : 2016-10-17

Page 20 of 93

No. : MH193094

Limits for Radiated Emissions FCC 47 CFR 15.247 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
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 Tx mode (2402.0 MHz) (GFSK) (9kHz – 30MHz): Pass

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

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

Field Strength of Spurious Emissions Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dB μ V	dB/m	dB μ V/m	dB μ V/m	dB μ V/m	
4804.0	13.4	41.5	54.9	74.0	19.1	Vertical
4804.0	13.1	42.4	55.5	74.0	18.5	Horizontal
7206.0	11.2	45.1	56.3	74.0	17.7	Vertical
7206.0	9.4	46.2	55.6	74.0	18.4	Horizontal
9608.0	7.5	48.0	55.5	74.0	18.5	Vertical
9608.0	6.6	48.8	55.4	74.0	18.6	Horizontal
12010.0	4.1	51.5	55.6	74.0	18.4	Vertical
12010.0	3.6	52.4	56.0	74.0	18.0	Horizontal

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Test Report

Date : 2016-10-17

Page 21 of 93

No. : MH193094

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4804.0	-0.2	41.5	41.3	54.0	12.7	Vertical
4804.0	-2.0	42.4	40.4	54.0	13.6	Horizontal
7206.0	-4.6	45.1	40.5	54.0	13.5	Vertical
7206.0	-5.9	46.2	40.3	54.0	13.7	Horizontal
9608.0	-7.9	48.0	40.1	54.0	13.9	Vertical
9608.0	-7.5	48.8	41.3	54.0	12.7	Horizontal
12010.0	-11.3	51.5	40.2	54.0	13.8	Vertical
12010.0	-10.1	52.4	42.3	54.0	11.7	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4882.0	13.8	41.6	55.4	74.0	18.6	Vertical
4882.0	13.5	42.5	56.0	74.0	18.0	Horizontal
7323.0	10.1	45.2	55.3	74.0	18.7	Vertical
7323.0	9.2	46.3	55.5	74.0	18.5	Horizontal
9764.0	7.5	48.1	55.6	74.0	18.4	Vertical
9764.0	5.5	48.9	54.4	74.0	19.6	Horizontal
12205.0	3.7	51.6	55.3	74.0	18.7	Vertical
12205.0	3.4	52.5	55.9	74.0	18.1	Horizontal

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Test Report

Date : 2016-10-17

Page 22 of 93

No. : MH193094

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4882.0	-0.9	41.6	40.7	54.0	13.3	Vertical
4882.0	-1.0	42.5	41.5	54.0	12.5	Horizontal
7323.0	-4.7	45.2	40.5	54.0	13.5	Vertical
7323.0	-6.0	46.3	40.3	54.0	13.7	Horizontal
9764.0	-7.8	48.1	40.3	54.0	13.7	Vertical
9764.0	-8.1	48.9	40.8	54.0	13.2	Horizontal
12205.0	-11.1	51.6	40.5	54.0	13.5	Vertical
12205.0	-10.6	52.5	41.9	54.0	12.1	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4960.0	14.6	41.4	56.0	74.0	18.0	Vertical
4960.0	12.9	42.7	55.6	74.0	18.4	Horizontal
7440.0	9.7	45.6	55.3	74.0	18.7	Vertical
7440.0	8.8	46.5	55.3	74.0	18.7	Horizontal
9920.0	6.9	48.6	55.5	74.0	18.5	Vertical
9920.0	5.3	49.7	55.0	74.0	19.0	Horizontal
12400.0	4.4	51.7	56.1	74.0	17.9	Vertical
12400.0	2.6	52.7	55.3	74.0	18.7	Horizontal

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Test Report

Date : 2016-10-17

Page 23 of 93

No. : MH193094

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4960.0	-0.1	41.4	41.3	54.0	12.7	Vertical
4960.0	-1.3	42.7	41.4	54.0	12.6	Horizontal
7440.0	-5.0	45.6	40.6	54.0	13.4	Vertical
7440.0	-5.3	46.5	41.2	54.0	12.8	Horizontal
9920.0	-9.1	48.6	39.5	54.0	14.5	Vertical
9920.0	-9.2	49.7	40.5	54.0	13.5	Horizontal
12400.0	-10.2	51.7	41.5	54.0	12.5	Vertical
12400.0	-11.5	52.7	41.2	54.0	12.8	Horizontal

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4804.0	14.5	41.5	56.0	74.0	18.0	Vertical
4804.0	13.4	42.4	55.8	74.0	18.2	Horizontal
7206.0	9.7	45.1	54.8	74.0	19.2	Vertical
7206.0	8.2	46.2	54.4	74.0	19.6	Horizontal
9608.0	7.6	48.0	55.6	74.0	18.4	Vertical
9608.0	5.8	48.8	54.6	74.0	19.4	Horizontal
12010.0	3.9	51.5	55.4	74.0	18.6	Vertical
12010.0	3.5	52.4	55.9	74.0	18.1	Horizontal

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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

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

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Test Report

Date : 2016-10-17

Page 24 of 93

No. : MH193094

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4804.0	-0.2	41.5	41.3	54.0	12.7	Vertical
4804.0	-1.9	42.4	40.5	54.0	13.5	Horizontal
7206.0	-4.8	45.1	40.3	54.0	13.7	Vertical
7206.0	-5.5	46.2	40.7	54.0	13.3	Horizontal
9608.0	-7.5	48.0	40.5	54.0	13.5	Vertical
9608.0	-7.5	48.8	41.3	54.0	12.7	Horizontal
12010.0	-10.1	51.5	41.4	54.0	12.6	Vertical
12010.0	-10.8	52.4	41.6	54.0	12.4	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4882.0	13.6	41.6	55.2	74.0	18.8	Vertical
4882.0	13.0	42.5	55.5	74.0	18.5	Horizontal
7323.0	10.6	45.2	55.8	74.0	18.2	Vertical
7323.0	8.3	46.3	54.6	74.0	19.4	Horizontal
9764.0	6.6	48.1	54.7	74.0	19.3	Vertical
9764.0	6.3	48.9	55.2	74.0	18.8	Horizontal
12205.0	4.7	51.6	56.3	74.0	17.7	Vertical
12205.0	2.0	52.5	54.5	74.0	19.5	Horizontal

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Test Report

Date : 2016-10-17

Page 25 of 93

No. : MH193094

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4882.0	-0.1	41.6	41.5	54.0	12.5	Vertical
4882.0	-1.9	42.5	40.6	54.0	13.4	Horizontal
7323.0	-4.8	45.2	40.4	54.0	13.6	Vertical
7323.0	-5.5	46.3	40.8	54.0	13.2	Horizontal
9764.0	-6.6	48.1	41.5	54.0	12.5	Vertical
9764.0	-8.9	48.9	40.0	54.0	14.0	Horizontal
12205.0	-9.8	51.6	41.8	54.0	12.2	Vertical
12205.0	-10.8	52.5	41.7	54.0	12.3	Horizontal

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4960.0	13.2	41.4	54.6	74.0	19.4	Vertical
4960.0	12.8	42.7	55.5	74.0	18.5	Horizontal
7440.0	8.9	45.6	54.5	74.0	19.5	Vertical
7440.0	9.2	46.5	55.7	74.0	18.3	Horizontal
9920.0	6.8	48.6	55.4	74.0	18.6	Vertical
9920.0	5.6	49.7	55.3	74.0	18.7	Horizontal
12400.0	4.8	51.7	56.5	74.0	17.5	Vertical
12400.0	2.3	52.7	55.0	74.0	19.0	Horizontal

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Test Report

Date : 2016-10-17

Page 26 of 93

No. : MH193094

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4960.0	0.3	41.4	41.7	54.0	12.3	Vertical
4960.0	-1.4	42.7	41.3	54.0	12.7	Horizontal
7440.0	-4.0	45.6	41.6	54.0	12.4	Vertical
7440.0	-6.0	46.5	40.5	54.0	13.5	Horizontal
9920.0	-7.8	48.6	40.8	54.0	13.2	Vertical
9920.0	-8.7	49.7	41.0	54.0	13.0	Horizontal
12400.0	-10.2	51.7	41.5	54.0	12.5	Vertical
12400.0	-12.5	52.7	40.2	54.0	13.8	Horizontal

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4804.0	13.5	41.5	55.0	74.0	19.0	Vertical
4804.0	13.2	42.4	55.6	74.0	18.4	Horizontal
7206.0	9.0	45.1	54.1	74.0	19.9	Vertical
7206.0	9.5	46.2	55.7	74.0	18.3	Horizontal
9608.0	7.3	48.0	55.3	74.0	18.7	Vertical
9608.0	6.2	48.8	55.0	74.0	19.0	Horizontal
12010.0	4.2	51.8	56.0	74.0	18.0	Vertical
12010.0	3.1	52.4	55.5	74.0	18.5	Horizontal

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Test Report

Date : 2016-10-17

Page 27 of 93

No. : MH193094

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4804.0	0.0	41.5	41.5	54.0	12.5	Vertical
4804.0	-1.2	42.4	41.2	54.0	12.8	Horizontal
7206.0	-5.8	45.1	39.3	54.0	14.7	Vertical
7206.0	-5.6	46.2	40.6	54.0	13.4	Horizontal
9608.0	-7.4	48.0	40.6	54.0	13.4	Vertical
9608.0	-8.3	48.8	40.5	54.0	13.5	Horizontal
12010.0	-10.6	51.8	41.2	54.0	12.8	Vertical
12010.0	-11.0	52.4	41.4	54.0	12.6	Horizontal

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4882.0	13.8	41.6	55.4	74.0	18.6	Vertical
4882.0	12.5	42.5	55.0	74.0	19.0	Horizontal
7323.0	10.3	45.2	55.5	74.0	18.5	Vertical
7323.0	7.9	46.3	54.2	74.0	19.8	Horizontal
9764.0	6.5	48.1	54.6	74.0	19.4	Vertical
9764.0	5.1	48.9	54.0	74.0	20.0	Horizontal
12205.0	4.2	51.6	55.8	74.0	18.2	Vertical
12205.0	3.5	52.5	56.0	74.0	18.0	Horizontal

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Test Report

Date : 2016-10-17

Page 28 of 93

No. : MH193094

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4882.0	-1.4	41.6	40.2	54.0	13.8	Vertical
4882.0	-2.0	42.5	40.5	54.0	13.5	Horizontal
7323.0	-5.1	45.2	40.1	54.0	13.9	Vertical
7323.0	-5.9	46.3	40.4	54.0	13.6	Horizontal
9764.0	-8.5	48.1	39.6	54.0	14.4	Vertical
9764.0	-8.5	48.9	40.4	54.0	13.6	Horizontal
12205.0	-10.9	51.6	40.7	54.0	13.3	Vertical
12205.0	-10.0	52.5	42.5	54.0	11.5	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
4960.0	12.7	41.4	54.1	74.0	19.9	Vertical
4960.0	12.5	42.7	55.2	74.0	18.8	Horizontal
7440.0	9.0	45.6	54.6	74.0	19.4	Vertical
7440.0	7.5	46.5	54.0	74.0	20.0	Horizontal
9920.0	6.3	48.6	54.9	74.0	19.1	Vertical
9920.0	5	49.7	54.7	74.0	19.3	Horizontal
12400.0	4.8	51.7	56.5	74.0	17.5	Vertical
12400.0	3.3	52.7	56.0	74.0	18.0	Horizontal

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Test Report

Date : 2016-10-17

Page 29 of 93

No. : MH193094

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
4960.0	-0.4	41.4	41.0	54.0	13.0	Vertical
4960.0	-2.3	42.7	40.4	54.0	13.6	Horizontal
7440.0	-3.8	45.6	41.8	54.0	12.2	Vertical
7440.0	-7.3	46.5	39.2	54.0	14.8	Horizontal
9920.0	-7.5	48.6	41.1	54.0	12.9	Vertical
9920.0	-9.4	49.7	40.3	54.0	13.7	Horizontal
12400.0	-9.4	51.7	42.3	54.0	11.7	Vertical
12400.0	-11.3	52.7	41.4	54.0	12.6	Horizontal

Remarks:

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

* Denotes restricted band of operation.

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

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty (9kHz-30MHz): 2.0dB

(30MHz -1GHz): 4.9dB

(1GHz -6GHz): 4.02dB

(6GHz -26.5GHz): 4.03dB

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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Test Report

Date : 2016-10-17

Page 30 of 93

No. : MH193094

Radiated 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. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Result: Tx mode (Lowest frequency band-edge)-GFSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2390.0	18.1	36.8	54.9	74.0	19.1	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2390.0	3.3	36.8	40.1	54.0	13.9	Vertical

Result: Tx mode (Highest frequency band-edge) -GFSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2483.5	18.8	36.4	55.2	74.0	18.8	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2483.5	4.2	36.4	40.6	54.0	13.4	Horizontal

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Test Report

Date : 2016-10-17

Page 31 of 93

No. : MH193094

Radiated 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. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Result: Tx mode (Lowest frequency band-edge) - $\pi/4$ -DQPSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2390.0	17.4	36.8	54.2	74.0	19.8	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2390.0	3.2	36.8	40.0	54.0	14.0	Vertical

Result: Tx mode (Highest frequency band-edge) - $\pi/4$ -DQPSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2483.5	18.6	36.4	55.0	74.0	19.0	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB μ V/m	E-Field Polarity
2483.5	4.1	36.4	40.5	54.0	13.5	Horizontal

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Test Report

Date : 2016-10-17

Page 32 of 93

No. : MH193094

Radiated 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. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Result: Tx mode (Lowest frequency band-edge)- 8DPSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
2390.0	18.1	36.8	54.9	74.0	19.1	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
2390.0	3.5	36.8	40.3	54.0	13.7	Vertical

Result: Tx mode (Highest frequency band-edge) -8DPSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
2483.5	18.7	36.4	55.1	74.0	18.9	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dBμV/m	E-Field Polarity
2483.5	4.6	36.4	41.0	54.0	13.0	Horizontal

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Test Report

Date : 2016-10-17

Page 33 of 93

No. : MH193094

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

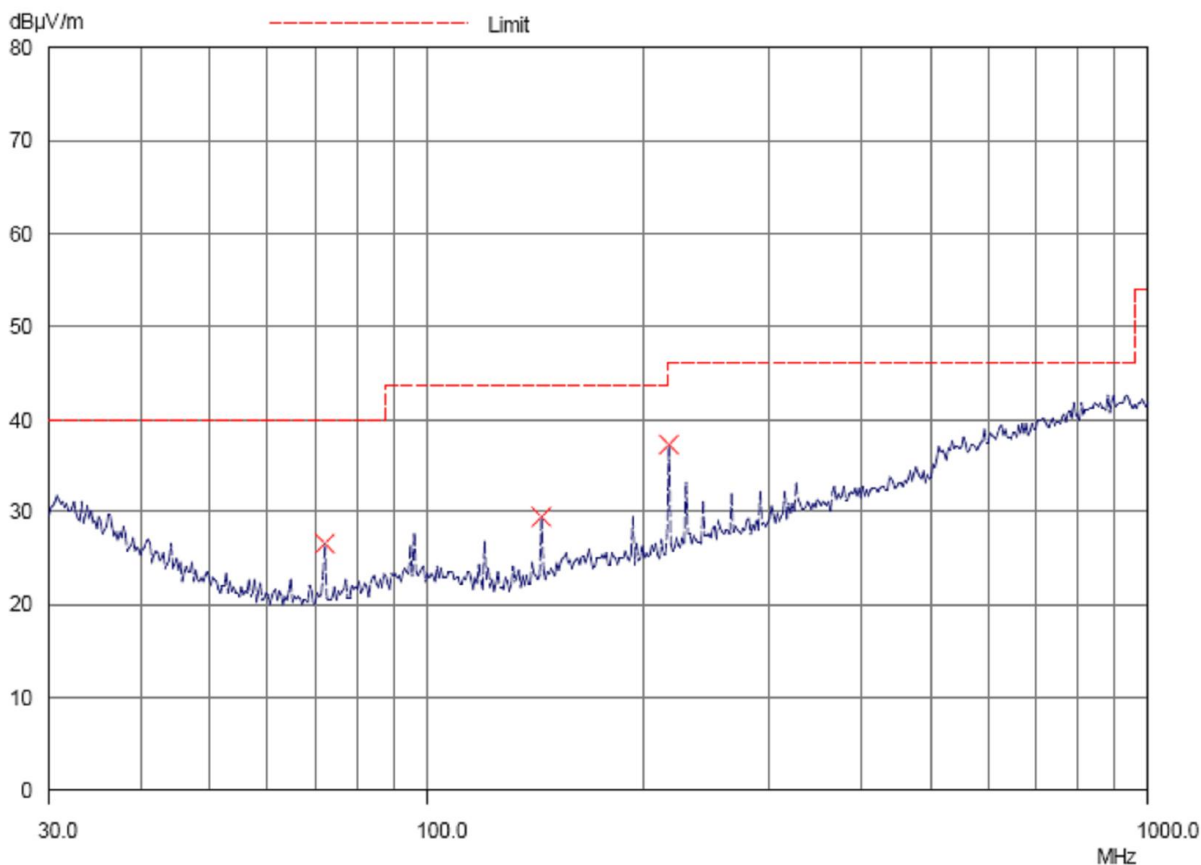
Frequency Range	Quasi-Peak Limits
[MHz]	[μ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above 960	500

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.

Results of Bluetooth Communication mode (GFSK 2402.0 MHz – worst case) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Horizontal



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Test Report

Date : 2016-10-17

Page 34 of 93

No. : MH193094

Result of Bluetooth Communication mode (GFSK 2402.0 MHz – worst case) (30MHz – 1GHz): Pass

Radiated Emissions Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dBμV/m	Limit @3m dBμV/m	Level @3m μV/m	Limit @3m μV/m
72.0	Horizontal	26.5	40.0	21.1	100
144.0	Horizontal	29.5	43.5	29.9	150
216.1	Horizontal	37.3	46.0	73.3	200

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Test Report

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Page 35 of 93

No. : MH193094

Limits for Radiated Emissions FCC 47 CFR 15.247 Class B1:

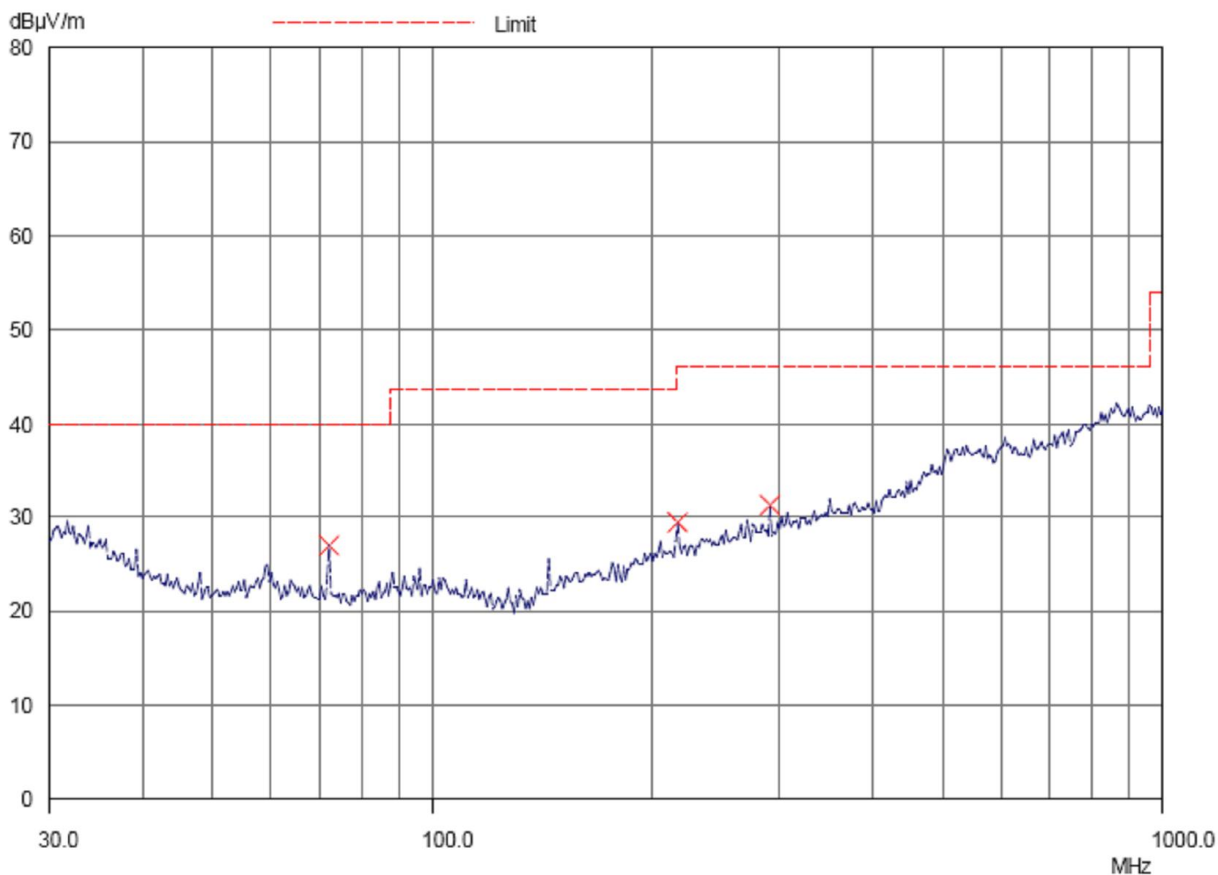
Frequency Range	Quasi-Peak Limits
[MHz]	[μ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above 960	500

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.

Results of Bluetooth Communication mode (GFSK 2402.0 MHz – worst case) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Vertical



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Test Report

Date : 2016-10-17

Page 36 of 93

No. : MH193094

Result of Bluetooth Communication mode (GFSK 2402.0 MHz – worst case) (30MHz – 1GHz): Pass

Radiated Emissions Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dBμV/m	Limit @3m dBμV/m	Level @3m μV/m	Limit @3m μV/m
72.0	Vertical	27.1	40.0	22.6	100
216.0	Vertical	29.4	46.0	29.5	200
288.1	Vertical	31.3	46.0	36.7	200

Remarks:

Calculated measurement uncertainty (30MHz – 1GHz): 4.9dB

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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Test Report

Date : 2016-10-17

No. : MH193094

Page 37 of 93

3.1.3 AC Mains Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.10:2013
Test Date:	2016-09-21
Mode of Operation:	Bluetooth communication mode
Test Voltage:	120V a.c. 60Hz

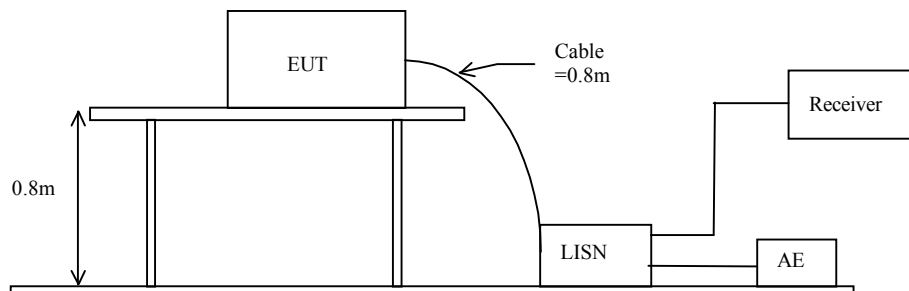
Test Method:

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.

Receiver Setting:

Bandw. = 9 kHz, Meas. Time= 10.0 ms, Step Width = 5.0kHz
Detector = MaxPeak and CISPR AV

Test Setup:



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Test Report

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Page 38 of 93

No. : MH193094

Limits for Conducted Emissions (FCC 47 CFR 15.207):

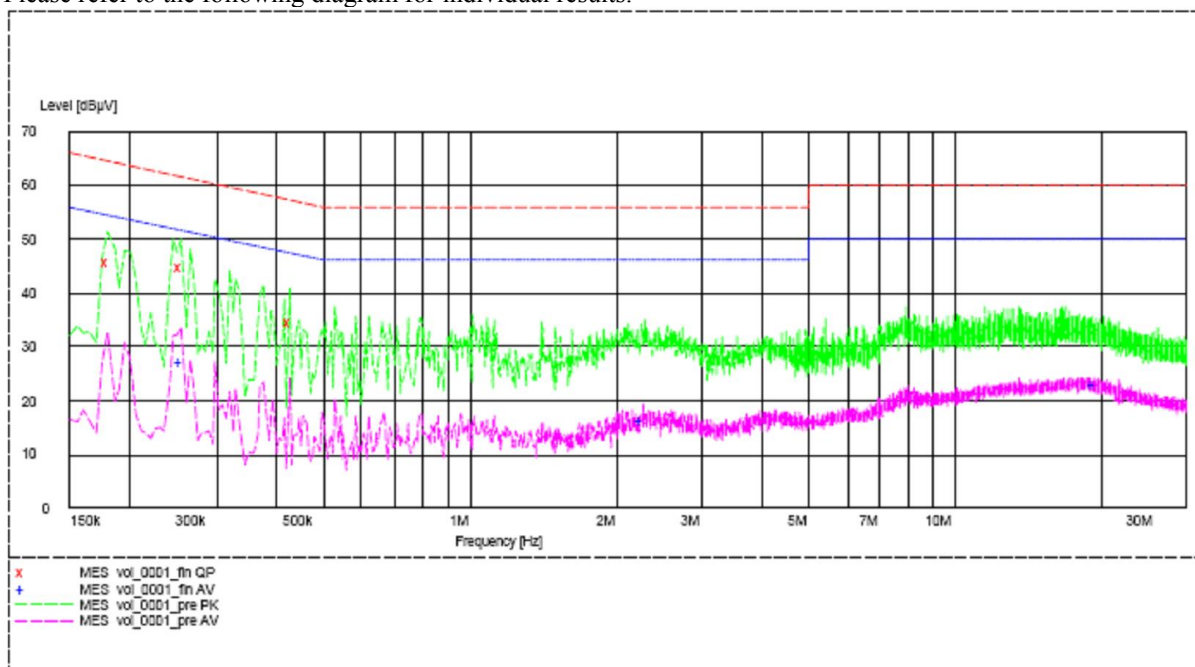
Frequency Range [MHz]	Quasi-Peak Limits [dB μ V]	Average [dB μ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

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

Results of Bluetooth communication mode (L): PASS

Please refer to the following diagram for individual results.



Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dB μ V	Limit dB μ V	Level dB μ V	Limit dB μ V
Live	0.180	45.9	65.0	-*-	-*-
Live	0.255	44.6	62.0	-*-	-*-
Live	0.425	34.6	57.0	-*-	-*-
Live	0.255	-*-	-*-	27.2	52.0
Live	2.270	-*-	-*-	16.5	46.0
Live	19.320	-*-	-*-	23.0	50.0

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Test Report

Date : 2016-10-17

Page 39 of 93

No. : MH193094

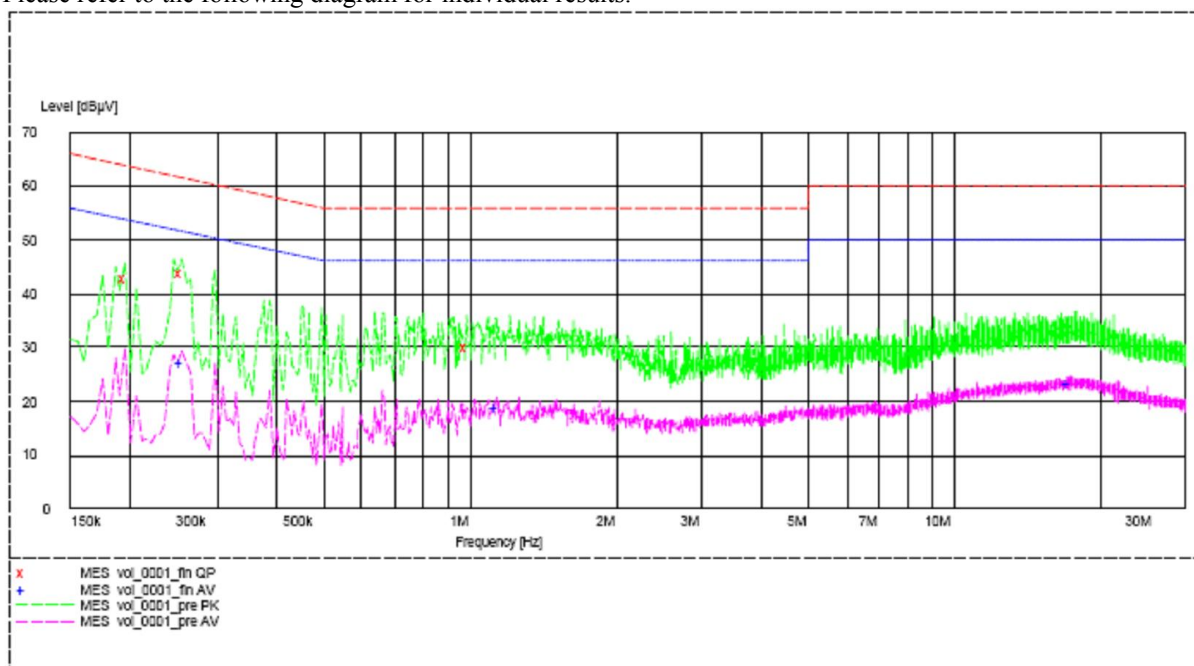
Frequency Range [MHz]	Quasi-Peak Limits [dB μ V]	Average [dB μ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* 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 Bluetooth communication mode (N): PASS

Please refer to the following diagram for individual results.



Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dB μ V	Limit dB μ V	Level dB μ V	Limit dB μ V
Neutral	0.195	42.9	64.0	-*-	-*-
Neutral	0.255	43.9	62.0	-*-	-*-
Neutral	0.985	30.0	56.0	-*-	-*-
Neutral	0.255	-*-	-*-	27.2	52.0
Neutral	1.135	-*-	-*-	18.8	46.0
Neutral	17.330	-*-	-*-	23.5	50.0

Remarks:

Calculated measurement uncertainty (0.15MHz – 30MHz): 3.25dB

-*- Emission(s) that is far below the corresponding limit line.

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Test Report

Date : 2016-10-17

No. : MH193094

Page 40 of 93

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:

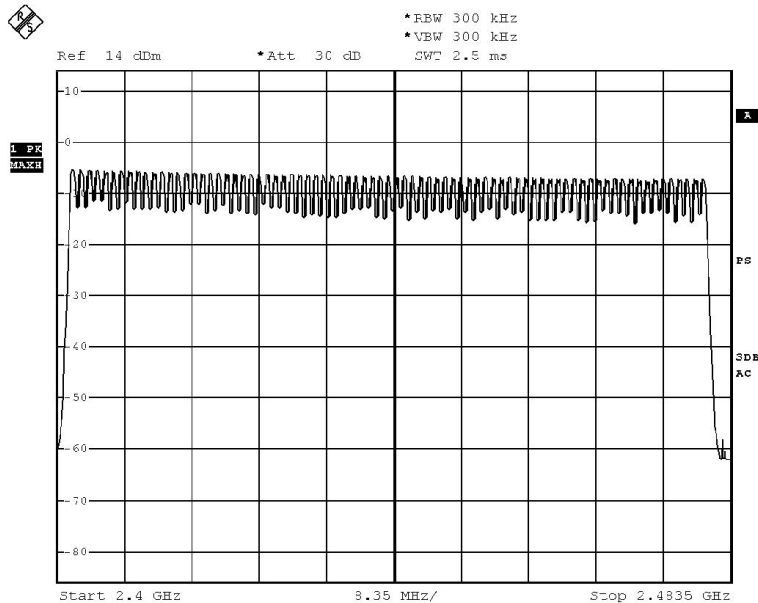
RBW = 300kHz, VBW \geq RBW, Sweep = Auto, Span = the frequency band of operation
Detector = Peak, Trace = Max. hold

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Measurement Data:

GFSK: 79 of 79 Channel



RMP

Date: 26.SEP.2016 15:43:33

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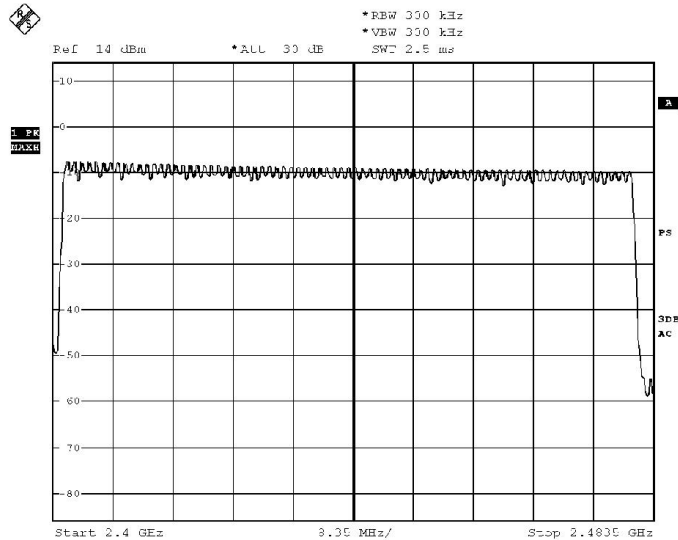
Test Report

Date : 2016-10-17

No. : MH193094

Page 41 of 93

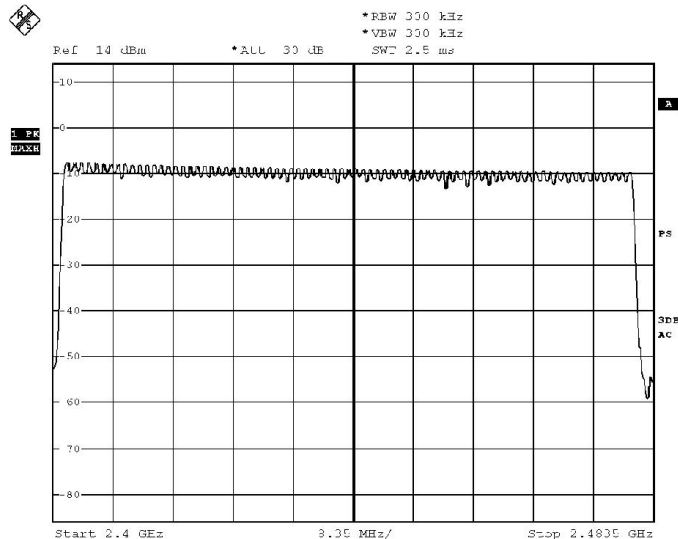
$\pi/4$ -DQPSK: 79 of 79 Channel



EMP

Date: 26.SEP.2016 15:48:55

8DPSK: 79 of 79 Channel



EMP

Date: 26.SEP.2016 15:58:50

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Test Report

Date : 2016-10-17

No. : MH193094

Page 42 of 93

3.1.5 20dB Bandwidth

Test Requirement:	FCC 47CFR 15.247(a)(1)
Test Method:	ANSI C63.10:2013
Test Date:	2016-09-26
Mode of Operation:	Tx mode

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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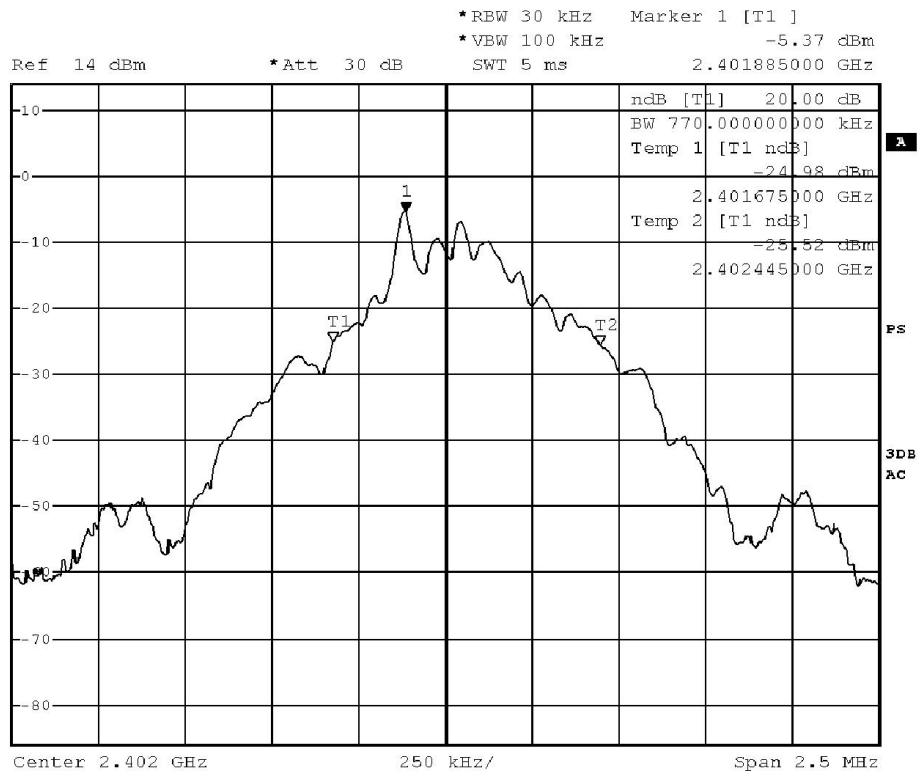
Date : 2016-10-17

Page 43 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2402	770.0	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)



BMP

Date: 26.SEP.2016 15:59:55

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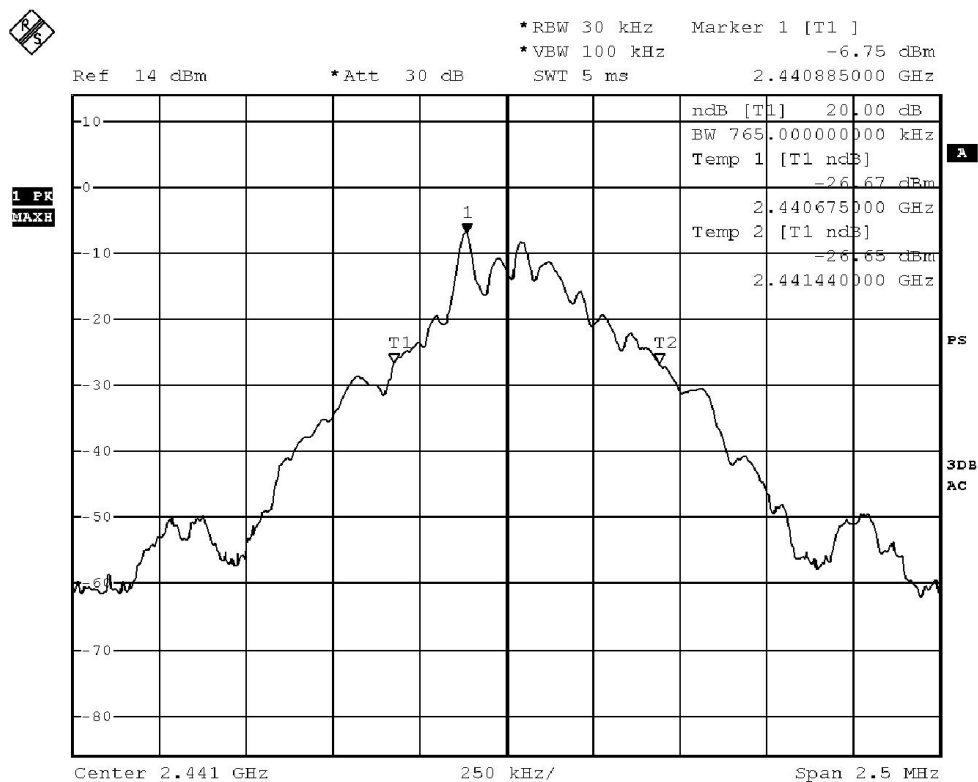
Date : 2016-10-17

Page 44 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2441	765.0	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



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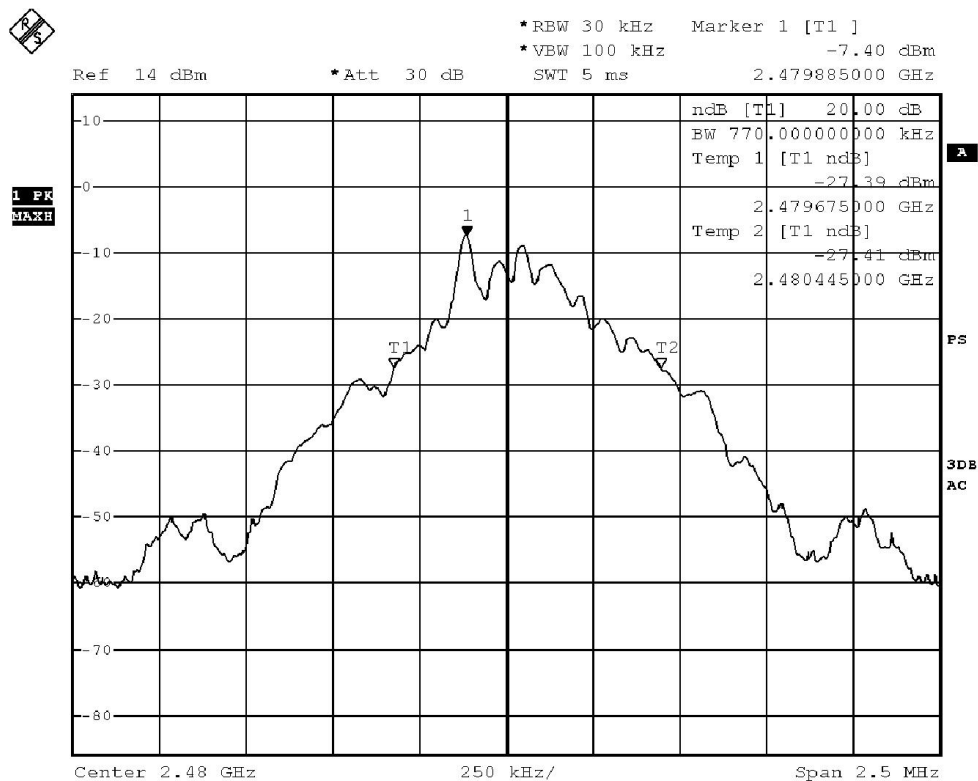
Date : 2016-10-17

Page 45 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2480	770.0	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)



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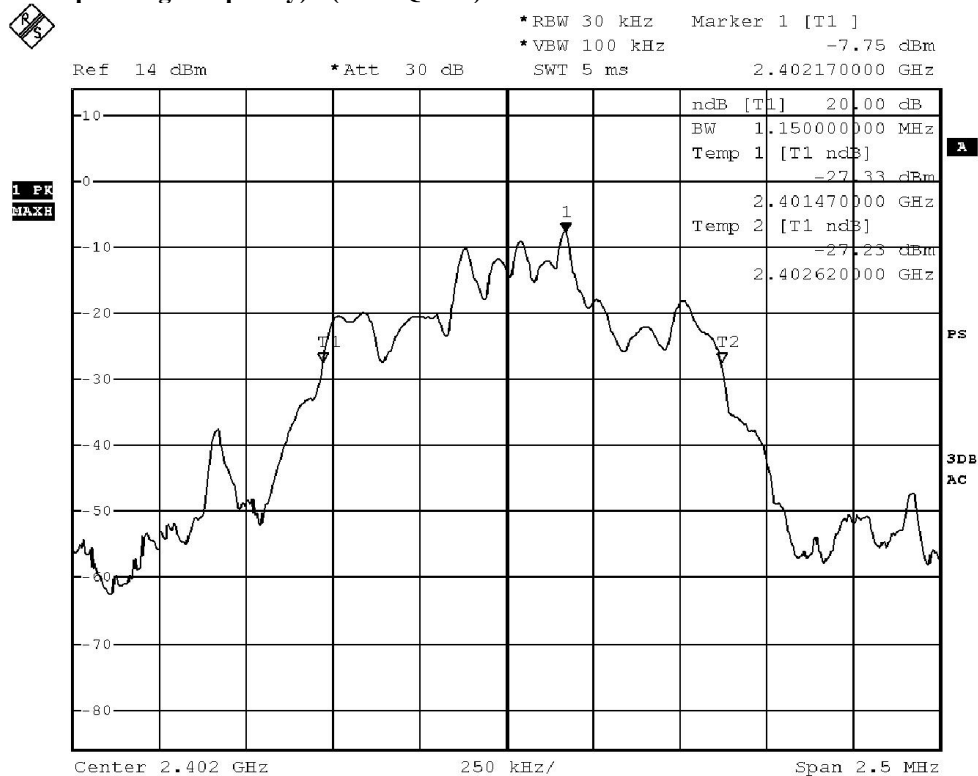
Date : 2016-10-17

Page 46 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.150	Within 2400-2483.5

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



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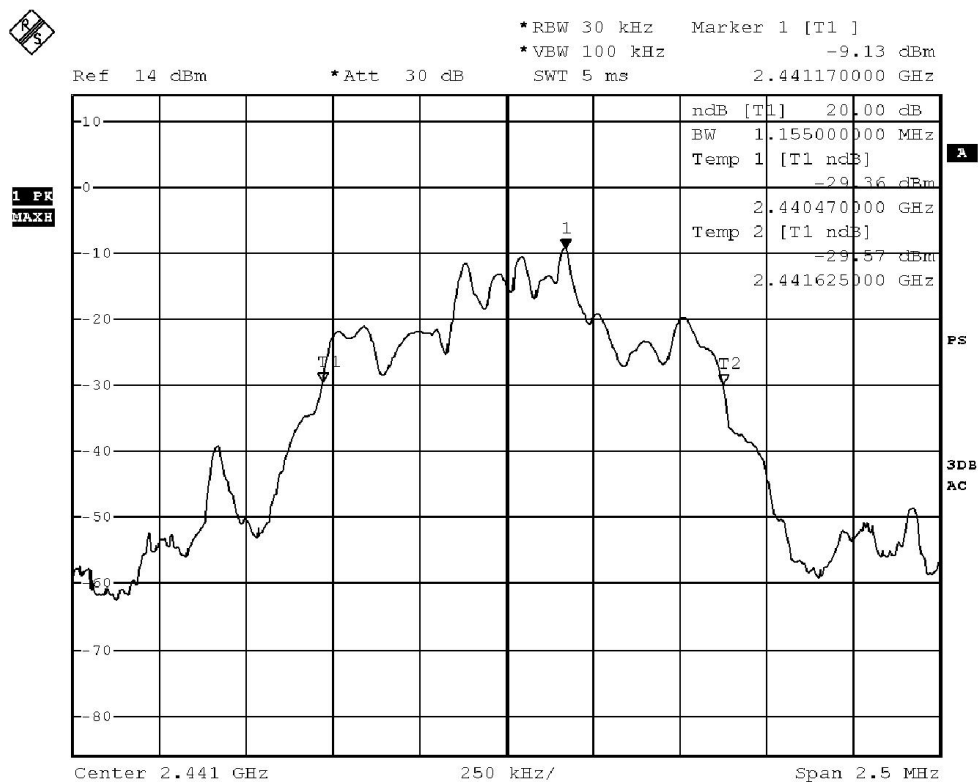
Date : 2016-10-17

Page 47 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.155	Within 2400-2483.5

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



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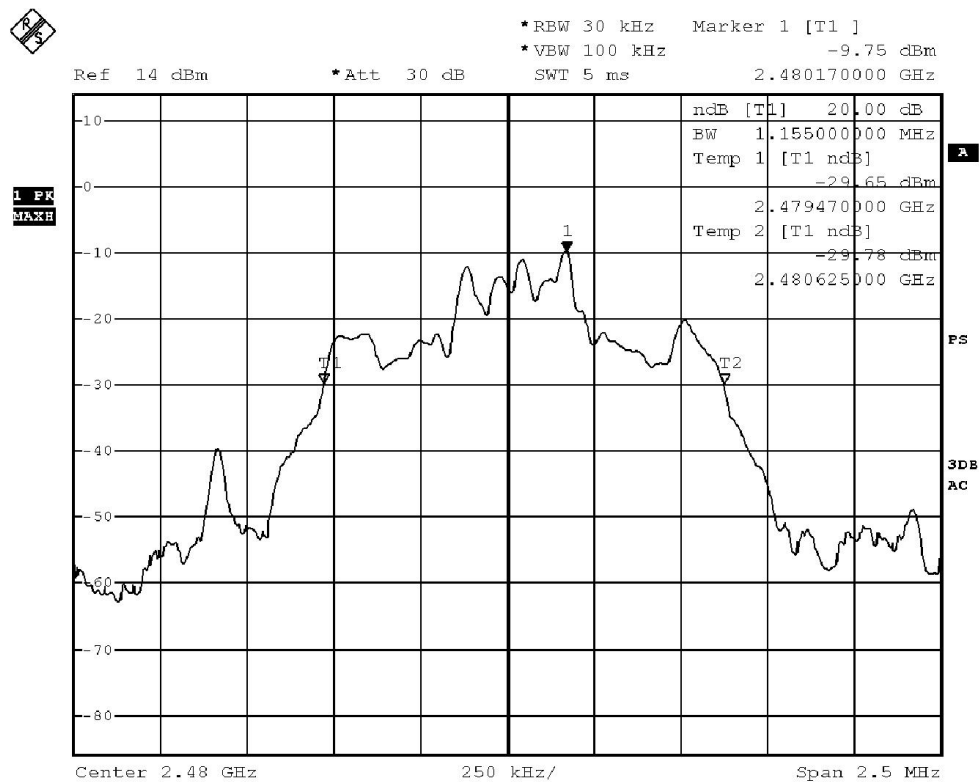
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Page 48 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.155	Within 2400-2483.5

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



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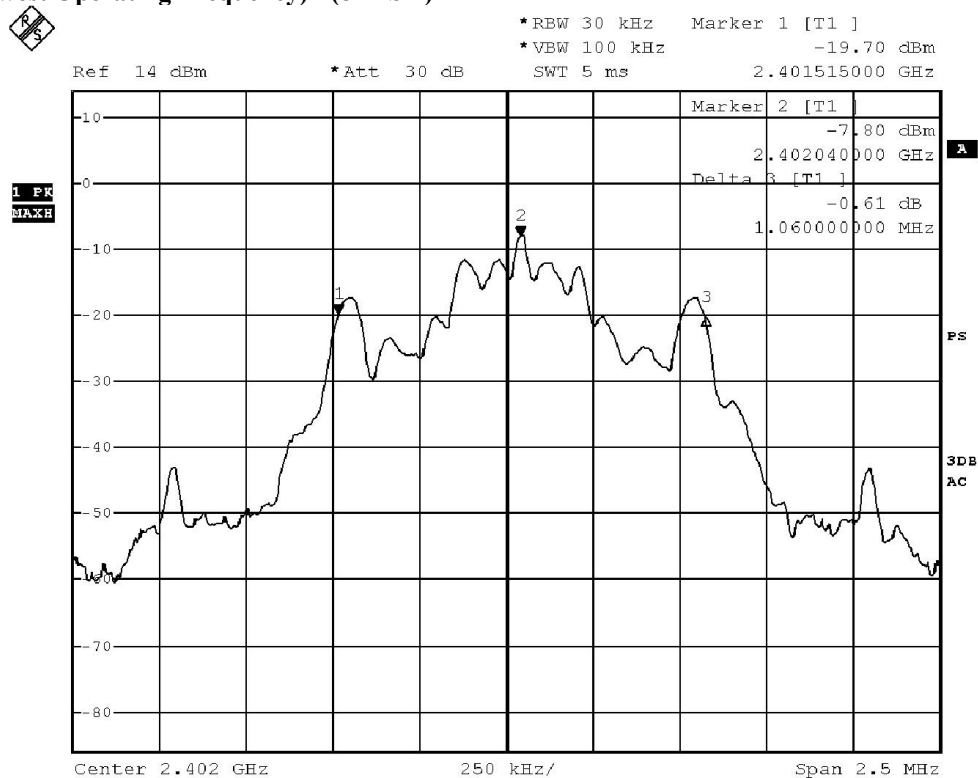
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Page 49 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.06	Within 2400-2483.5

(Lowest Operating Frequency) - (8DPSK)



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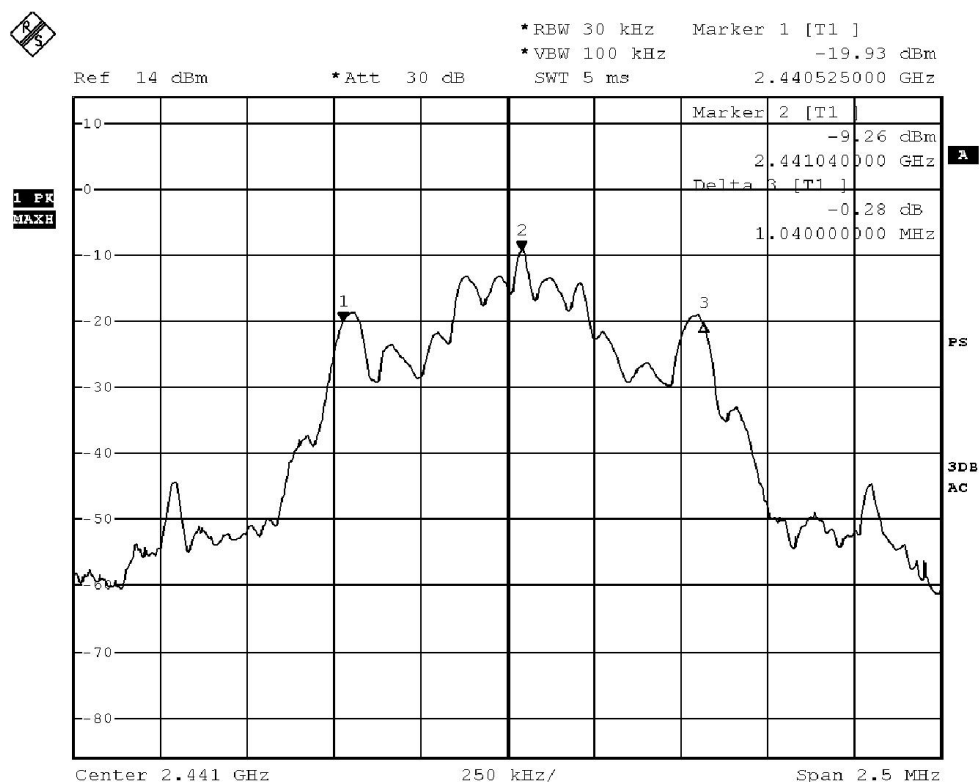
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Page 50 of 93

No. : MH193094

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.04	Within 2400-2483.5

(Middle Operating Frequency) - (8DPSK)



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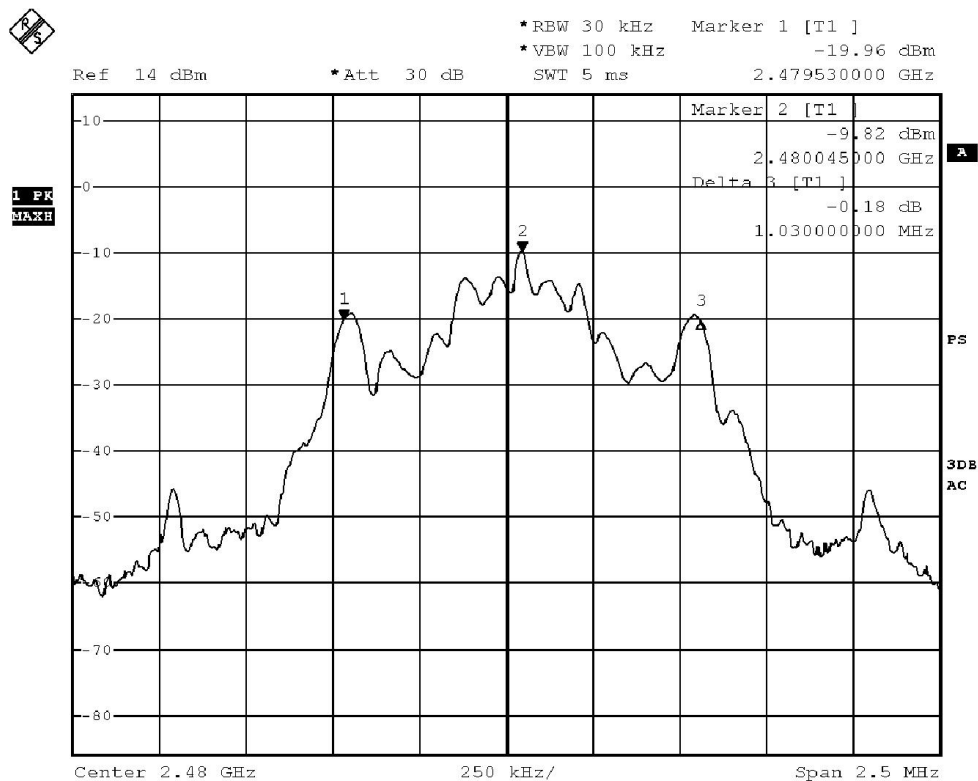
Date : 2016-10-17

No. : MH193094

Page 51 of 93

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.03	Within 2400-2483.5

(Highest Operating Frequency) - (8DPSK)



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Test Report

Date : 2016-10-17

No. : MH193094

Page 52 of 93

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:

The measured maximum bandwidth $\times 2/3 = 1.155\text{MHz} \times 2/3 = 770\text{kHz}$

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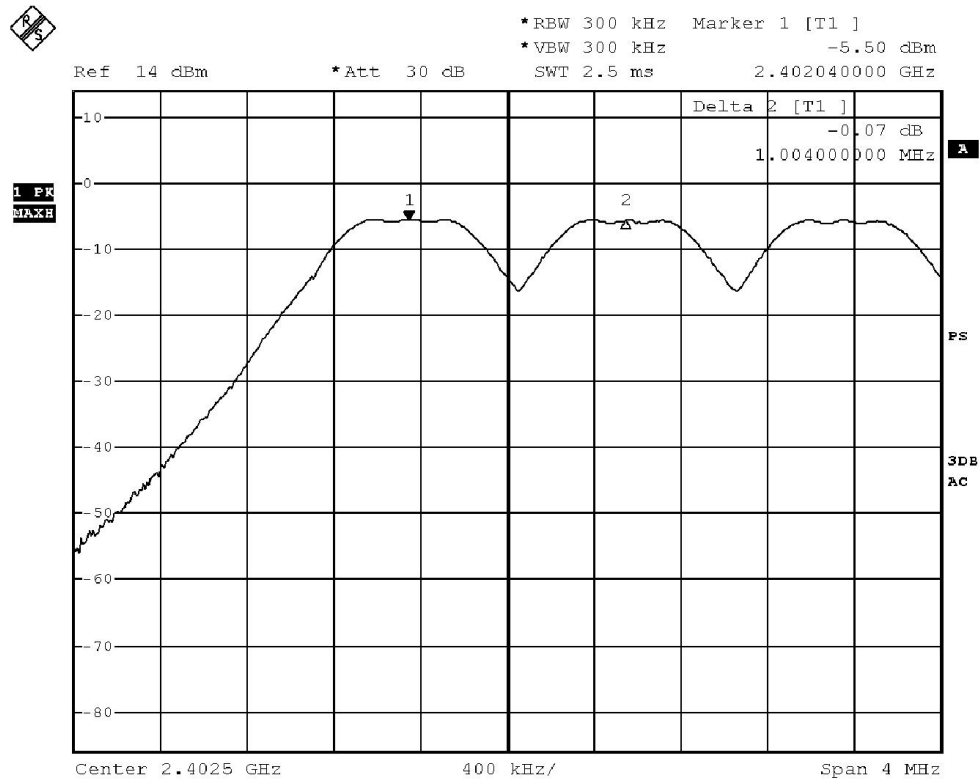
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Date : 2016-10-17

No. : MH193094

Page 53 of 93

Channel separation = 1MHz (>770kHz) (Lowest) (GFSK)



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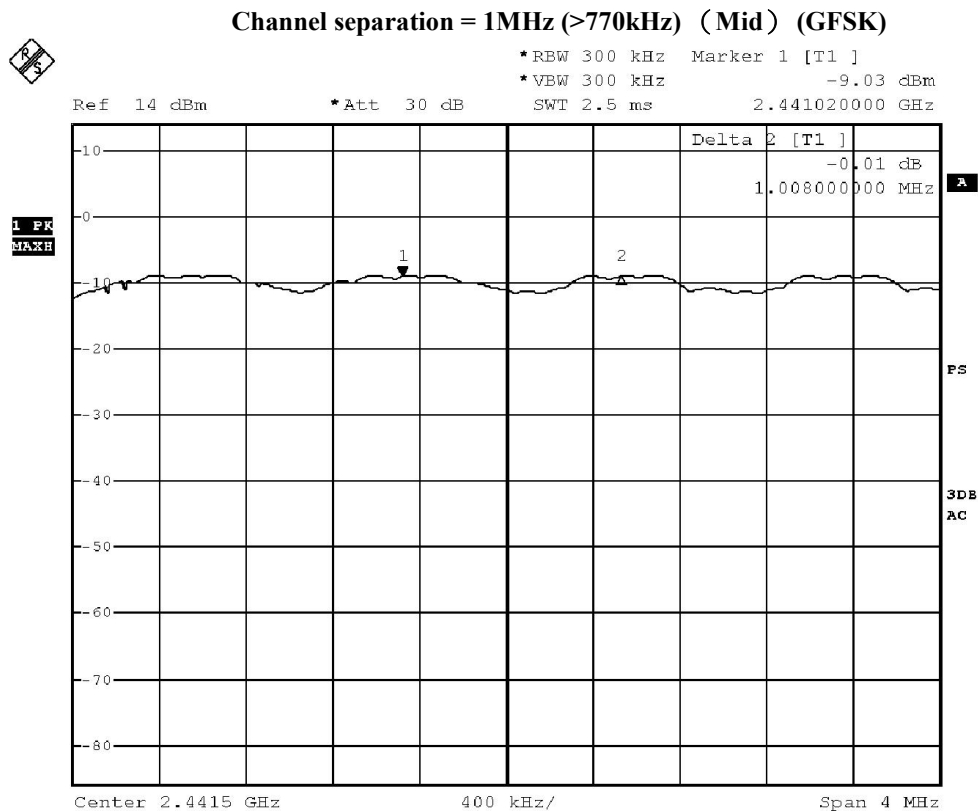


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No. : MH193094

Page 54 of 93



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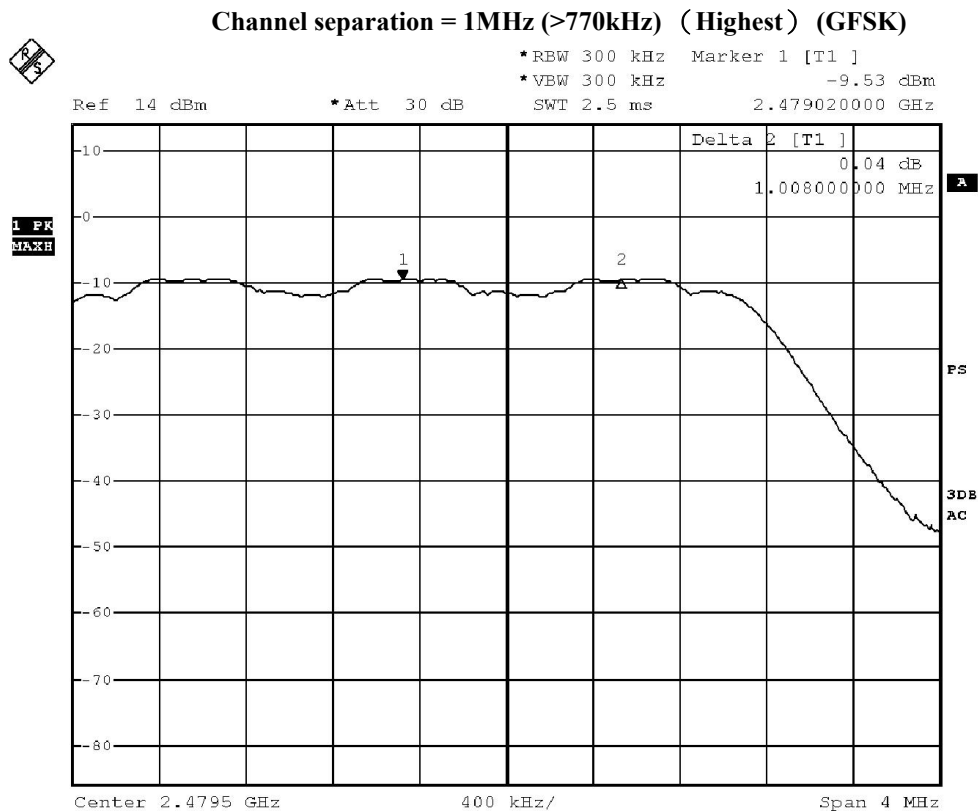


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No. : MH193094

Page 55 of 93



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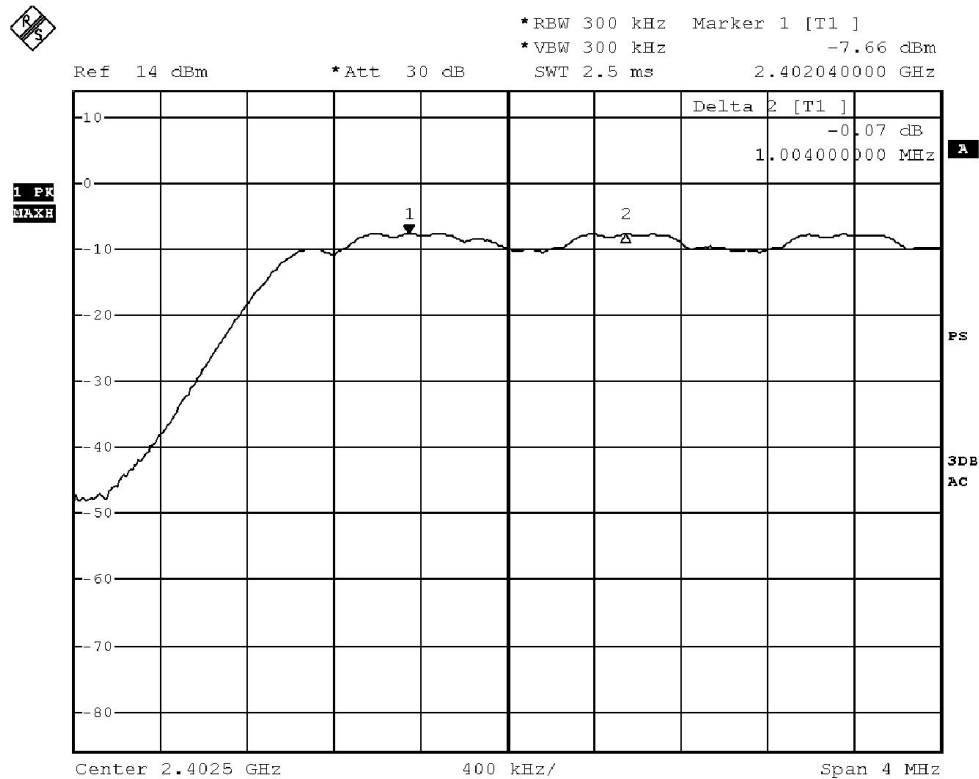
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No. : MH193094

Page 56 of 93

Channel separation = 1MHz (>770kHz) (Lowest) ($\pi/4$ DQPSK)



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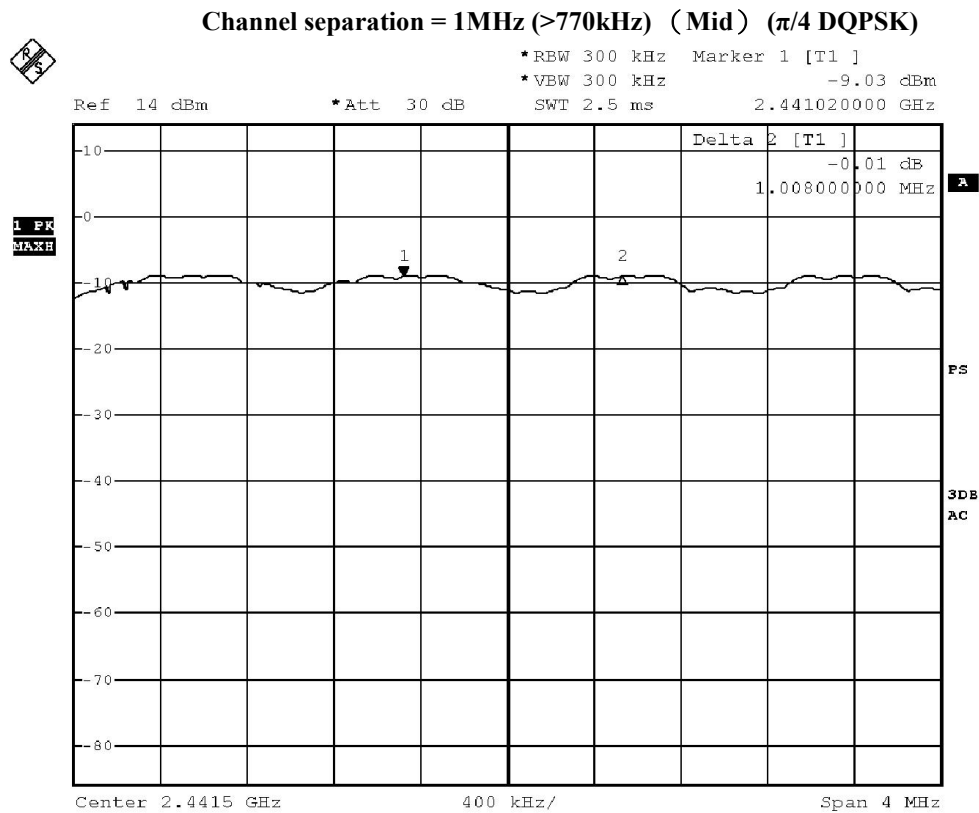


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No. : MH193094

Page 57 of 93



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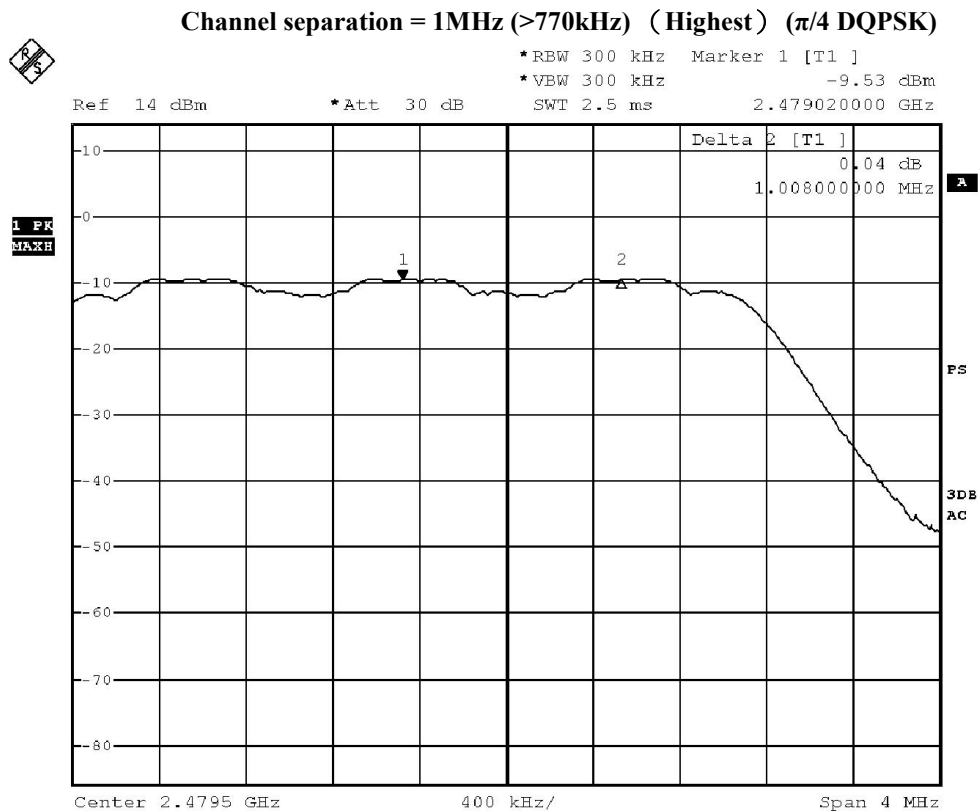


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No. : MH193094

Page 58 of 93



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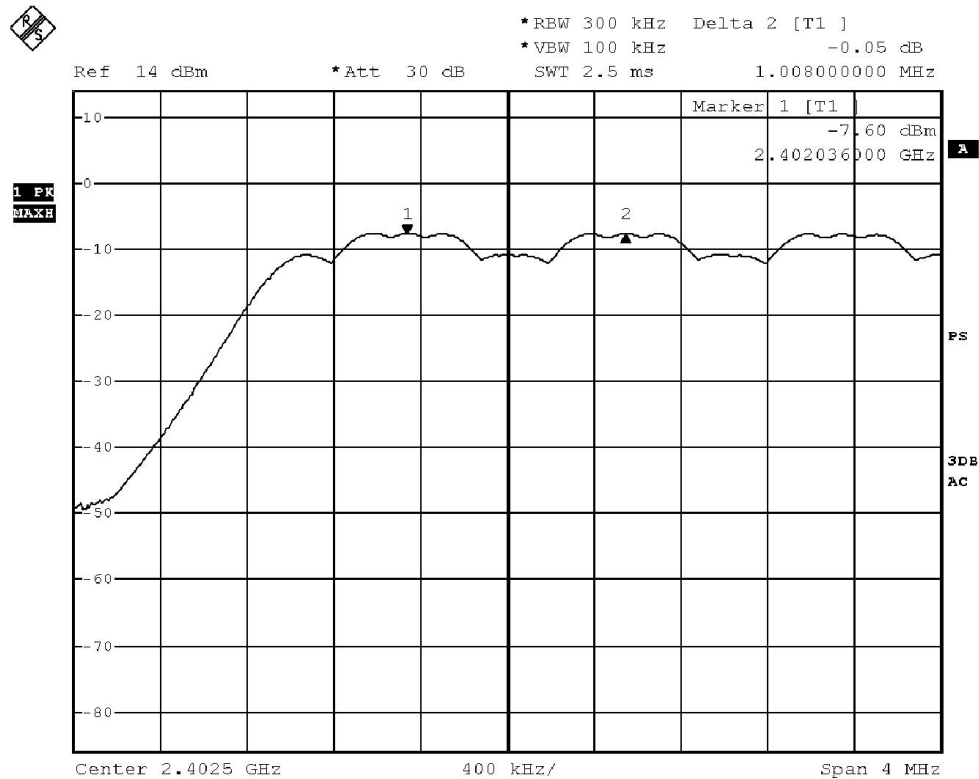
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Date : 2016-10-17

No. : MH193094

Page 59 of 93

Channel separation = 1MHz (>770kHz) (Lowest) (8DPSK)



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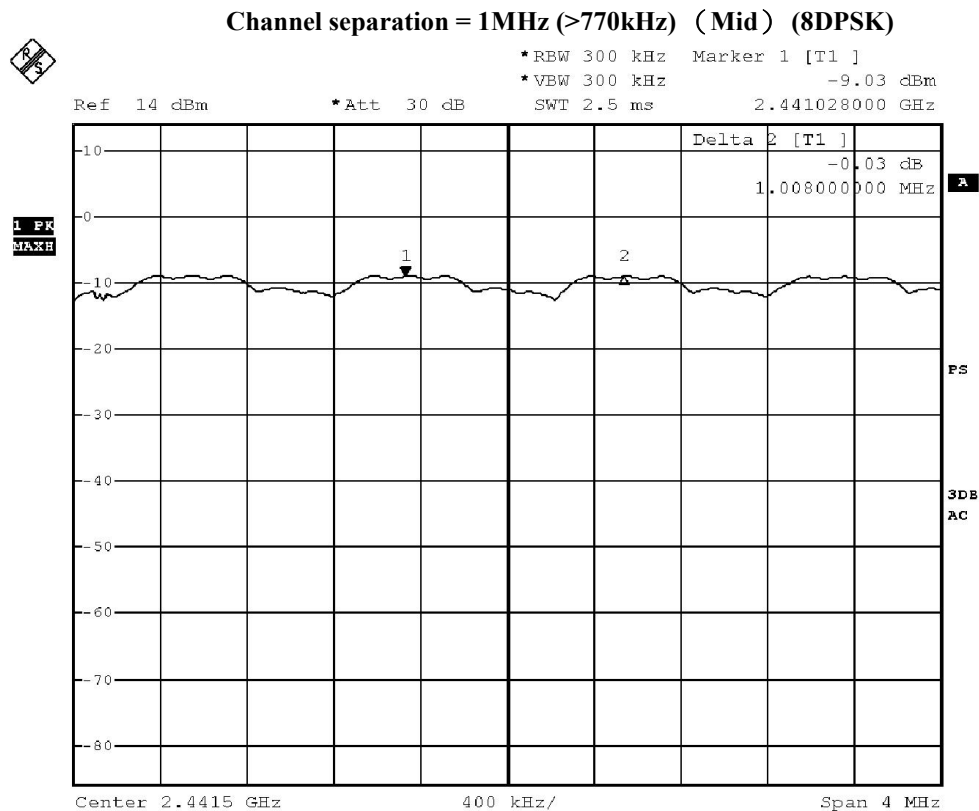


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No. : MH193094

Page 60 of 93



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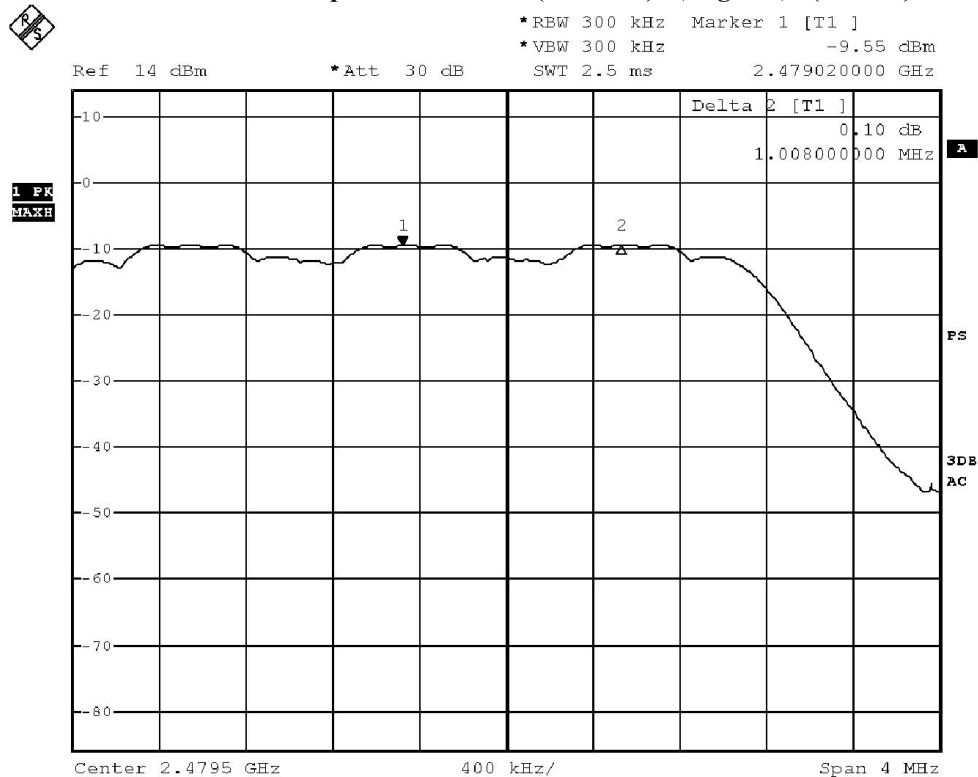
Test Report

Date : 2016-10-17

No. : MH193094

Page 61 of 93

Channel separation = 1MHz (>770kHz) (Highest) (8DPSK)



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No. : MH193094

Page 62 of 93

3.1.7 Band-edge Compliance of RF Conducted 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.

According to the test method DA 00-705.

Spectrum Analyzer Setting:

RBW = 100kHz, VBW= 300kHz, Sweep = Coupled,

Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

Detector = Peak, Trace = Max. hold

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

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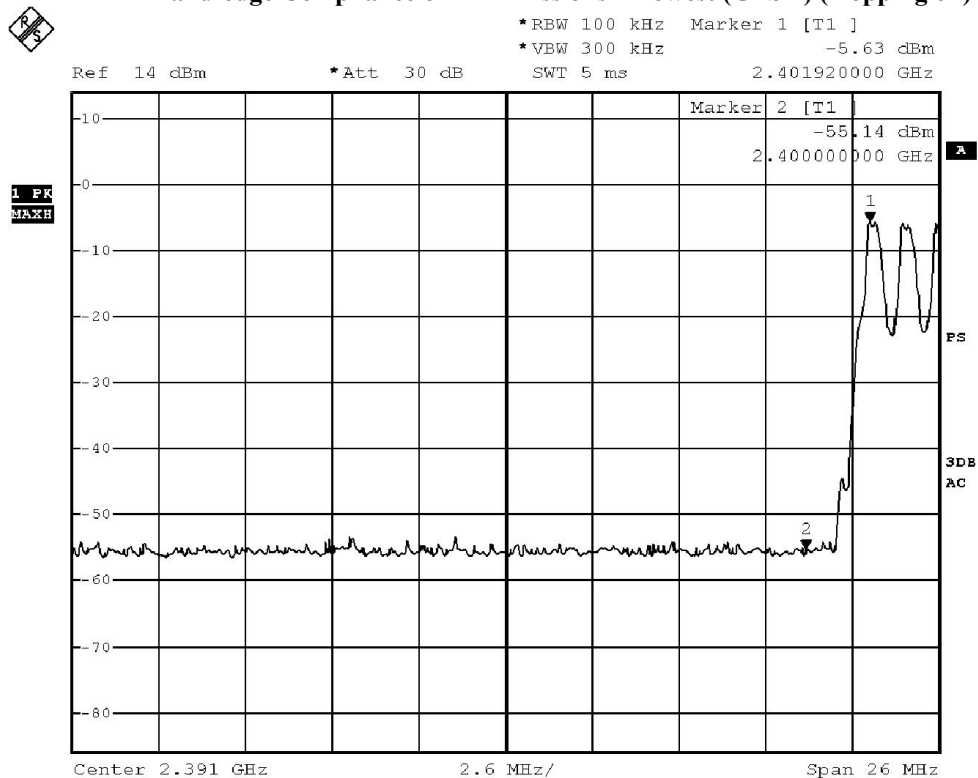
No. : MH193094

Page 63 of 93

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	49.51

Band-edge Compliance of RF Emissions – Lowest (GFSK) (Hopping on)



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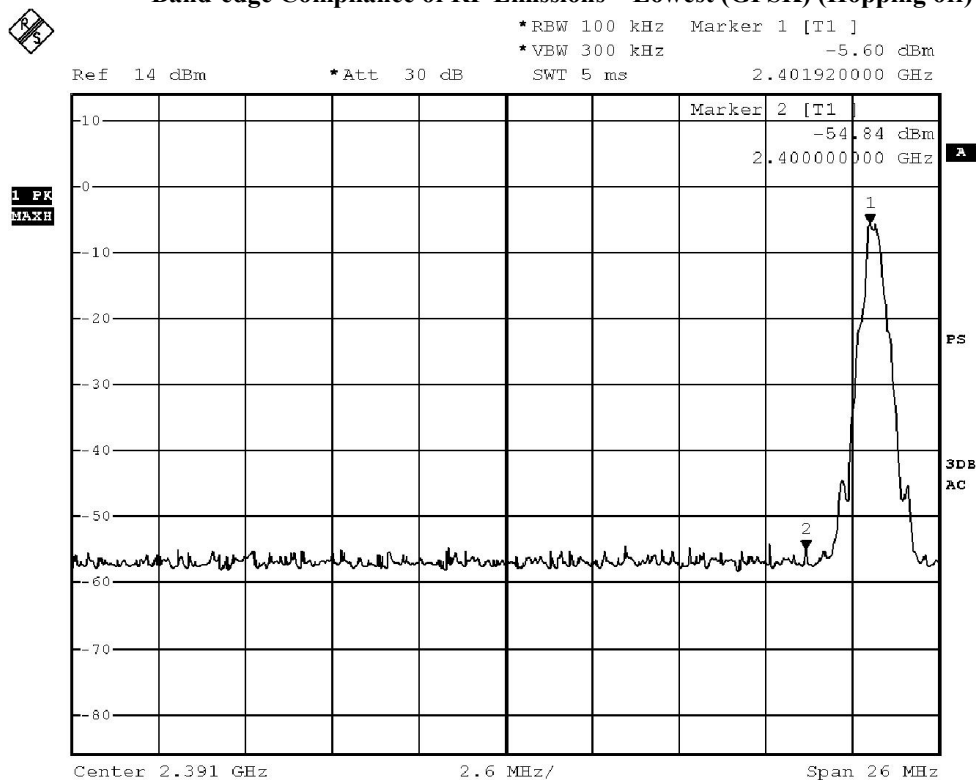
No. : MH193094

Page 64 of 93

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	49.24

Band-edge Compliance of RF Emissions – Lowest (GFSK) (Hopping off)



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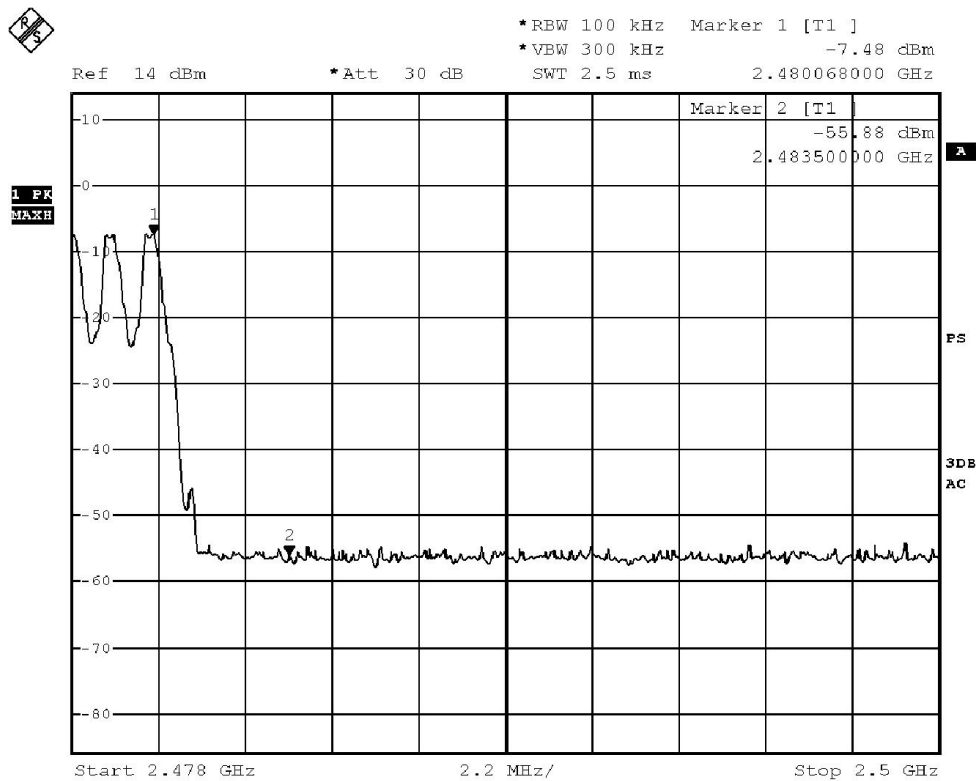
Page 65 of 93

No. : MH193094

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	48.40

Band-edge Compliance of RF Emissions – Highest (GFSK) (Hopping on)



BMP

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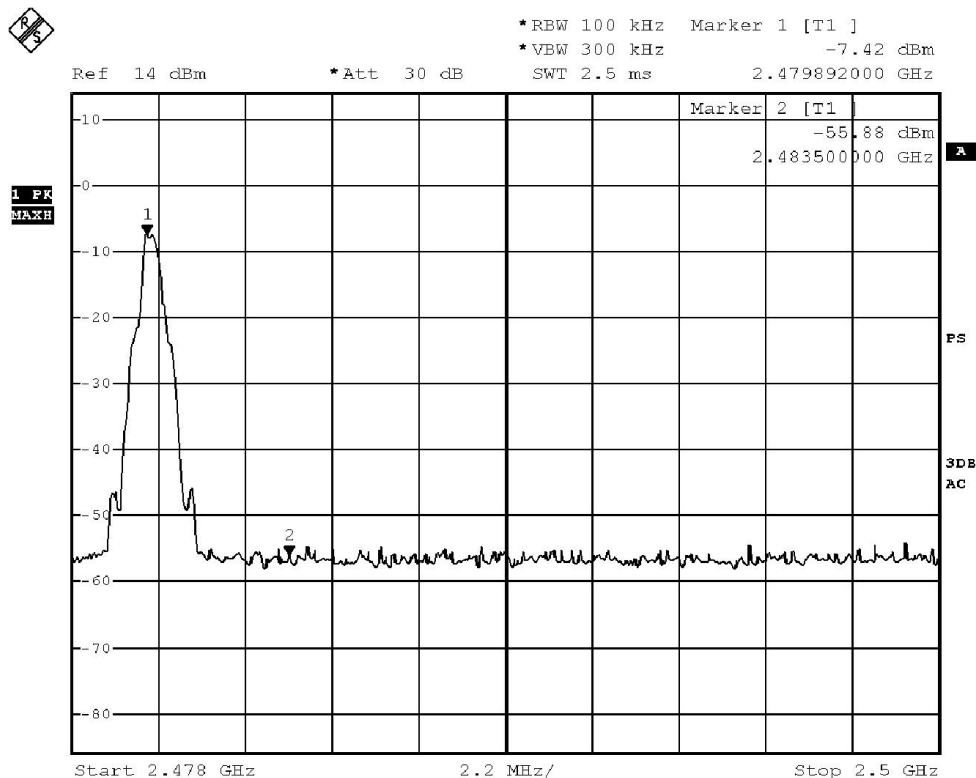
Page 66 of 93

No. : MH193094

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	48.46

Band-edge Compliance of RF Emissions – Highest (GFSK) (Hopping off)



BMP

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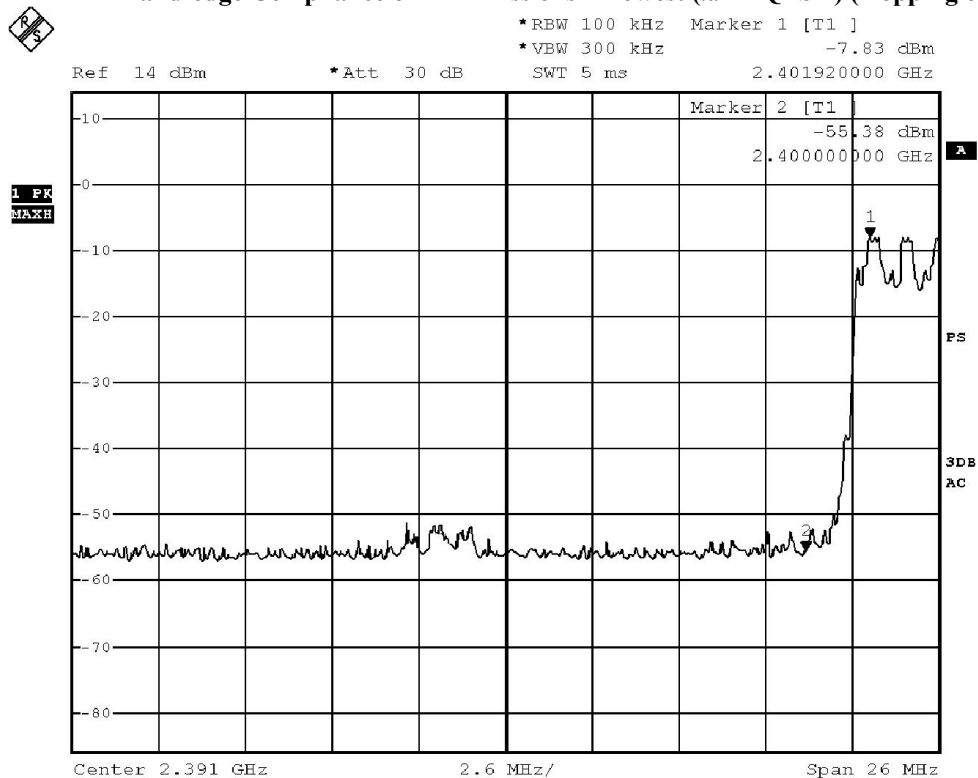
No. : MH193094

Page 67 of 93

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	47.55

Band-edge Compliance of RF Emissions – Lowest ($\pi/4$ DQPSK) (Hopping on)



BMP

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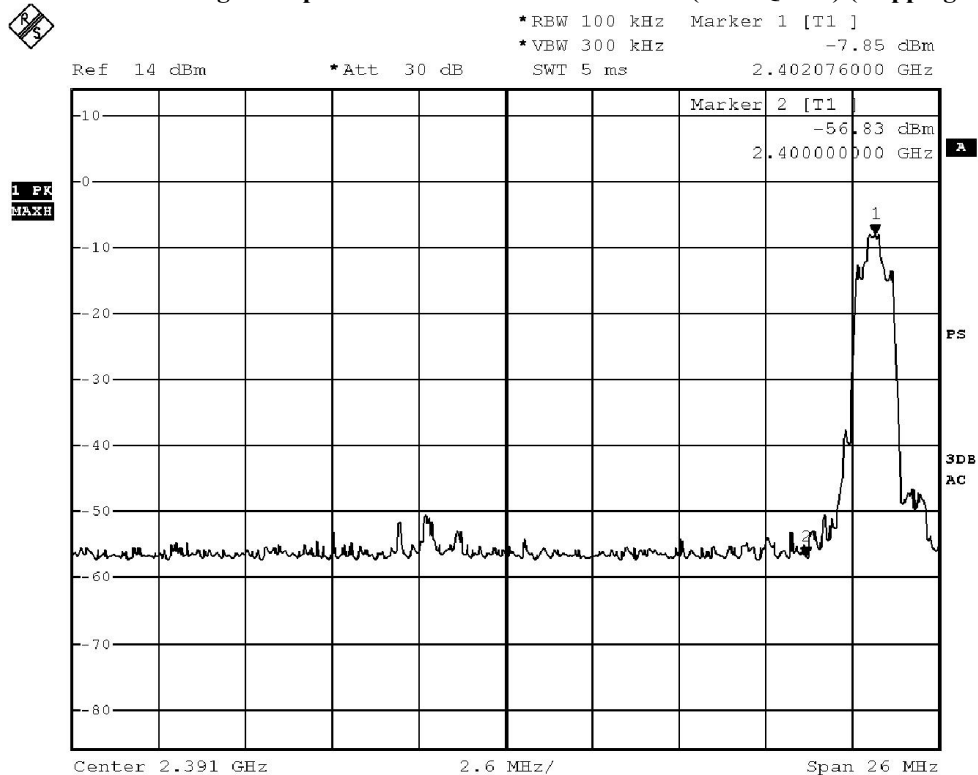
No. : MH193094

Page 68 of 93

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	48.98

Band-edge Compliance of RF Emissions – Lowest ($\pi/4$ DQPSK) (Hopping off)



BMP

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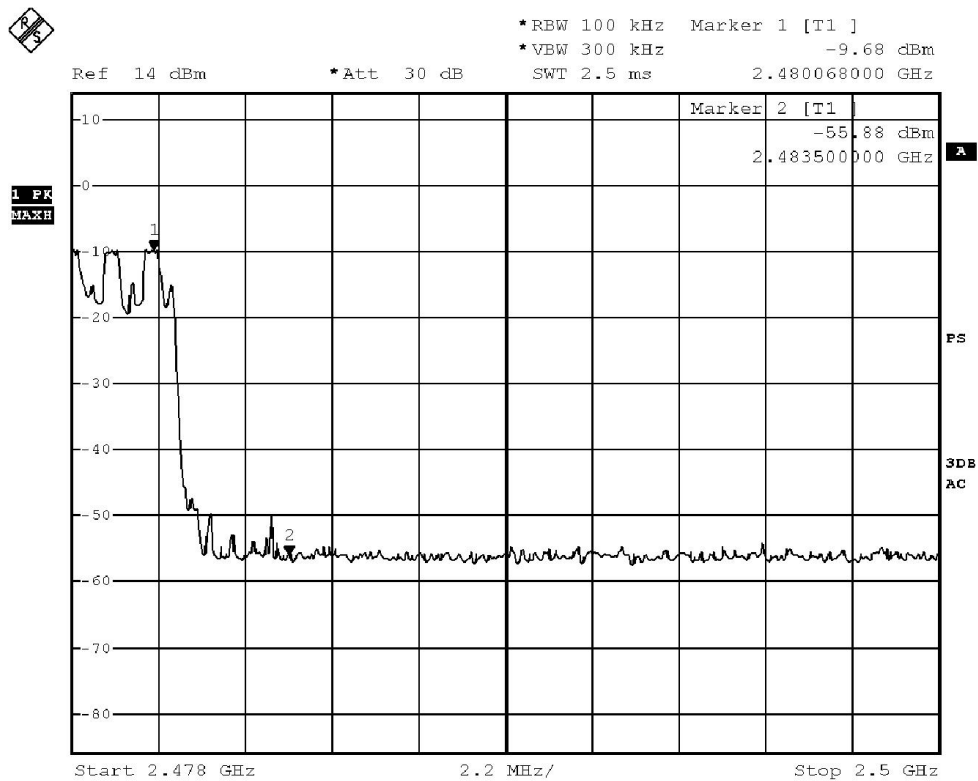
Page 69 of 93

No. : MH193094

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	46.20

Band-edge Compliance of RF Emissions – Highest ($\pi/4$ DQPSK) (Hopping on)



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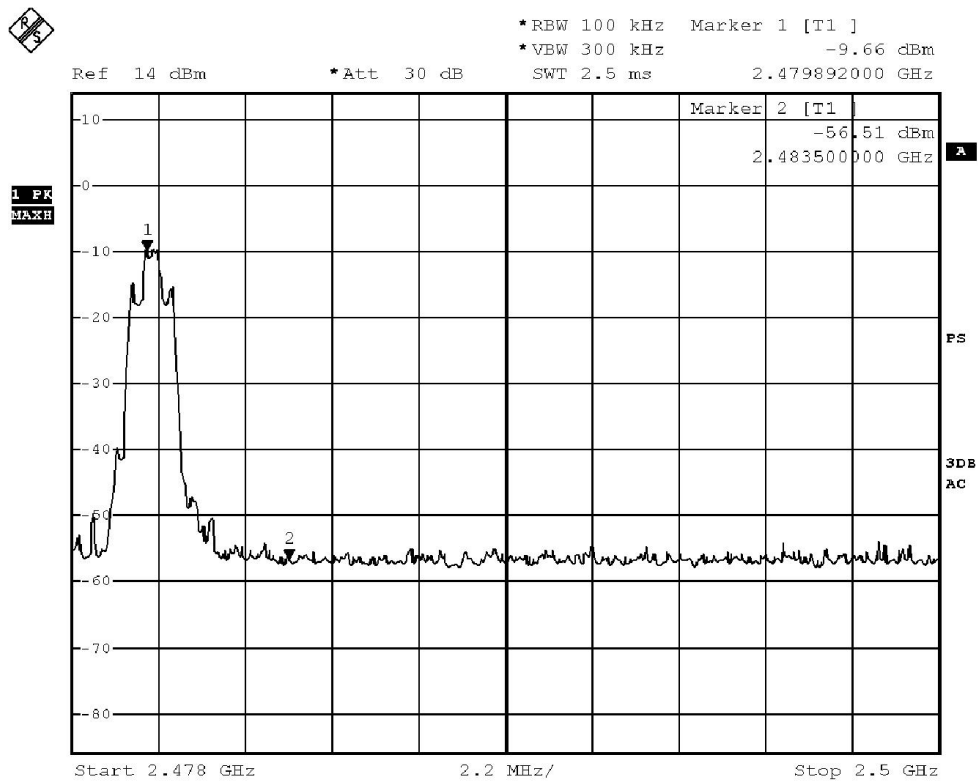
Page 70 of 93

No. : MH193094

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	46.85

Band-edge Compliance of RF Emissions – Highest ($\pi/4$ DQPSK) (Hopping off)



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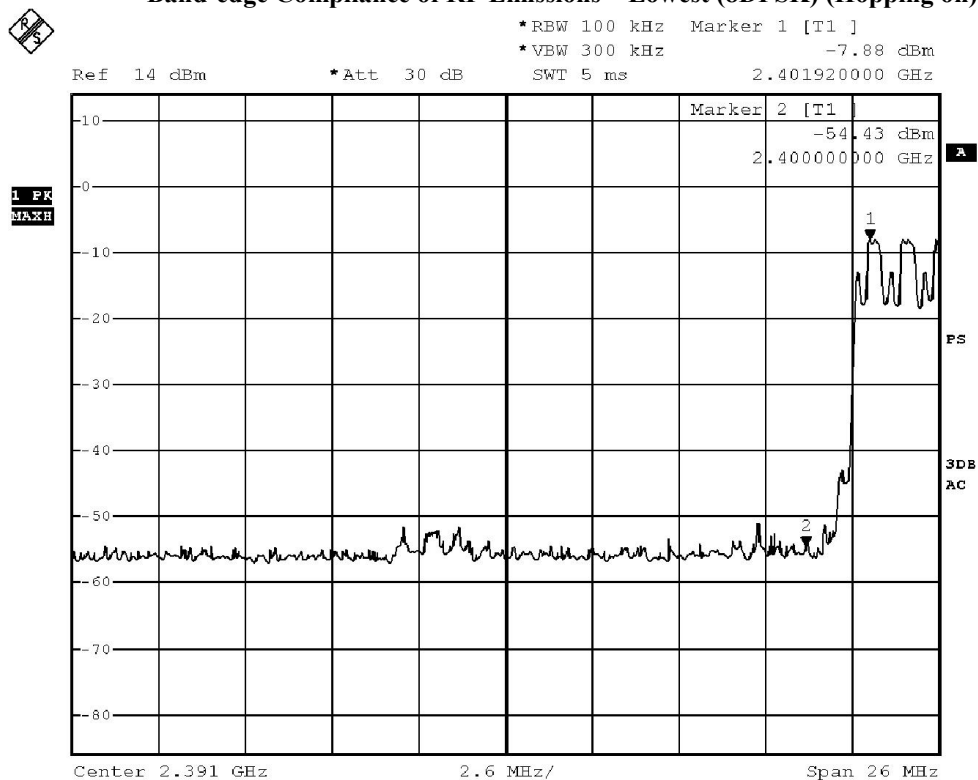
No. : MH193094

Page 71 of 93

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	46.55

Band-edge Compliance of RF Emissions – Lowest (8DPSK) (Hopping on)



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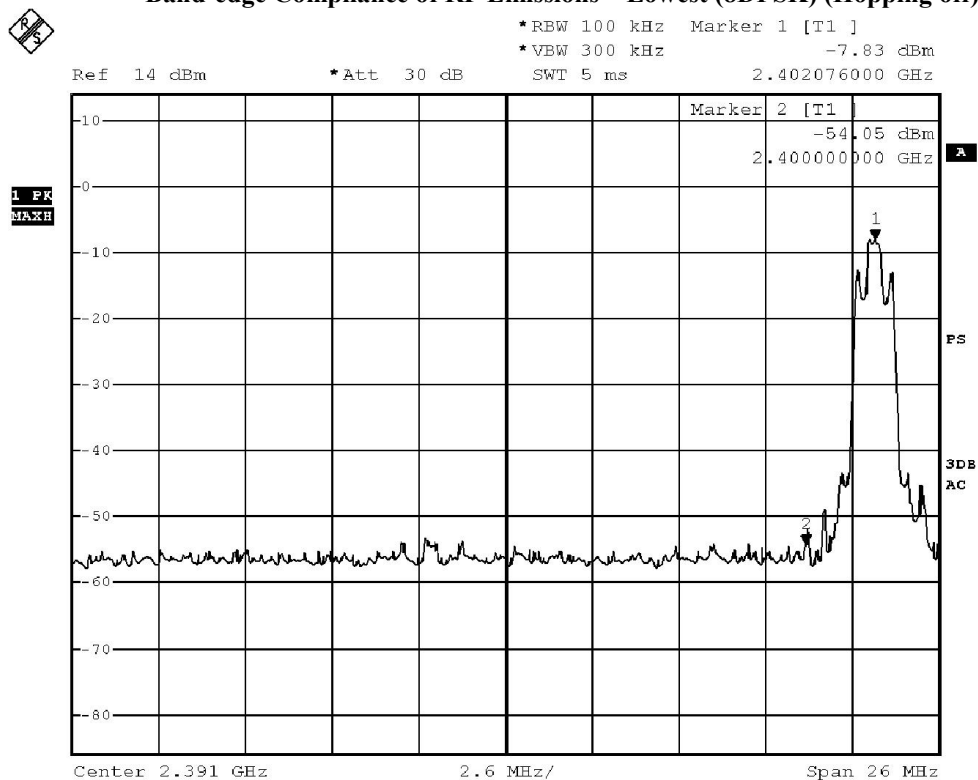
No. : MH193094

Page 72 of 93

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	46.22

Band-edge Compliance of RF Emissions – Lowest (8DPSK) (Hopping off)



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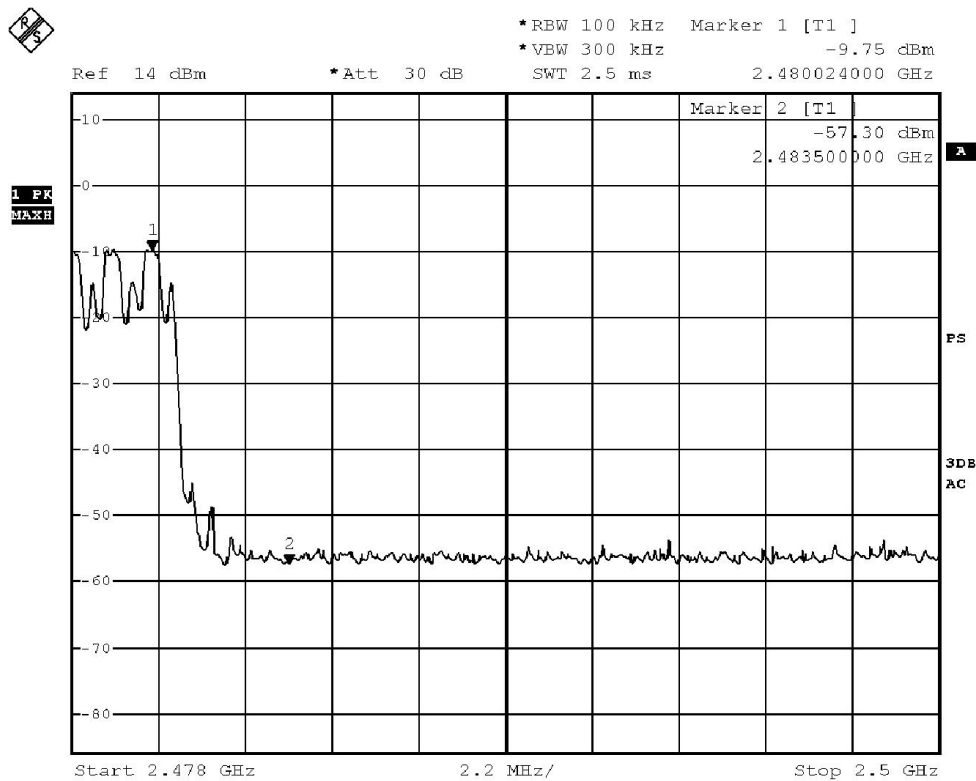
Page 73 of 93

No. : MH193094

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	47.55

Band-edge Compliance of RF Emissions – Highest (8DPSK) (Hopping on)



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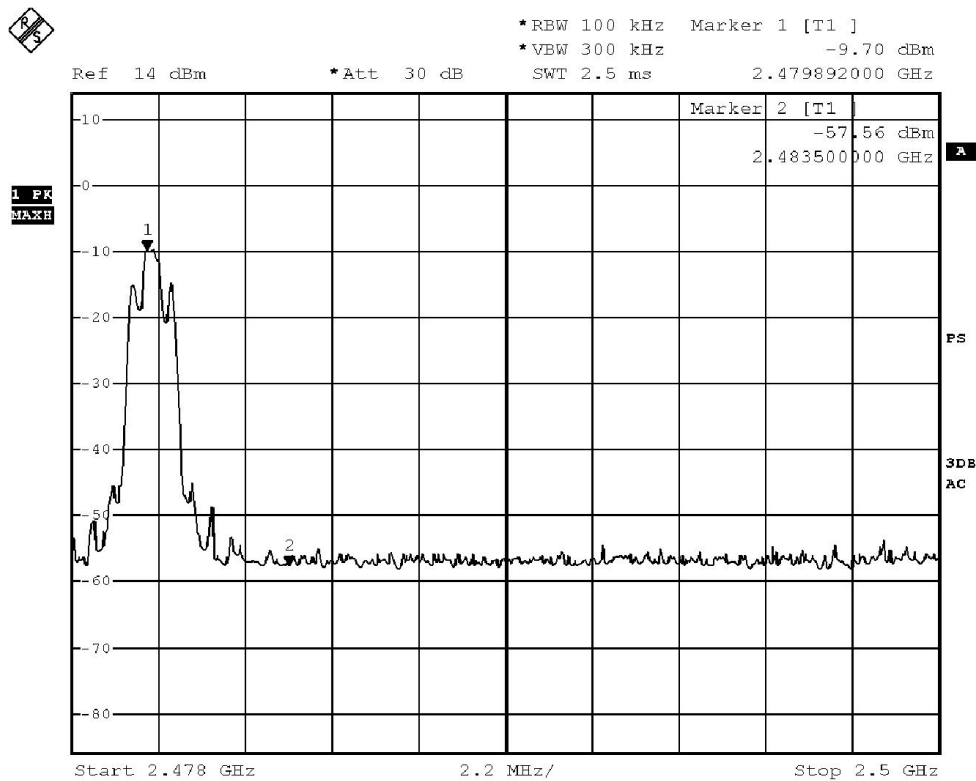
Page 74 of 93

No. : MH193094

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	47.86

Band-edge Compliance of RF Emissions – Highest (8DPSK) (Hopping off)



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Date : 2016-10-17

No. : MH193094

Page 75 of 93

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,

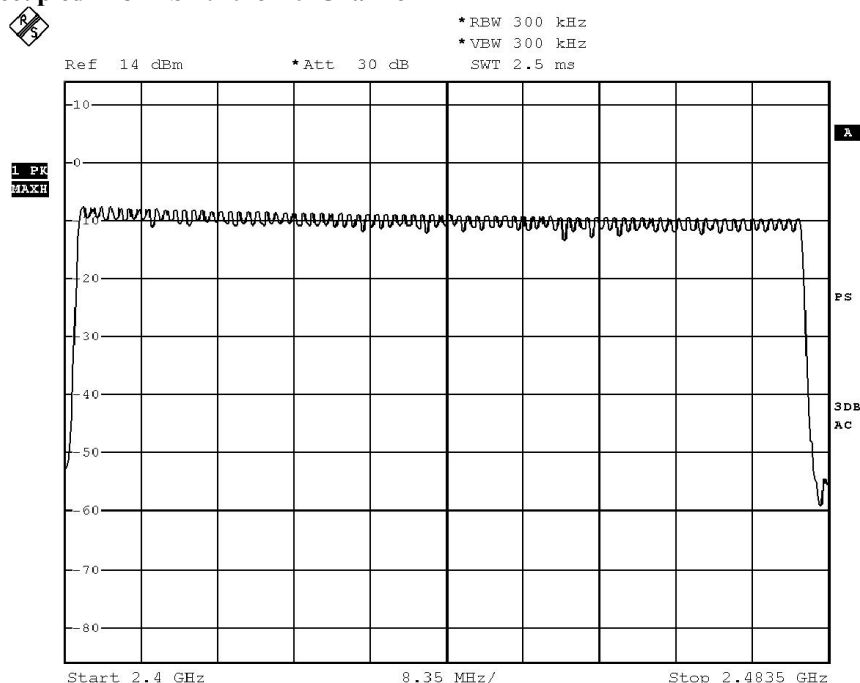
Span = Zero, Detector = Peak, Trace = Max. hold

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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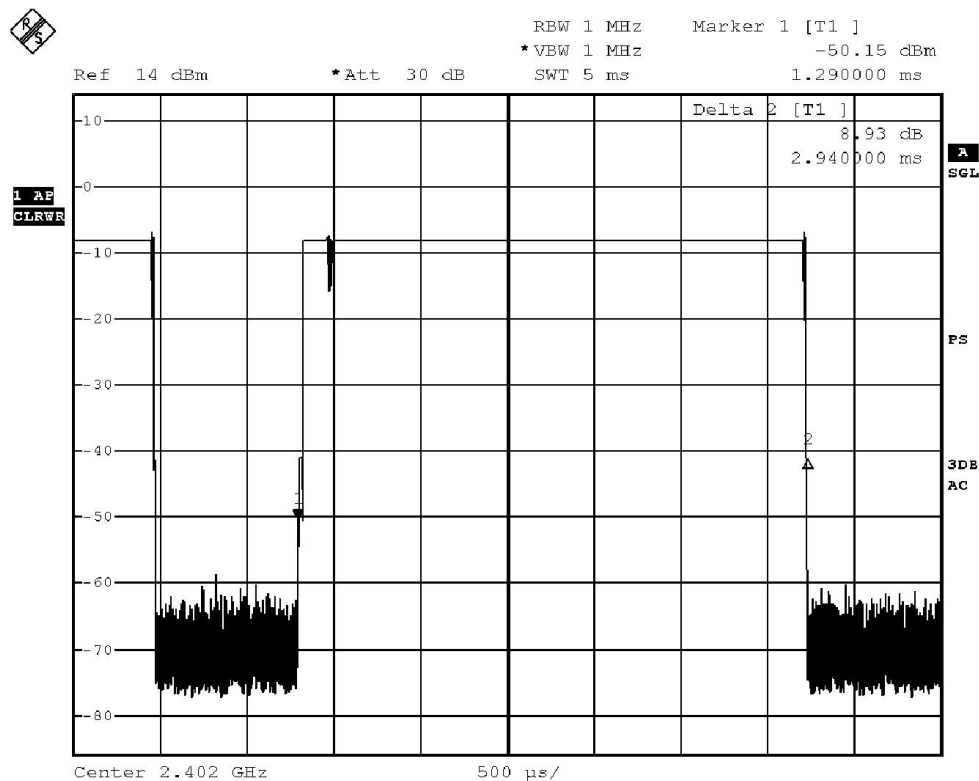
No. : MH193094

Page 76 of 93

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]



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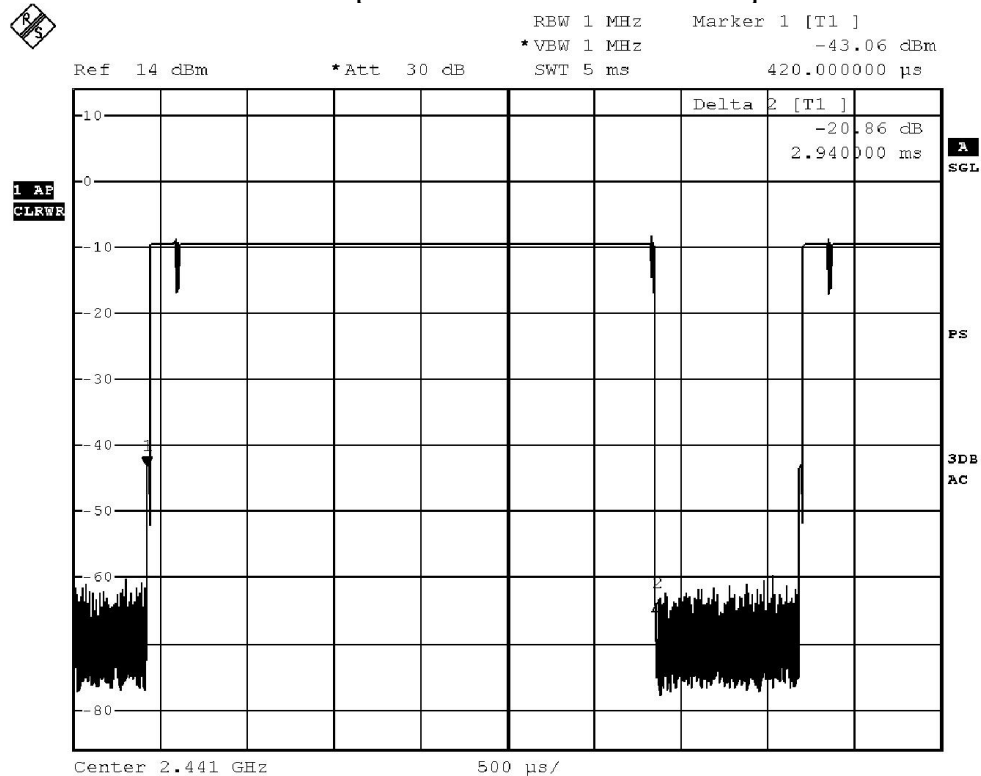
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No. : MH193094

Page 77 of 93

Fig. B
[Pulse duration of Middle Channel]



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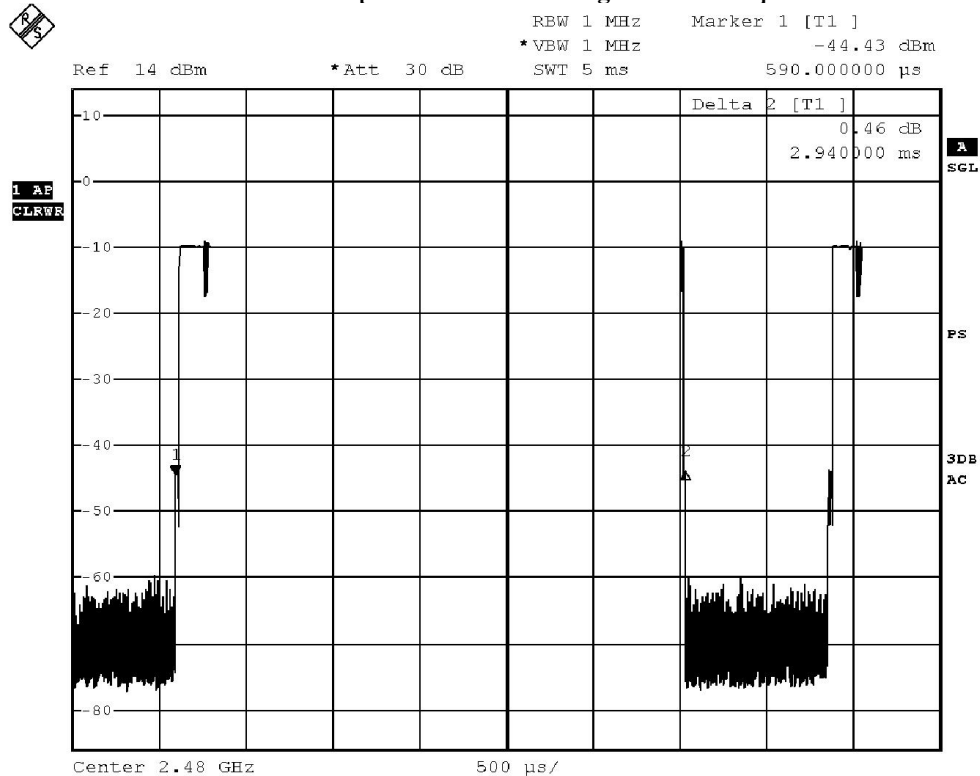
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No. : MH193094

Page 78 of 93

Fig. C
[Pulse duration of Highest Channel]



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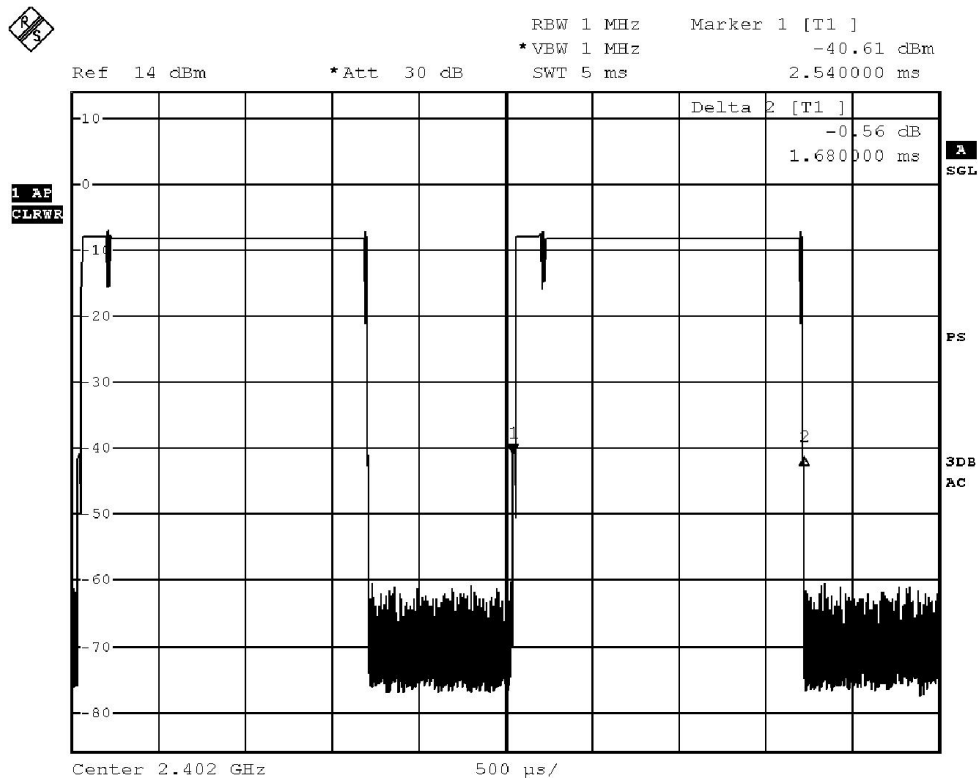
Date : 2016-10-17
No. : MH193094

Page 79 of 93

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]



BMP

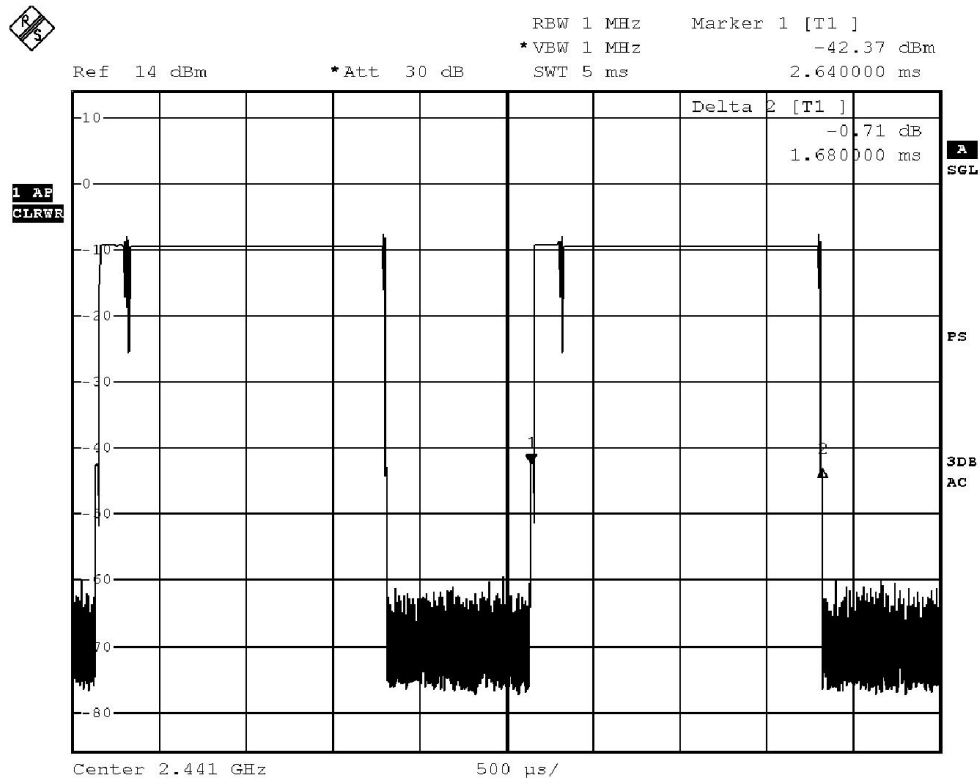
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Date : 2016-10-17
No. : MH193094

Page 80 of 93

Fig. E
[Pulse duration of Middle Channel]



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Date: 26.SEP.2016 17:02:43



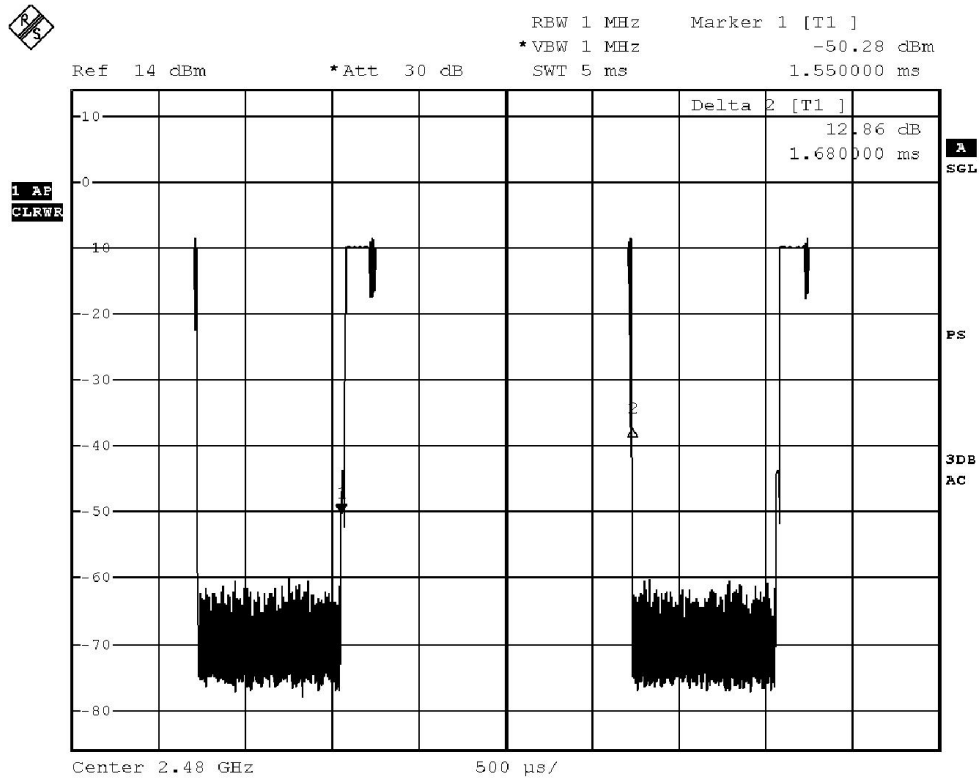
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Fig. F
[Pulse duration of Highest Channel]



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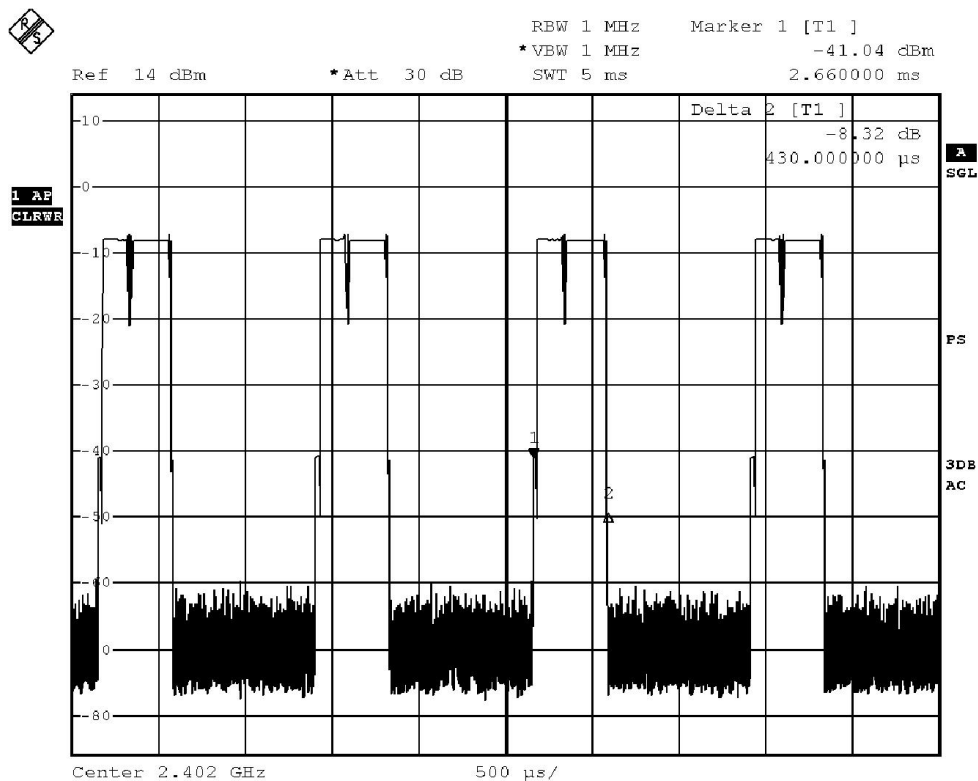
No. : MH193094

Page 82 of 93

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]



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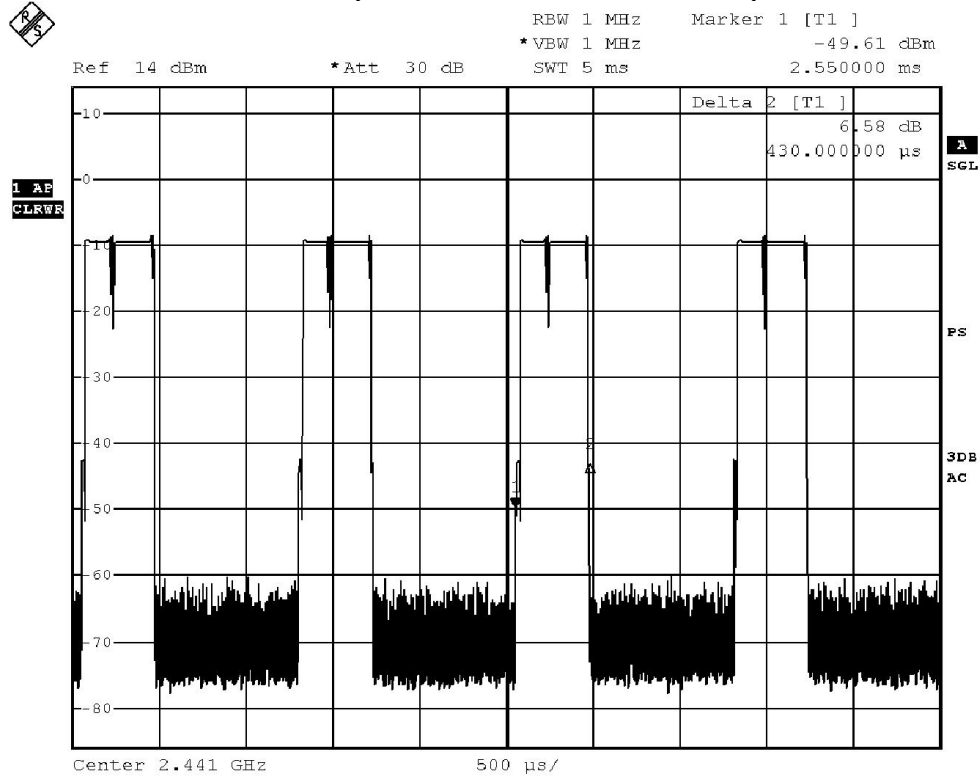
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Page 83 of 93

Fig. H
[Pulse duration of Middle Channel]



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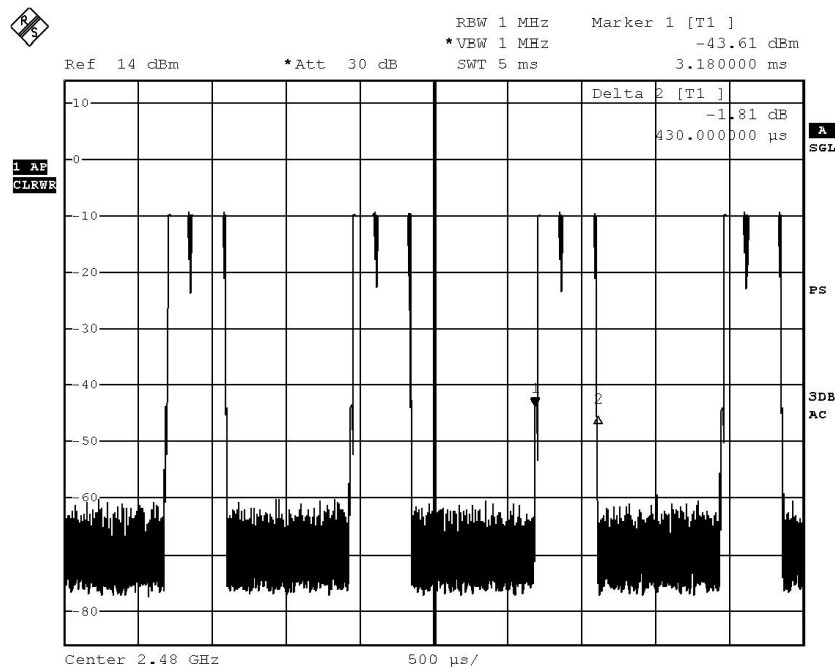
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Date : 2016-10-17

No. : MH193094

Page 84 of 93

Fig. I
[Pulse duration of Highest Channel]



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Time of occupancy (Dwell Time):

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Results
DH5	2402	2.940	0.313	0.400	Complies
DH5	2441	2.940	0.313	0.400	Complies
DH5	2480	2.940	0.313	0.400	Complies
DH3	2402	1.680	0.269	0.400	Complies
DH3	2441	1.680	0.269	0.400	Complies
DH3	2480	1.680	0.269	0.400	Complies
DH1	2402	0.430	0.138	0.400	Complies
DH1	2441	0.430	0.138	0.400	Complies
DH1	2480	0.430	0.138	0.400	Complies

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Test Report

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No. : MH193094

Page 85 of 93

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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No. : MH193094

Page 86 of 93

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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Date : 2016-10-17

No. : MH193094

Page 87 of 93

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 Chip antenna. There is no external antenna, the antenna gain = 2.5dBi. User is unable to remove or changed the Antenna.

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No. : MH193094

Page 88 of 93

3.1.12 RF Exposure

Test Requirement: FCC 47CFR 15.247(i)
Test Date: 2016-10-17
Mode of Operation: Tx 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 = 0.351 mW

$$\begin{aligned} P_d &= P_G / 4\pi R^2 = (0.351 \times 1.78) / 12.566 \times (20)^2 \\ &= (0.62478) / 12.566 \times 400 = 0.62478 / 5026.4 \\ &= 0.000124 \text{ mW/cm}^2 \end{aligned}$$

where:

- * P_d = power density in mW/cm²
- * G = Antenna numeric gain (1.78); $\text{Log } G = g/10$ ($g = 2.5 \text{ dBi}$).
- * P = Conducted RF power to antenna (0.351 mW).
- * R = Minimum allowable distance. (20 cm)

*The power density $P_d = 0.000124 \text{ mW/cm}^2$ is less than 1 mW/cm^2 (listed MPE limit)

*The SAR evaluation is not needed (For desktop device, $R > 20 \text{ cm}$)

* The EUT(antenna) must be 0.2 meters away from the General Population.

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Date : 2016-10-17

No. : MH193094

Page 89 of 93

Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2016/04/24	2017/04/24
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2016/06/01	2017/06/01
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
EM355	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00094856	2016/03/03	2018/03/03
EM353	LOOP ANTENNA	ETS LINDGREN	6502	00206533	2016/03/16	2018/03/16
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
RE01	RF CABLE	N/A	N/A	N/A	2016-9-28	2018-9-27
RE02	RF CABLE	N/A	N/A	N/A	2016-9-28	2018-9-27

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2015/10/22	2016/10/22
EM145	EMI TEST RECEIVER	R & S	ESCS 30	830245/021	2016/06/01	2017/06/01
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2016/01/12	2017/01/12
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057- 99A	2012/02/03	2017/02/03

Remarks:-

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

The Hong Kong Standards and Testing Centre Limited

Head Office: 10 Dai Wang Street, Tai Po 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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Test Report

Date : 2016-10-17

No. : MH193094

Page 90 of 93

Appendix B

Photographs of EUT

Front View of the product



Rear View of the product



Inside View of the product



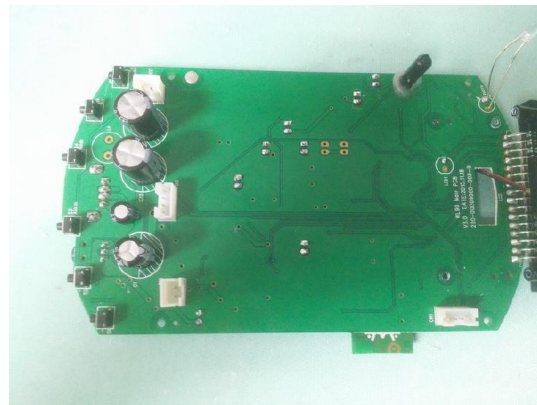
Inside View of the product



Inner Circuit Top View



Inner Circuit Bottom View



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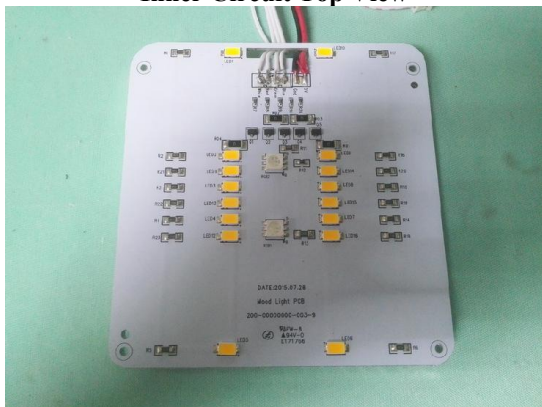
Date : 2016-10-17

No. : MH193094

Page 91 of 93

Photographs of EUT

Inner Circuit Top View



Inner Circuit Bottom View



Inner Circuit Top View



Inner Circuit Bottom View



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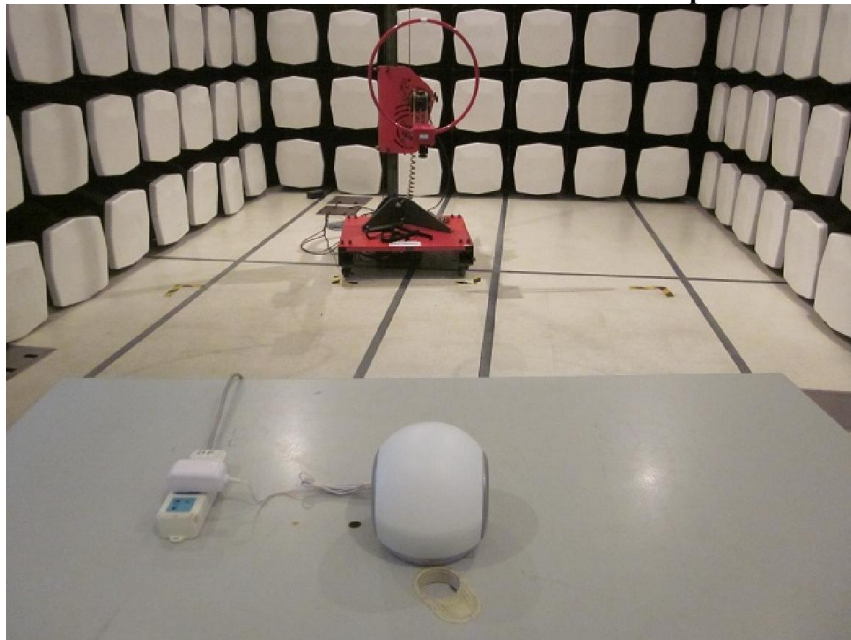
Date : 2016-10-17

No. : MH193094

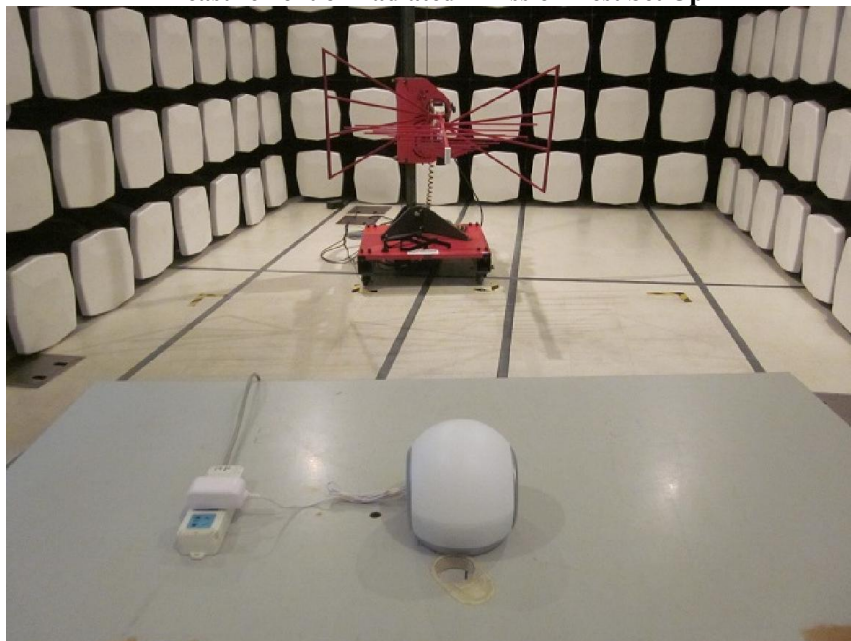
Page 92 of 93

Photographs of EUT

Measurement of Radiated Emission Test Set Up



Measurement of Radiated Emission Test Set Up



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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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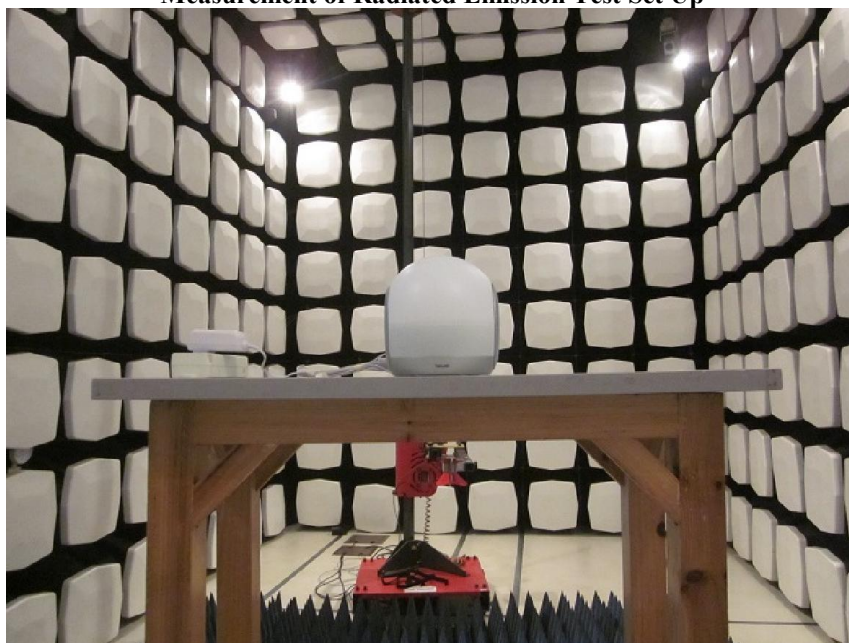
Date : 2016-10-17

No. : MH193094

Page 93 of 93

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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