



STC Test Report

Date: 2015-05-30

Page 1 of 96

No.: MH191506

Applicant: GP Electronics (HK) Limited.
6/F, Gold Peak Bldg., 30 Kwai Wing Road, Kwai Chung,
New Territories, Hong Kong

Manufacturer: GP Electronics (Huizhou) Co., Ltd.
No.76, Hui Feng Si Road, Zhong Kai Hi-Tech Ind.
Development Zone, Huizhou, Guangdong, 516006 China

Description of Sample(s): Product: Bluetooth Speaker
Brand Name: KEF
Model Number: MUO
FCC ID: UXD15001

Date Sample(s) Received: 2015-05-18

Date Tested: 2015-05-21 to 2015-05-26

Investigation Requested: Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2014 and ANSI C63.4: 2009 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)

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 Ltd.

10 Dai Wang Street, Taipo Industrial Estate, N.T., Hong Kong

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STC Test Report

Date: 2015-05-30

Page 2 of 96

No.: MH191506

CONTENT:

Cover	Page 1 of 96
Content	Page 2 of 96
<u>1.0 General Details</u>	
1.1 Test Laboratory	Page 3 of 96
1.2 Equipment Under Test [EUT] Description of EUT operation	Page 3 of 96
1.3 Date of Order	Page 3 of 96
1.4 Submitted Sample	Page 3 of 96
1.5 Test Duration	Page 3 of 96
1.6 Country of Origin	Page 3 of 96
1.7 RF Module Details	Page 4 of 96
1.8 Antenna Details	Page 4 of 96
<u>2.0 Technical Details</u>	
2.1 Investigations Requested	Page 5 of 96
2.2 Test Standards and Results Summary	Page 5 of 96
2.3 Table for Test Modes	Page 6 of 96
<u>3.0 Test Results</u>	
3.1 Emission	Page 7 - 91 of 96
<u>Appendix A</u>	
List of Measurement Equipment	Page 92 of 96
<u>Appendix B</u>	
Photographs	Page 93-96 of 96

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STC Test Report

Date: 2015-05-30

Page 3 of 96

No.: MH191506

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: Bluetooth Speaker
Manufacturer: GP Electronics (Huizhou) Co., Ltd.
No.76, Hui Feng Si Road, Zhong Kai Hi-Tech Ind.
Development Zone, Huizhou, Guangdong, 516006 China
Brand Name: KEF
Model Number: MUO
Rating: 5.0Vd.c. by adapter/ 7.5Vd.c. by battery
The AC/DC adaptor was provided by the applicant with following details:
Brand name: DYS; Model no.: APP521-050200U
Input: 100-240Va.c. 50/60Hz 0.45A;
Output: 5.0Vd.c. 2.0A

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a Bluetooth Speaker, modulation by IC; and type is frequency hopping speed spectrum Modulation. Transmit continuously with 100% duty cycle.

1.3 Date of Order

2015-05-18

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2015-05-21 to 2015-05-29

1.6 Country of Origin

China

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STC Test Report

Date: 2015-05-30

Page 4 of 96

No.: MH191506

1.7 RF Module Details

Module Model Number:	JS-BTM8670
Module FCC ID:	N/A
Module Transmission Type:	Bluetooth V4.0+EDR
Modulation:	FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK)
Data Rates:	1 MBps: 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:	Meander line antenna
Antenna Gain:	2.2dBi

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STC Test Report

Date: 2015-05-30

Page 5 of 96

No.: MH191506

2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2014 Regulations. FCC Pubic Notice DA 00-705 and ANSI C63.4: 2009 for FCC Certification.

2.2 Test Standards and Results Summary Tables

EMISSION 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)	FCC Pubic Notice DA 00-705	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Radiated Spurious Emissions	FCC 47CFR 15.209	ANSI C63.4:2009	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.4:2009	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of Hopping Frequency	FCC 47CFR 15.247(a)(2)(b)(1)	FCC Pubic Notice DA 00-705	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20dB Bandwidth	FCC 47CFR 15.247(a)(2)	FCC Pubic Notice DA 00-705	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hopping Channel Separation	FCC 47CFR 15.247(a)(1)	FCC Pubic Notice DA 00-705	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Band-edge measurement (Radiated)	FCC 47CFR 15.247(c)	FCC Pubic Notice DA 00-705	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time of Occupancy (Dwell Time)	FCC 47CFR 15.247(a)(1)(iii)	FCC Pubic Notice DA 00-705	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"/>
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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STC Test Report

Date: 2015-05-30

Page 6 of 96

No.: MH191506

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	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	2MBps
Time of Occupancy(Dwell Time)	8DPSK (DH1 / DH3 / DH5)	2MBps
Radiated Spurious Emissions	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps
Band-edge compliance of Conducted Emission	GFSK / $\pi/4$ -DQPSK / 8DPSK	2MBps

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STC Test Report

Date: 2015-05-30

Page 7 of 96

No.: MH191506

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:	FCC Public Notice DA 00-705
Test Date:	2015-05-23
Mode of Operation:	Tx mode

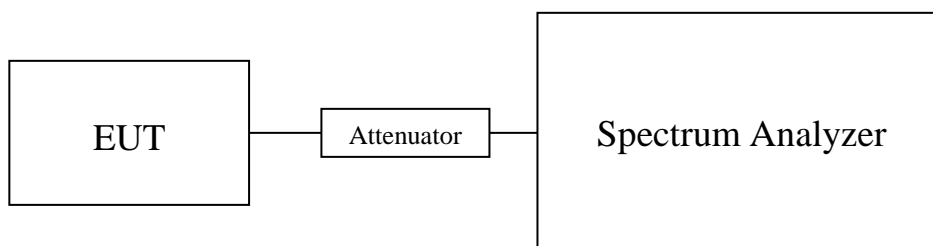
Test Method:

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 dBm.

Spectrum Analyzer Setting:

RBW = 3 MHz, VBW = 3MHz, Sweep = Auto, Span = 10MHz
Detector = Peak, Trace = Max. hold

Test Setup:



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STC Test Report

Date: 2015-05-30

Page 8 of 96

No.: MH191506

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	0.000713

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000809

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000804

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000505

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000573

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000558

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000527

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000597

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000579

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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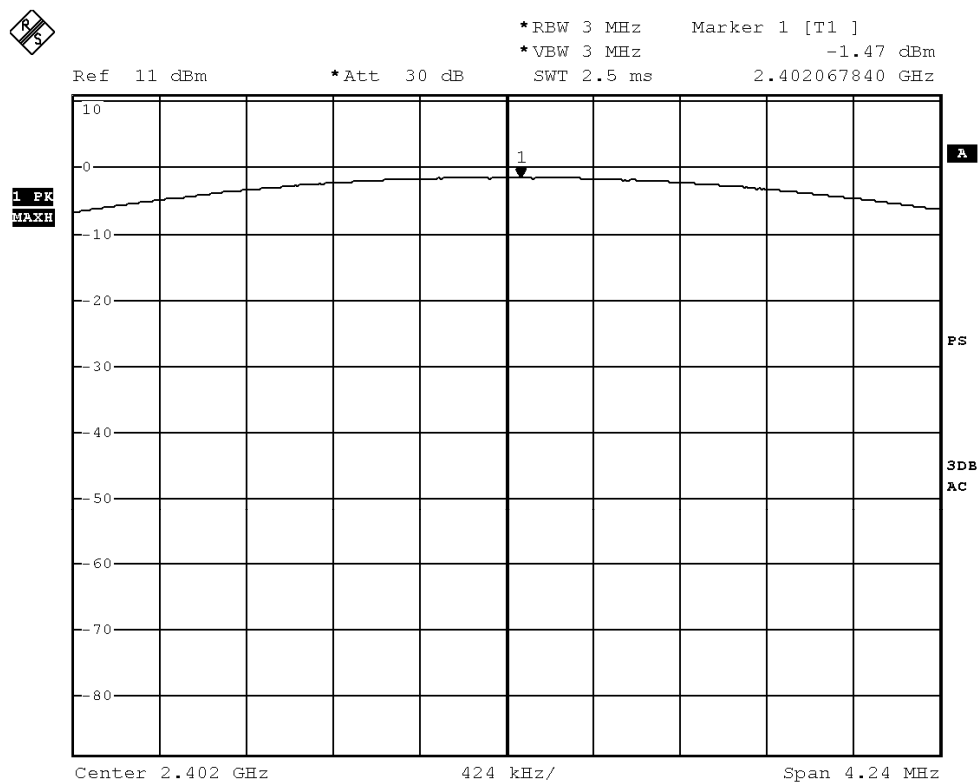
Date: 2015-05-30

Page 9 of 96

No.: MH191506

Test plot of Maximum Peak Conducted Output Power :

Bluetooth Communication mode (GFSK, 2402MHz)



BMP

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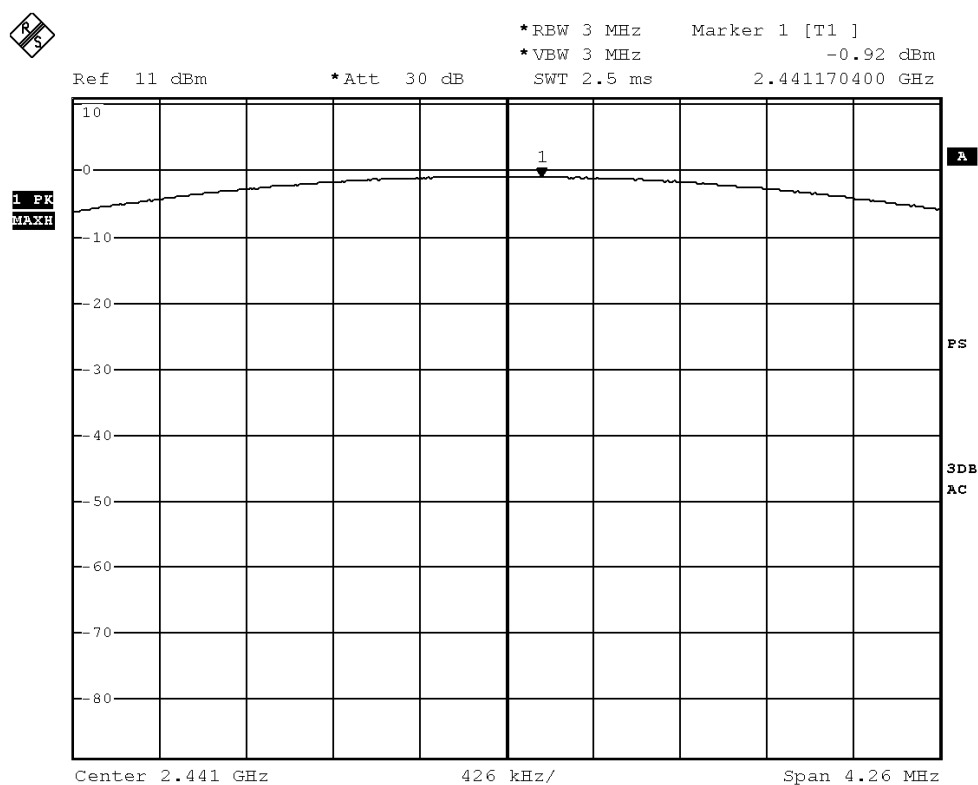
STC Test Report

Date: 2015-05-30

Page 10 of 96

No.: MH191506

Bluetooth Communication mode (GFSK, 2441MHz)



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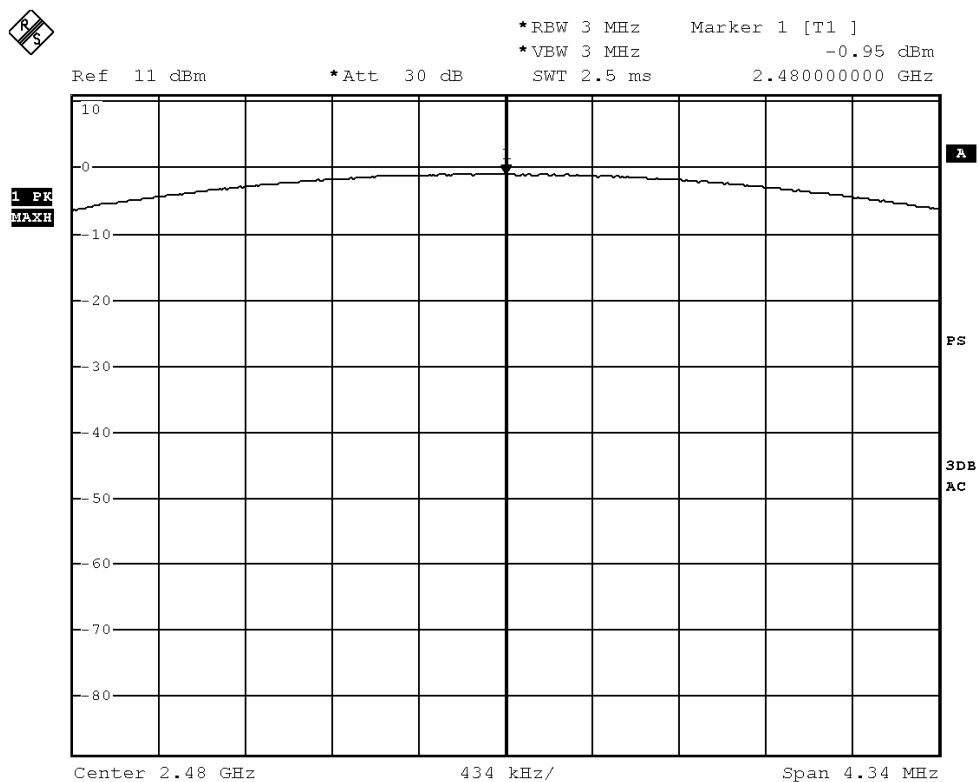
STC Test Report

Date: 2015-05-30

Page 11 of 96

No.: MH191506

Bluetooth Communication mode (GFSK, 2480MHz)



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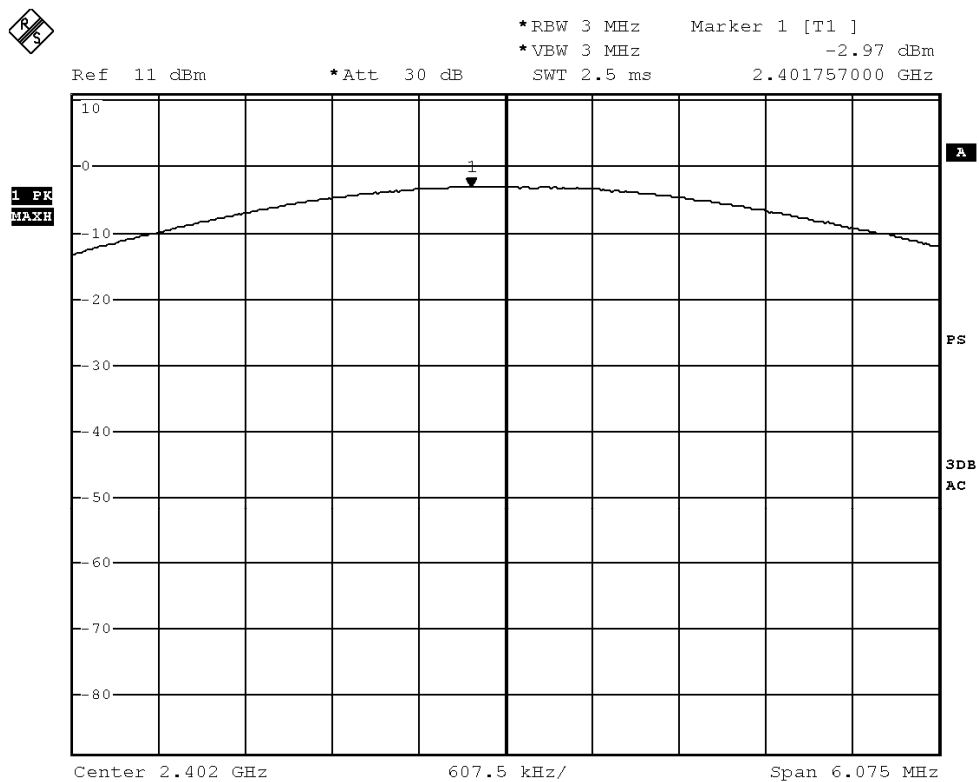
STC Test Report

Date: 2015-05-30

Page 12 of 96

No.: MH191506

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



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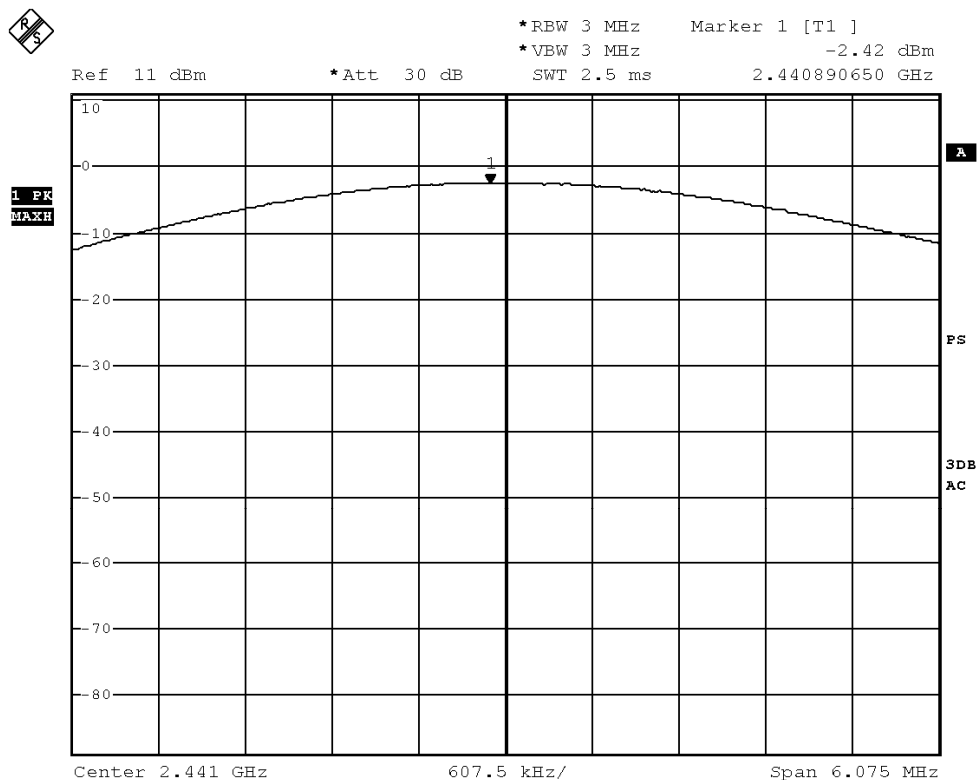
STC Test Report

Date: 2015-05-30

Page 13 of 96

No.: MH191506

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



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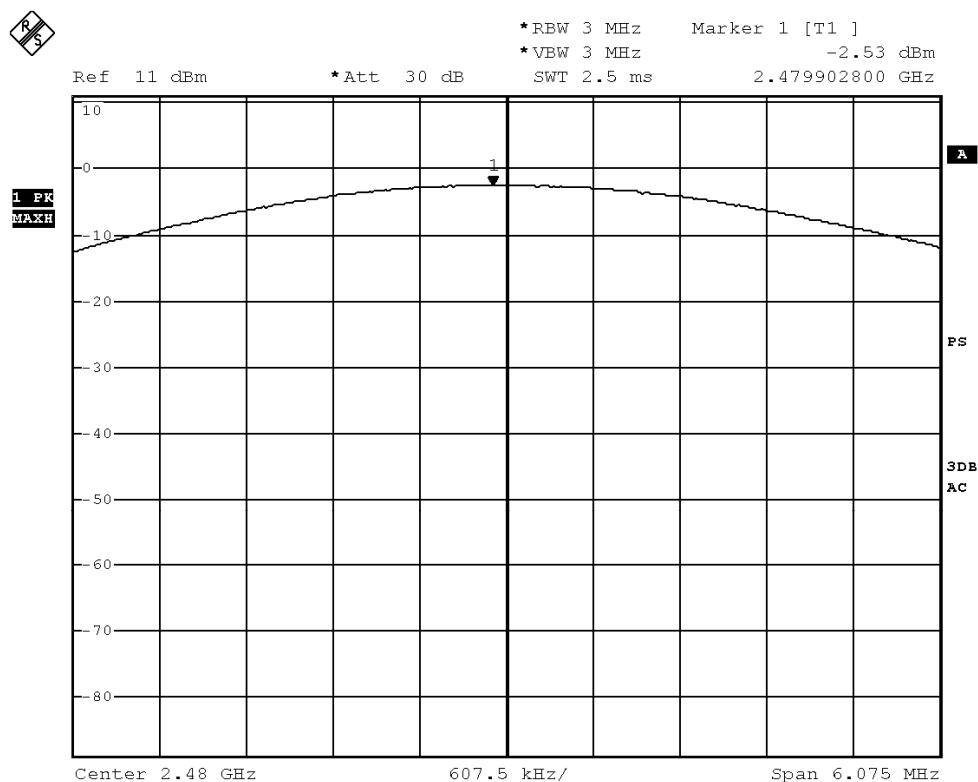
STC Test Report

Date: 2015-05-30

Page 14 of 96

No.: MH191506

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



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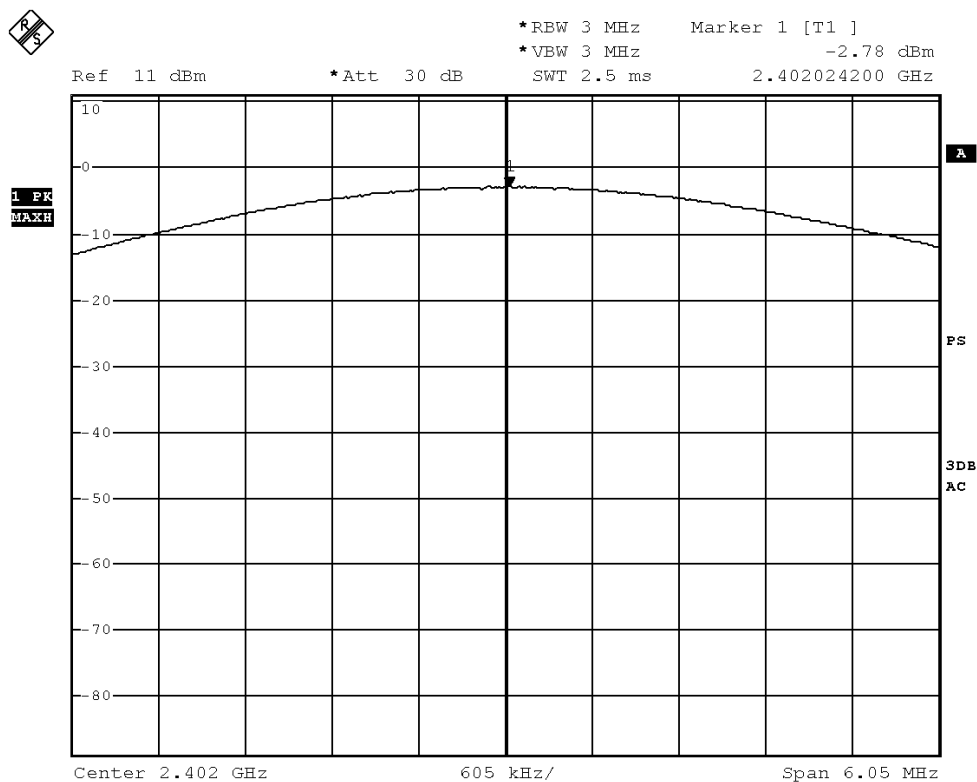
STC Test Report

Date: 2015-05-30

Page 15 of 96

No.: MH191506

Bluetooth Communication mode (8DPSK, 2402MHz)



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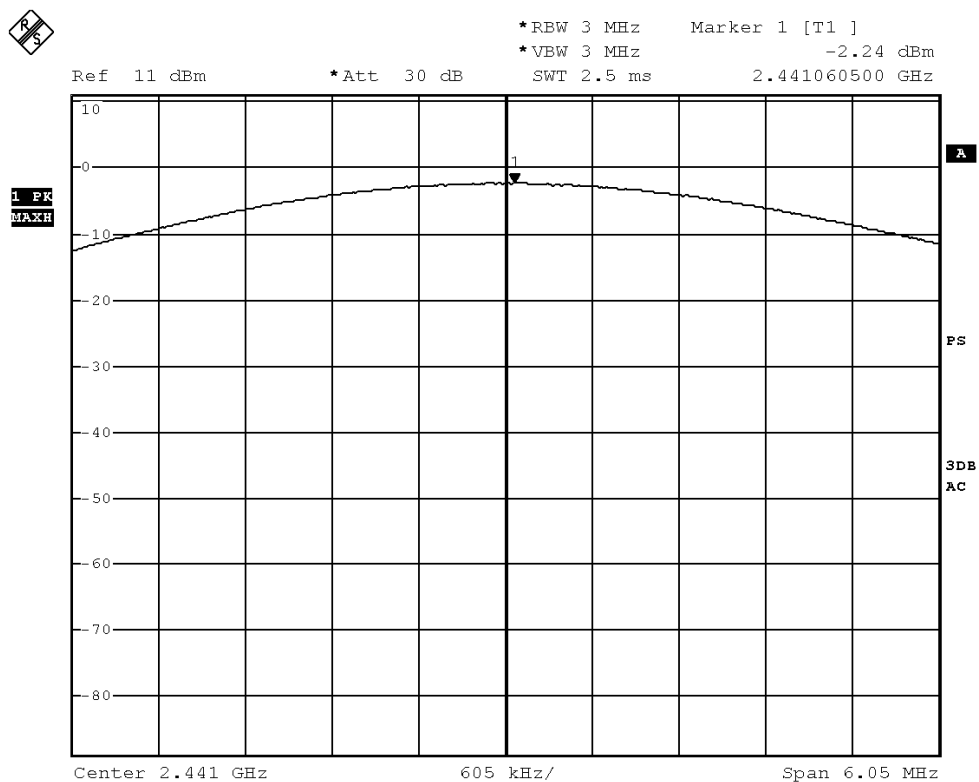
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Date: 2015-05-30

Page 16 of 96

No.: MH191506

Bluetooth Communication mode (8DPSK, 2441MHz)



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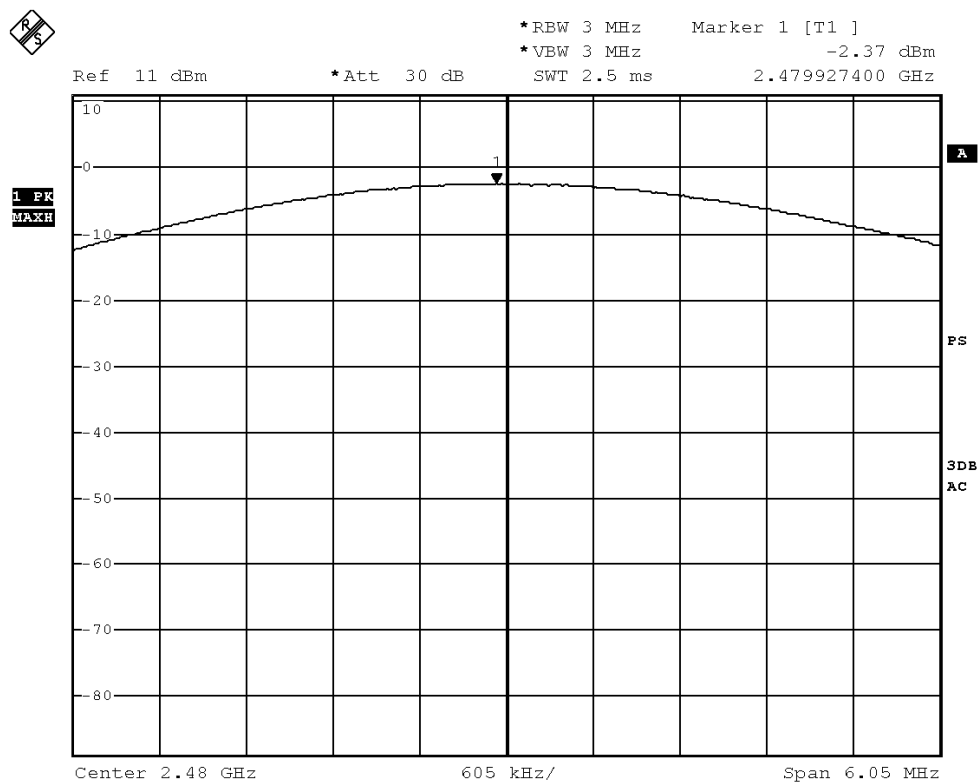
STC Test Report

Date: 2015-05-30

Page 17 of 96

No.: MH191506

Bluetooth Communication mode (8DPSK, 2480MHz)



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STC Test Report

Date: 2015-05-30

Page 18 of 96

No.: MH191506

3.1.2 Radiated Spurious Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.4:2009
Test Date:	2015-05-21 to 2015-05-26
Mode of Operation:	Tx mode / Bluetooth Communication mode/ Bluetooth Communication+ Charge mode (GFSK / $\pi/4$ -DQPSK/ 8DPSK)

Test Method:

The sample was placed 0.8m 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 Registration Number: 607756.

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STC Test Report

Date: 2015-05-30

Page 19 of 96

No.: MH191506

Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)

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

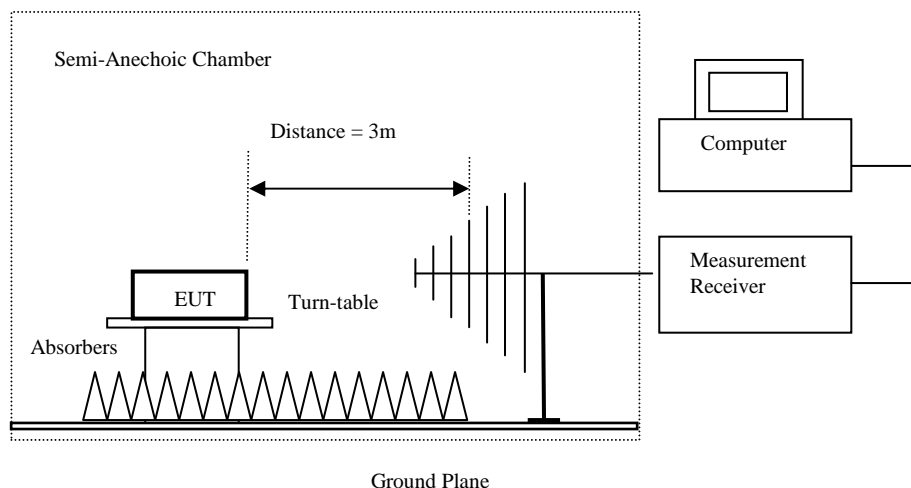
30MHz – 1GHz (QP)

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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STC Test Report

Date: 2015-05-30

Page 20 of 96

No.: MH191506

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

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

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

Result of Tx mode (2402.0 MHz) (GFSK mode) (9kHz – 30MHz): Pass

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

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

Field Strength of Spurious Emissions 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
4804.0	13.3	41.5	54.8	74.0	19.2	Vertical
4804.0	13.3	42.4	55.7	74.0	18.3	Horizontal
7206.0	10.4	45.1	55.5	74.0	18.5	Vertical
7206.0	9.4	46.2	55.6	74.0	18.4	Horizontal
9608.0	7.7	48.0	55.7	74.0	18.3	Vertical
9608.0	6.6	48.8	55.4	74.0	18.6	Horizontal
12010.0	4.0	51.5	55.5	74.0	18.5	Vertical
12010.0	3.6	52.4	56.0	74.0	18.0	Horizontal

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STC Test Report

Date: 2015-05-30

Page 21 of 96

No.: MH191506

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

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
4804.0	0.6	41.5	42.1	54.0	11.9	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	-7.5	48.0	40.5	54.0	13.5	Vertical
9608.0	-7.5	48.8	41.3	54.0	12.7	Horizontal
12010.0	-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 mode) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/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 (2441.0 MHz) (GFSK mode) (30MHz – 1000MHz): PASS

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

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STC Test Report

Date: 2015-05-30

Page 22 of 96

No.: MH191506

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4882.0	14.9	41.6	56.5	74.0	17.5	Vertical
4882.0	13.8	42.5	56.3	74.0	17.7	Horizontal
7323.0	10.2	45.2	55.4	74.0	18.6	Vertical
7323.0	9.2	46.3	55.5	74.0	18.5	Horizontal
9764.0	7.7	48.1	55.8	74.0	18.2	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	3.3	52.5	55.8	74.0	18.2	Horizontal

Result of Tx mode (2441.0 MHz) (GFSK mode) (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 dBuV/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	-7.7	48.1	40.4	54.0	13.6	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

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STC Test Report

Date: 2015-05-30

Page 23 of 96

No.: MH191506

Result of Tx mode (2480.0 MHz) (GFSK mode) (9kHz – 30MHz): Pass

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

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4960.0	15.7	41.4	57.1	74.0	16.9	Vertical
4960.0	12.8	42.7	55.5	74.0	18.5	Horizontal
7440.0	10.0	45.6	55.6	74.0	18.4	Vertical
7440.0	8.8	46.5	55.3	74.0	18.7	Horizontal
9920.0	6.8	48.6	55.4	74.0	18.6	Vertical
9920.0	5.3	49.7	55.0	74.0	19.0	Horizontal
12400.0	4.3	51.7	56.0	74.0	18.0	Vertical
12400.0	2.8	52.7	55.5	74.0	18.5	Horizontal

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STC Test Report

Date: 2015-05-30

Page 24 of 96

No.: MH191506

Result of Tx mode (2480.0 MHz) (GFSK mode) (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 dBuV/m	E-Field Polarity
4960.0	0.2	41.4	41.6	54.0	12.4	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 mode) (9kHz – 30MHz): Pass

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

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

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STC Test Report

Date: 2015-05-30

Page 25 of 96

No.: MH191506

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4804.0	15.1	41.5	56.6	74.0	17.4	Vertical
4804.0	13.5	42.4	55.9	74.0	18.1	Horizontal
7206.0	9.8	45.1	54.9	74.0	19.1	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	3.4	52.4	55.8	74.0	18.2	Horizontal

Result of Tx mode (2402.0 MHz) ($\pi/4$ -DQPSK mode) (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 dBuV/m	E-Field Polarity
4804.0	0.0	41.5	41.5	54.0	12.5	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	-7.3	48.0	40.7	54.0	13.3	Vertical
9608.0	-7.8	48.8	41.0	54.0	13.0	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

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STC Test Report

Date: 2015-05-30

Page 26 of 96

No.: MH191506

Result of Tx mode (2441.0 MHz) ($\pi/4$ -DQPSK mode) (9kHz – 30MHz): Pass

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

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4882.0	14.8	41.6	56.4	74.0	17.6	Vertical
4882.0	13.4	42.5	55.9	74.0	18.1	Horizontal
7323.0	10.5	45.2	55.7	74.0	18.3	Vertical
7323.0	8.3	46.3	54.6	74.0	19.4	Horizontal
9764.0	6.8	48.1	54.9	74.0	19.1	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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STC Test Report

Date: 2015-05-30

Page 27 of 96

No.: MH191506

Result of Tx mode (2441.0 MHz) ($\pi/4$ -DQPSK mode) (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 dBuV/m	E-Field Polarity
4882.0	0.1	41.6	41.7	54.0	12.3	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 mode) (9kHz – 30MHz): Pass

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

Results of Tx mode (2480.0 MHz) ($\pi/4$ -DQPSK mode) (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						

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STC Test Report

Date: 2015-05-30

Page 28 of 96

No.: MH191506

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4960.0	14.3	41.4	55.7	74.0	18.3	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	6.9	48.6	55.5	74.0	18.5	Vertical
9920.0	5.6	49.7	55.3	74.0	18.7	Horizontal
12400.0	4.7	51.7	56.4	74.0	17.6	Vertical
12400.0	2.3	52.7	55.0	74.0	19.0	Horizontal

Result of Tx mode (2480.0 MHz) ($\pi/4$ -DQPSK mode) (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 dBuV/m	E-Field Polarity
4960.0	0.5	41.4	41.9	54.0	12.1	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	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

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STC Test Report

Date: 2015-05-30

Page 29 of 96

No.: MH191506

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

Field Strength of Spurious Emissions						
Quasi-Peak Value						
Frequency	Measured Level	Correction Factor	Field Strength	Field Strength	Limit	E-Field Polarity
MHz	dBuV	dB/m	dBuV/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) (8DPSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dBuV/m	
4804.0	15.5	41.5	57.0	74.0	17.0	Vertical
4804.0	13.5	42.4	55.9	74.0	18.1	Horizontal
7206.0	9.3	45.1	54.4	74.0	19.6	Vertical
7206.0	9.5	46.2	55.7	74.0	18.3	Horizontal
9608.0	7.5	48.0	55.5	74.0	18.5	Vertical
9608.0	6.3	48.8	55.1	74.0	18.9	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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STC Test Report

Date: 2015-05-30

Page 30 of 96

No.: MH191506

Result of Tx mode (2402.0 MHz) (8DPSK) (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 dBuV/m	E-Field Polarity
4804.0	0.4	41.5	41.9	54.0	12.1	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 μ V/m	Limit μ V/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Results of Tx mode (2441.0 MHz) (8DPSK) (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 μ V/m	Limit μ V/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

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STC Test Report

Date: 2015-05-30

Page 31 of 96

No.: MH191506

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4882.0	14.9	41.6	56.5	74.0	17.5	Vertical
4882.0	13.6	42.5	56.1	74.0	17.9	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	6.6	48.1	54.7	74.0	19.3	Vertical
9764.0	5.6	48.9	54.5	74.0	19.5	Horizontal
12205.0	4.2	51.5	55.7	74.0	18.3	Vertical
12205.0	4	52.5	56.5	74.0	17.5	Horizontal

Result of Tx mode (2441.0 MHz) (8DPSK) (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 dBuV/m	E-Field Polarity
4882.0	-1.4	41.6	40.2	54.0	13.8	Vertical
4882.0	-1.6	42.5	40.9	54.0	13.1	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

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STC Test Report

Date: 2015-05-30

Page 32 of 96

No.: MH191506

Result of Tx mode (2480.0 MHz) (8DPSK) (9kHz – 30MHz): Pass

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

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
4960.0	15.7	41.4	57.1	74.0	16.9	Vertical
4960.0	13.6	42.7	56.3	74.0	17.7	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	5.0	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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STC Test Report

Date: 2015-05-30

Page 33 of 96

No.: MH191506

Result of Tx mode (2480.0 MHz) (8DPSK) (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 dBuV/m	E-Field Polarity
4960.0	0.6	41.4	42.0	54.0	12.0	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	-7.1	48.6	41.5	54.0	12.5	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:

* 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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STC Test Report

Date: 2015-05-30

Page 34 of 96

No.: MH191506

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

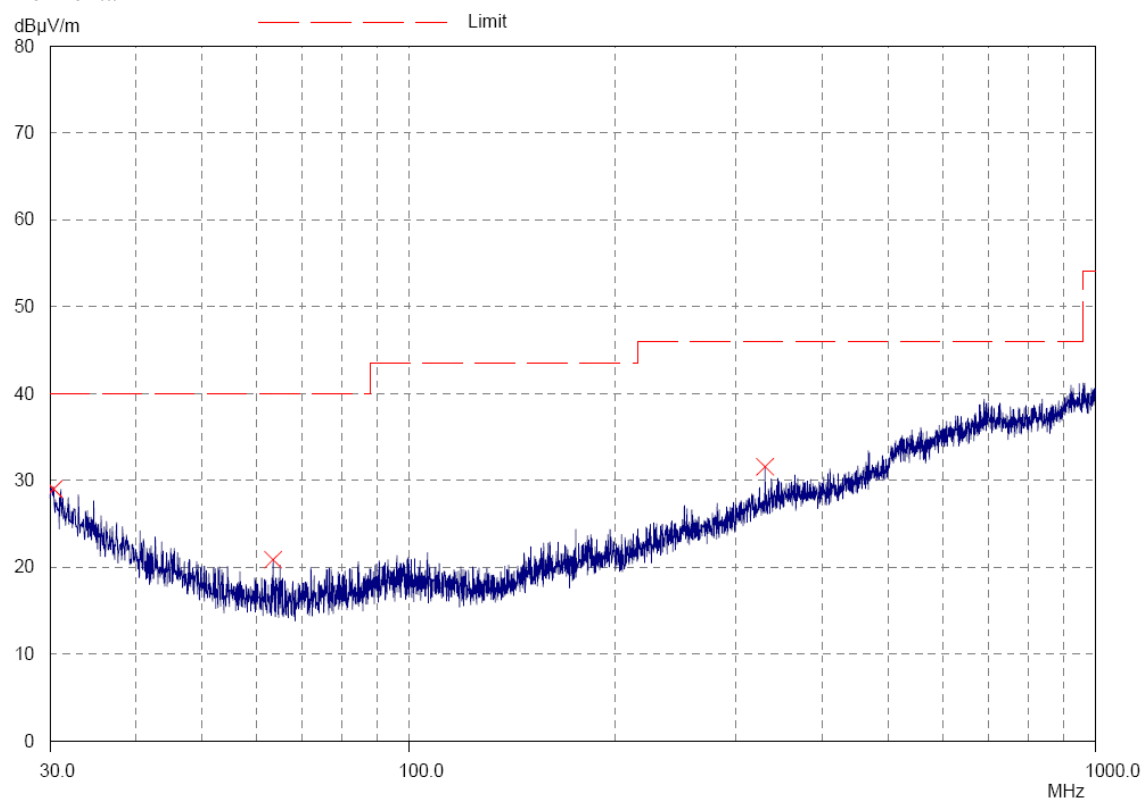
Frequency Range	Quasi-Peak Limits
[MHz]	[$\mu\text{V/m}$]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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.

Result of Bluetooth Communication mode (GFSK / $\pi/4$ -DQPSK/ 8DPSK) (30MHz – 1GHz): Pass

Please refer to the following table for result details

Horizontal



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STC Test Report

Date: 2015-05-30

Page 35 of 96

No.: MH191506

Result of Bluetooth Communication mode (GFSK / π /4-DQPSK/ 8DPSK) (30MHz – 1GHz): Pass

Radiated Emissions Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dB μ V/m	Limit @3m dB μ V/m	Level @3m μ V/m	Limit @3m μ V/m
30.4	Horizontal	29.0	40.0	28.2	100
63.4	Horizontal	20.8	40.0	11.0	100
330.6	Horizontal	31.5	46.0	37.6	200

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STC Test Report

Date: 2015-05-30

Page 36 of 96

No.: MH191506

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

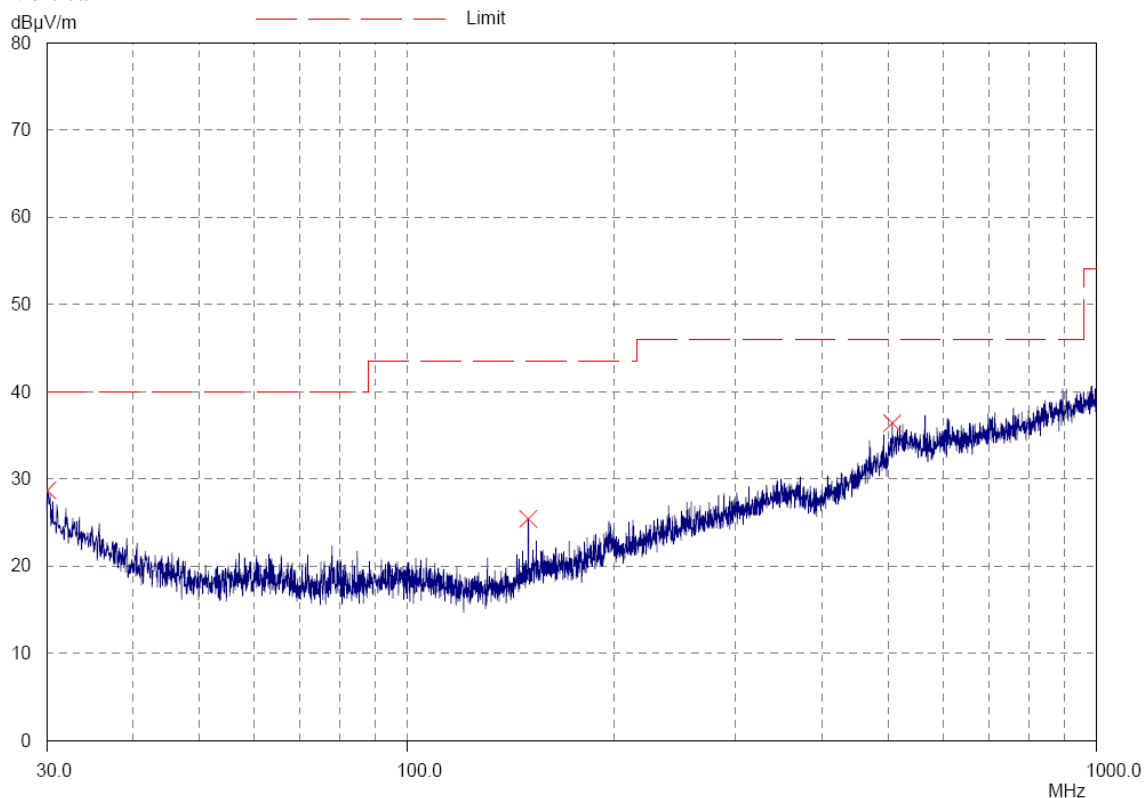
Frequency Range	Quasi-Peak Limits
[MHz]	[$\mu\text{V/m}$]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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.

Result of Bluetooth Communication mode (GFSK / $\pi/4$ -DQPSK/ 8DPSK) (30MHz – 1GHz): Pass

Please refer to the following table for result details

Vertical



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STC Test Report

Date: 2015-05-30

Page 37 of 96

No.: MH191506

Result of Bluetooth Communication mode (GFSK / π /4-DQPSK/ 8DPSK) (30MHz – 1GHz): Pass

Radiated Emissions					
Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dB μ V/m	Limit @3m dB μ V/m	Level @3m μ V/m	Limit @3m μ V/m
30.1	Vertical	28.7	40.0	27.2	100
150.0	Vertical	25.4	43.5	18.6	150
506.3	Vertical	36.4	46.0	66.1	200

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STC Test Report

Date: 2015-05-30

Page 38 of 96

No.: MH191506

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

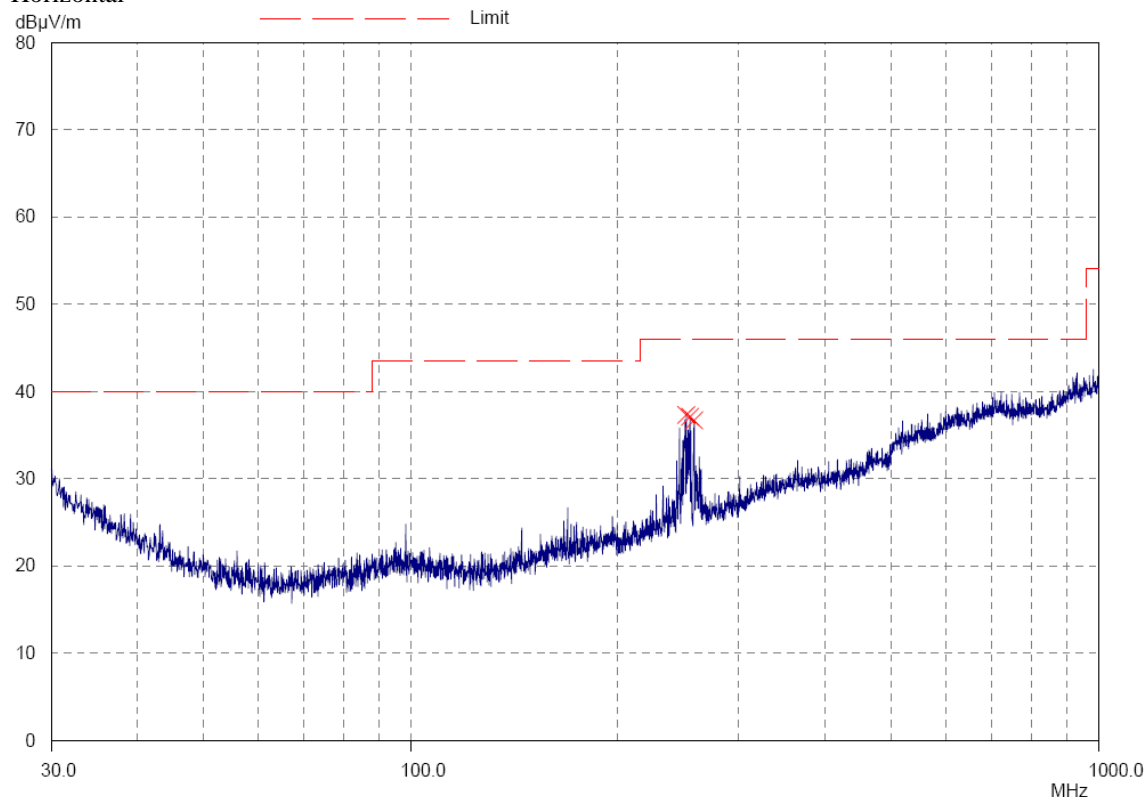
Frequency Range	Quasi-Peak Limits
[MHz]	[$\mu\text{V/m}$]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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.

Result of Bluetooth Communication+Charge mode (GFSK / $\pi/4$ -DQPSK/ 8DPSK) (30MHz – 1GHz): **Pass**

Please refer to the following table for result details

Horizontal



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STC Test Report

Date: 2015-05-30

Page 39 of 96

No.: MH191506

Result of Bluetooth Communication+ Charge mode (GFSK / $\pi/4$ -DQPSK/ 8DPSK) (30MHz – 1GHz):
Pass

Radiated Emissions					
Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dB μ V/m	Limit @3m dB μ V/m	Level @3m μ V/m	Limit @3m μ V/m
251.6	Horizontal	37.3	46.0	73.3	200
254.7	Horizontal	37.1	46.0	71.6	200
258.3	Horizontal	36.7	46.0	68.4	200

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STC Test Report

Date: 2015-05-30

Page 40 of 96

No.: MH191506

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

Frequency Range	Quasi-Peak Limits
[MHz]	[$\mu\text{V/m}$]
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

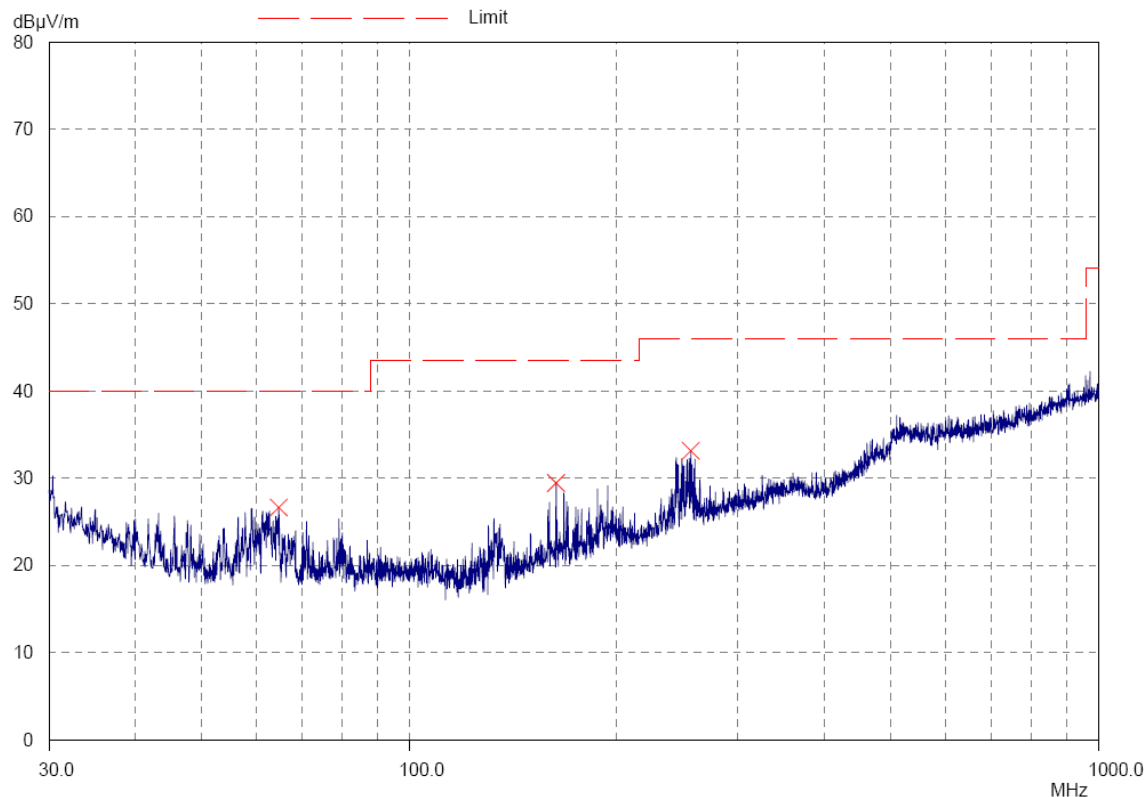
The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Result of Bluetooth Communication+ Charge mode (GFSK / $\pi/4$ -DQPSK/ 8DPSK) (30MHz – 1GHz):

Pass

Please refer to the following table for result details

Vertical



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STC Test Report

Date: 2015-05-30

Page 41 of 96

No.: MH191506

Result of Bluetooth Communication+Charge mode (GFSK / π /4-DQPSK/ 8DPSK) (30MHz – 1GHz):
Pass

Radiated Emissions					
Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dB μ V/m	Limit @3m dB μ V/m	Level @3m μ V/m	Limit @3m μ V/m
64.6	Vertical	29.6	40.0	30.2	100
163.4	Vertical	29.4	43.5	29.5	150
256.1	Vertical	33.1	46.0	45.2	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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STC Test Report

Date: 2015-05-30

Page 42 of 96

No.: MH191506

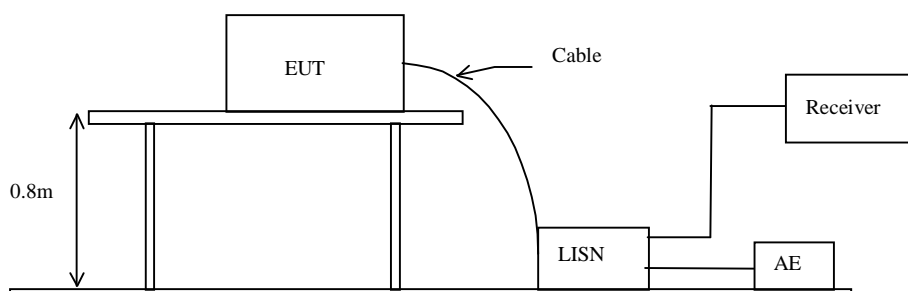
3.1.3 AC Mains Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.4:2009
Test Date:	2015-05-22
Mode of Operation:	Bluetooth Communication + Charge mode
Test Voltage:	120Va.c., 60Hz

Test Method:

The test was performed in accordance with ANSI C63.4: 2009, 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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STC Test Report

Date: 2015-05-30

Page 43 of 96

No.: MH191506

Limit for Conducted Emissions (FCC 47 CFR 15.207):

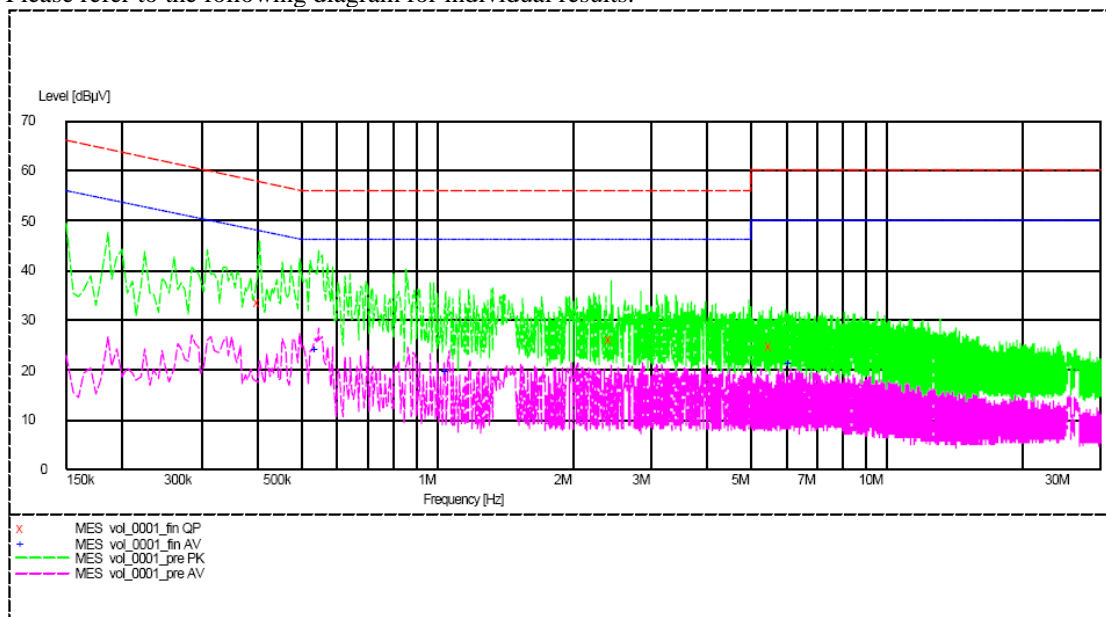
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* 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.

Result of Bluetooth Communication + Charge mode (L): PASS

Please refer to the following diagram for individual results.



Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dBμV	Limit dBμV	Level dBμV	Limit dBμV
Live	0.405	33.6	58.0	-*-	-*-
Live	2.445	26.2	56.0	-*-	-*-
Live	5.575	24.8	60.0	-*-	-*-
Live	0.545	-*-	-*-	24.1	46.0
Live	1.065	-*-	-*-	19.6	46.0
Live	6.145	-*-	-*-	21.1	50.0

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STC Test Report

Date: 2015-05-30

Page 44 of 96

No.: MH191506

Limit for Conducted Emissions (FCC 47 CFR 15.207):

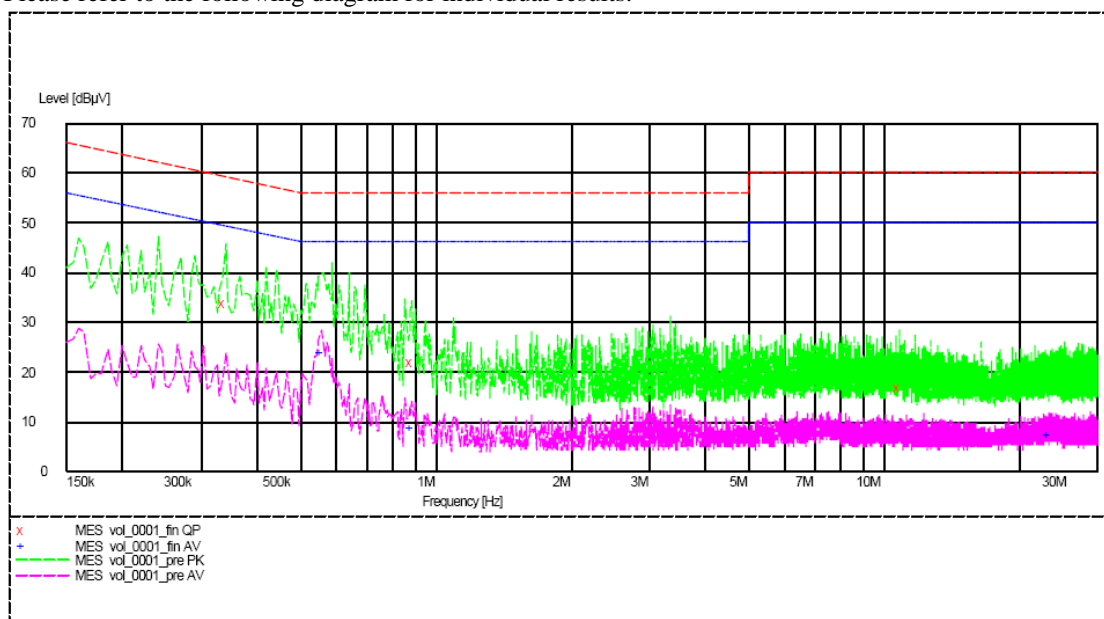
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* 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.

Result of Bluetooth Communication + Charge mode (N): PASS

Please refer to the following diagram for individual results.



Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dBμV	Limit dBμV	Level dBμV	Limit dBμV
Neutral	0.340	34.0	59.0	-*-	-*-
Neutral	0.885	21.9	56.0	-*-	-*-
Neutral	10.890	16.9	60.0	-*-	-*-
Neutral	0.555	-*-	-*-	23.7	46.0
Neutral	0.885	-*-	-*-	8.7	46.0
Neutral	23.375	-*-	-*-	7.3	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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Date: 2015-05-30

Page 45 of 96

No.: MH191506

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 = 1MHz, 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.

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STC Test Report

Date: 2015-05-30

Page 46 of 96

No.: MH191506

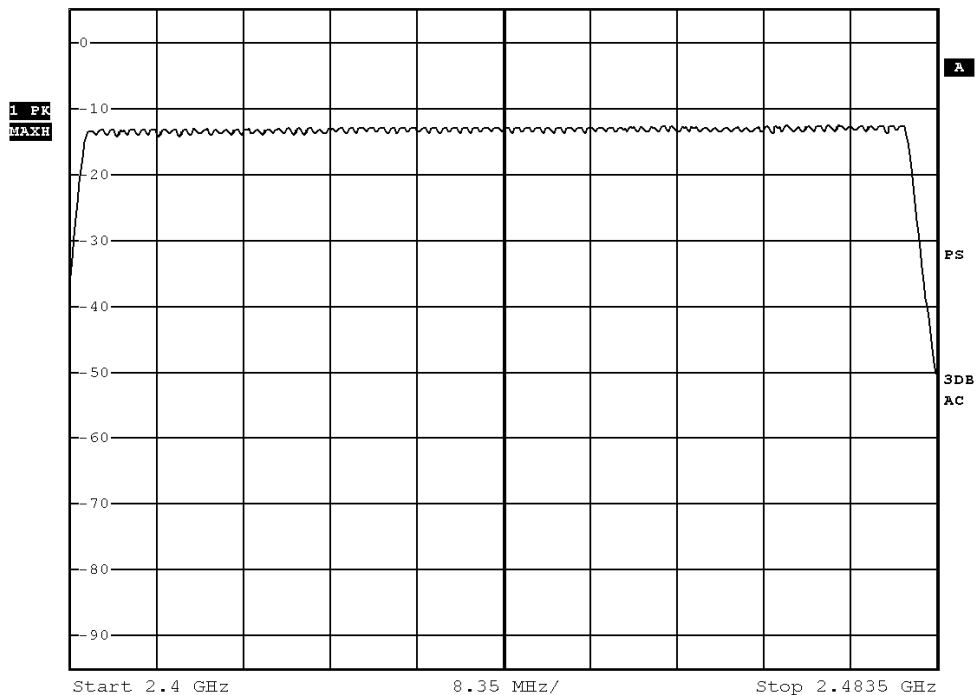
Measurement Data: GFSK: 79 of 79 Channel



*RBW 1 MHz
*VBW 1 MHz
SWT 2.5 ms

Ref 5 dBm

*Att 25 dB



BMP

Date: 23.MAY.2015 09:55:10

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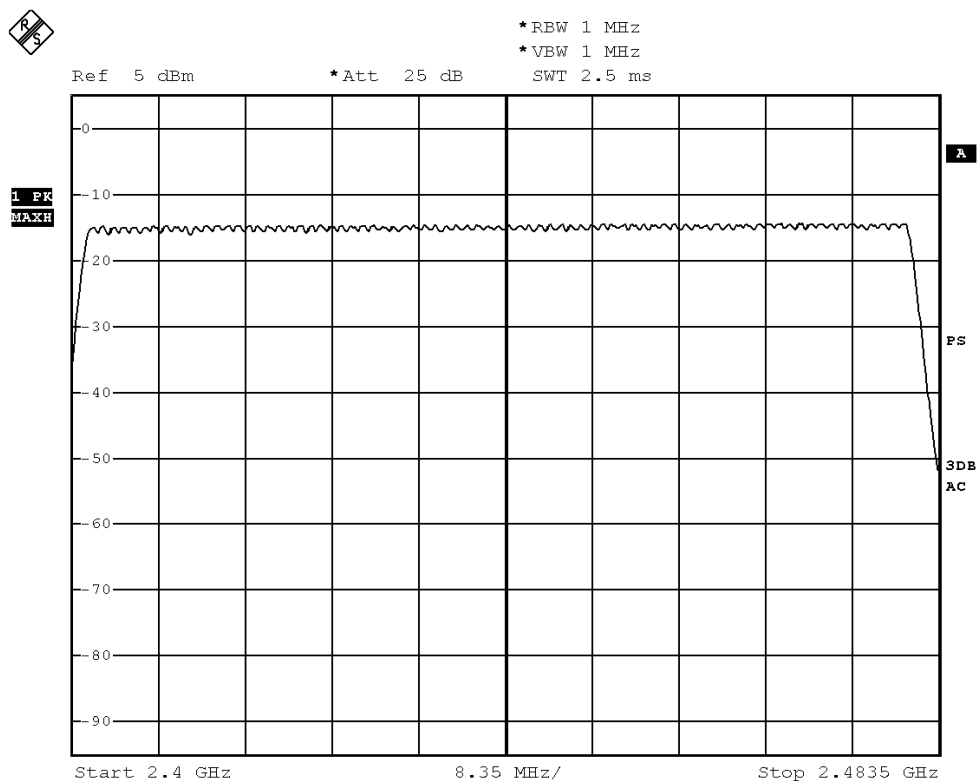
STC Test Report

Date: 2015-05-30

Page 47 of 96

No.: MH191506

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



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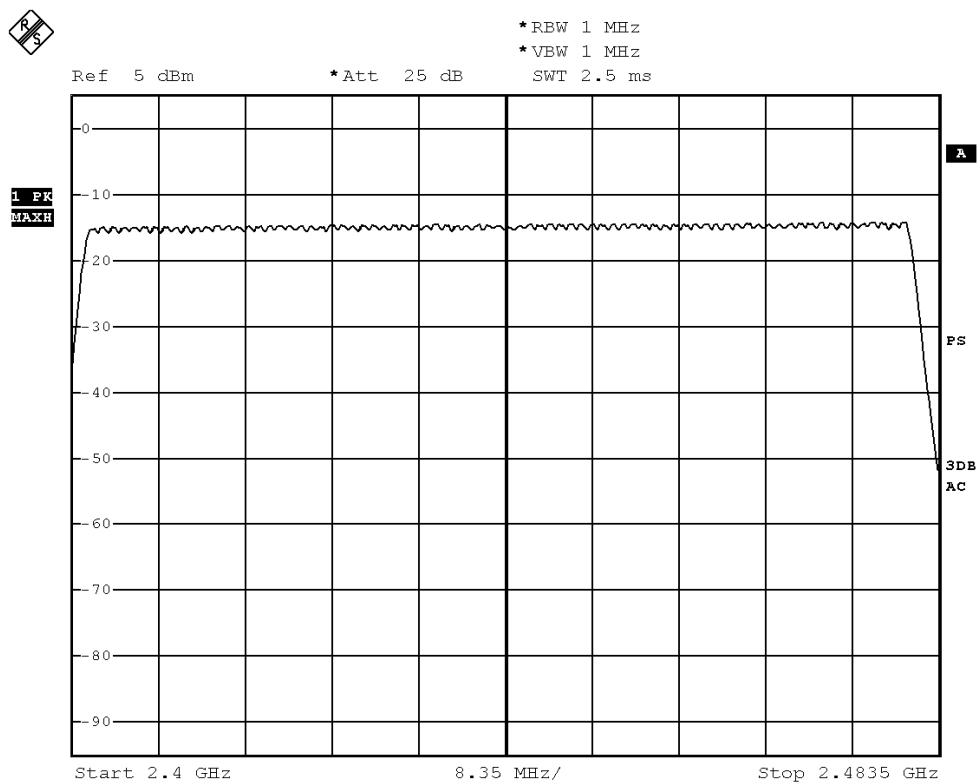
STC Test Report

Date: 2015-05-30

Page 48 of 96

No.: MH191506

8DPSK: 79 of 79 Channel



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STC Test Report

Date: 2015-05-30

Page 49 of 96

No.: MH191506

3.1.5 20dB Bandwidth

Test Requirement:	FCC 47CFR 15.247(a)(1)
Test Method:	ANSI C63.4:2009
Test Date:	2015-05-23
Mode of Operation:	Communication 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.

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

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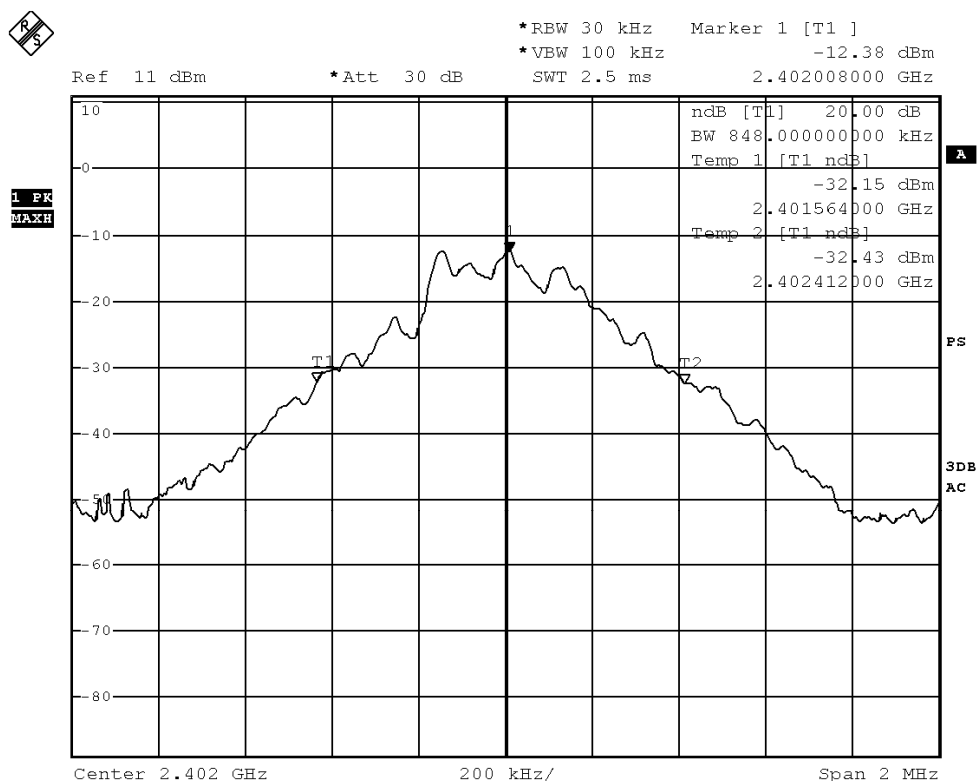
Date: 2015-05-30

Page 50 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	0.848	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)



BMP

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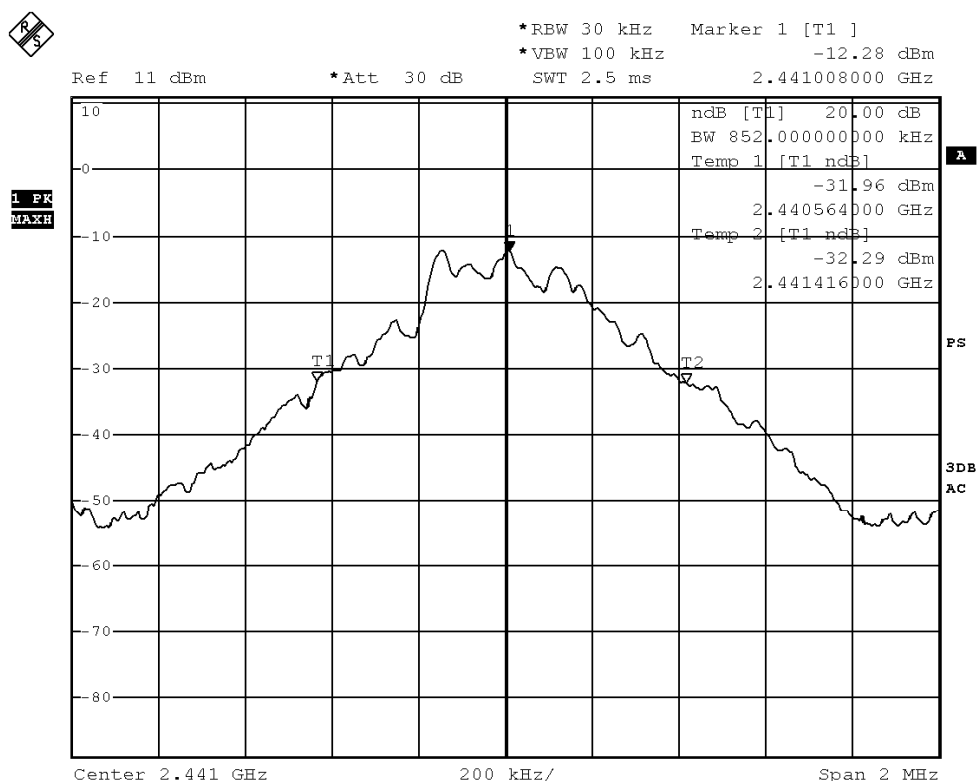
Date: 2015-05-30

Page 51 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	0.852	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



BMP

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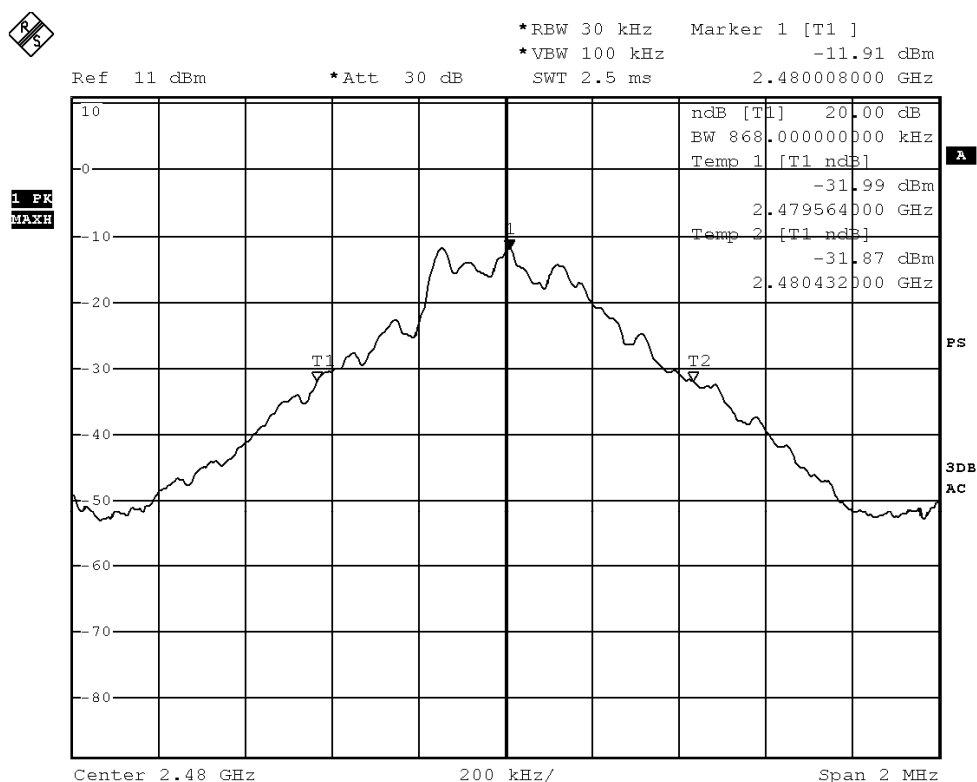
Date: 2015-05-30

Page 52 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	0.868	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)



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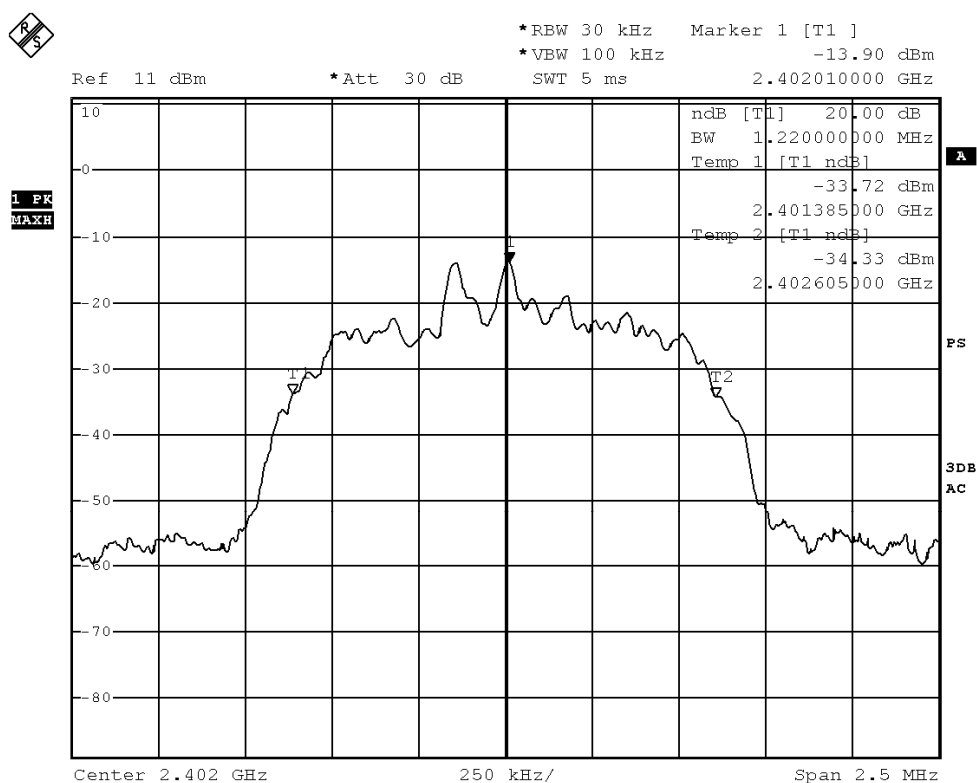
Date: 2015-05-30

Page 53 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.220	Within 2400-2483.5

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



BMP

Date: 23.MAY.2015 13:19:27

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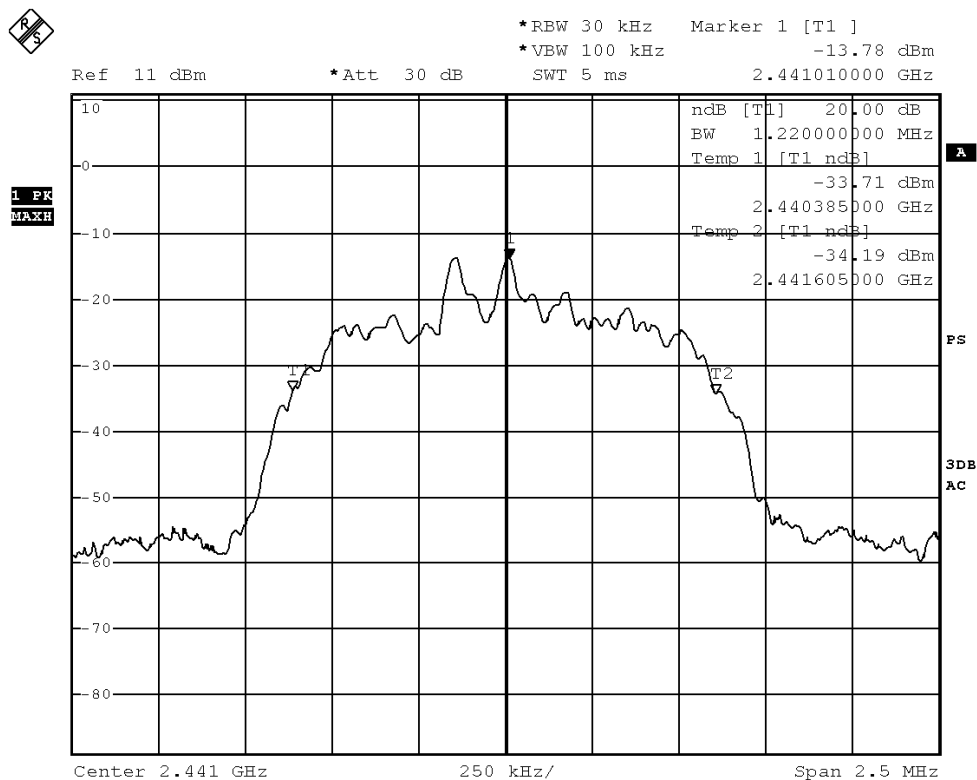
Date: 2015-05-30

Page 54 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.220	Within 2400-2483.5

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



BMP

Date: 23.MAY.2015 13:18:35

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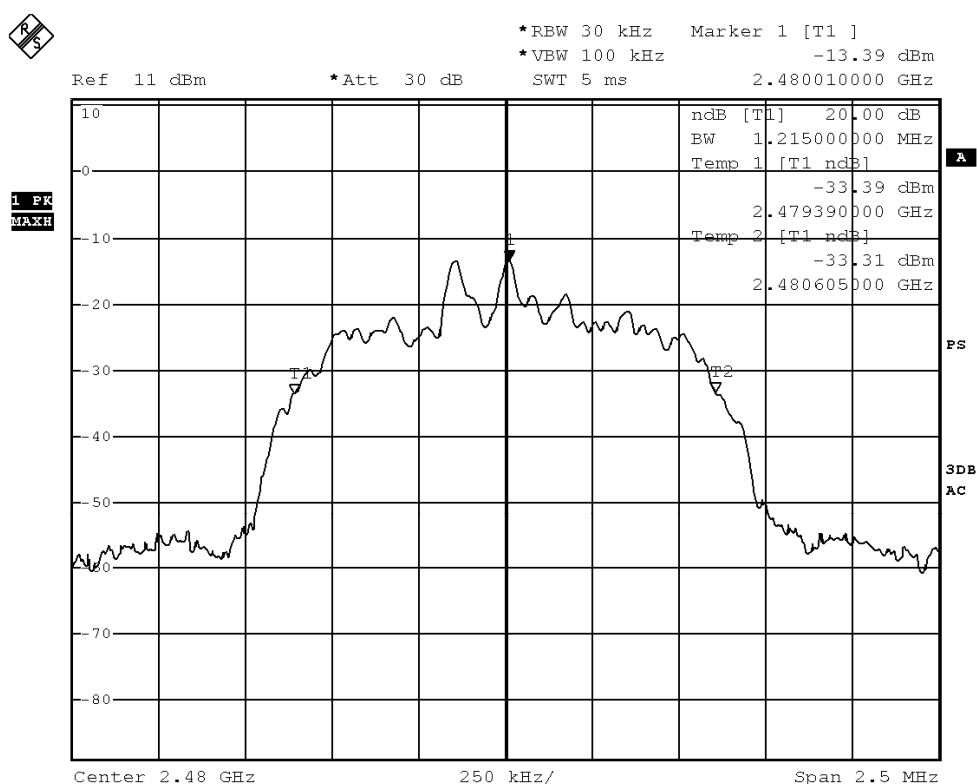
Date: 2015-05-30

Page 55 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.215	Within 2400-2483.5

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



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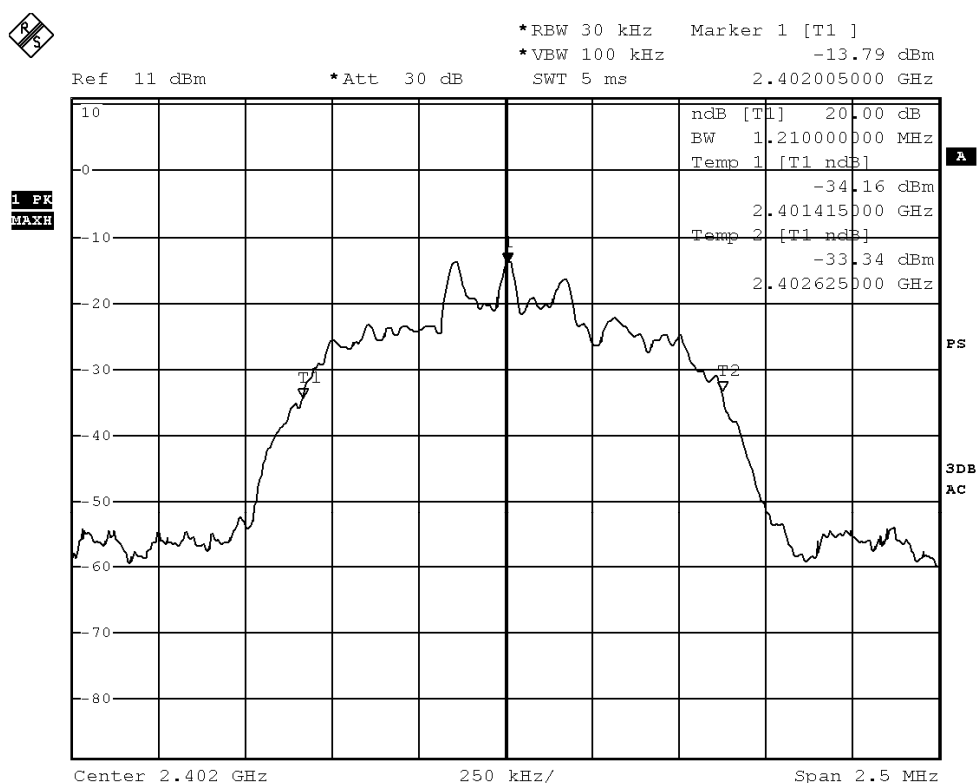
Date: 2015-05-30

Page 56 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.210	Within 2400-2483.5

(Lowest Operating Frequency) - (8DPSK)



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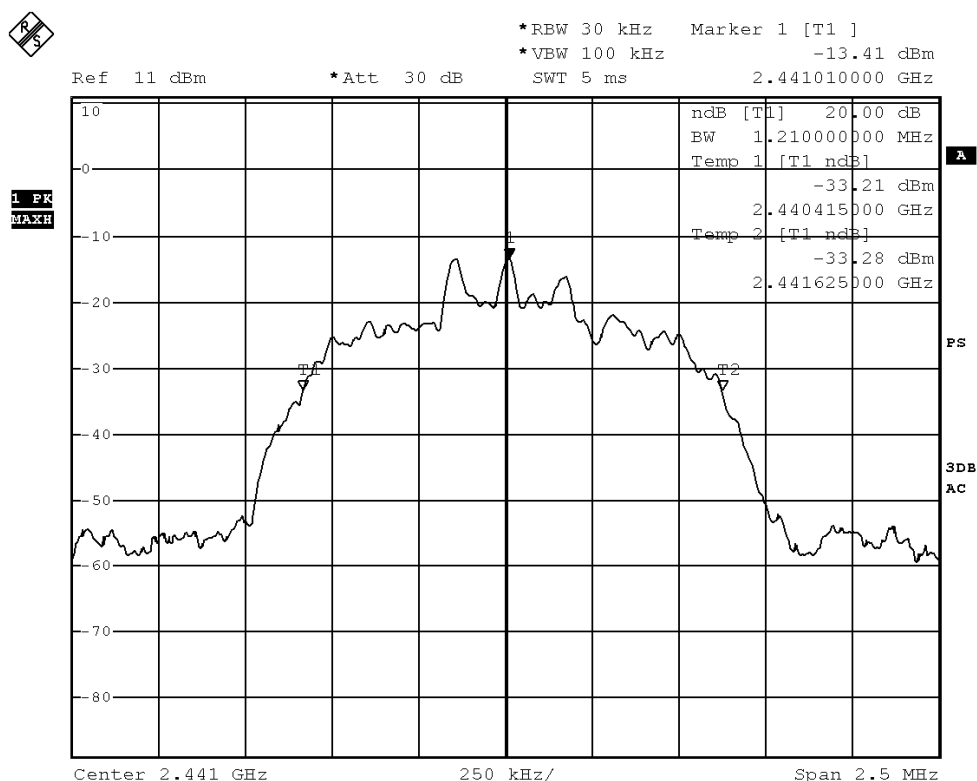
Date: 2015-05-30

Page 57 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.210	Within 2400-2483.5

(Middle Operating Frequency) - (8DPSK)



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Date: 23.MAY.2015 13:16:45

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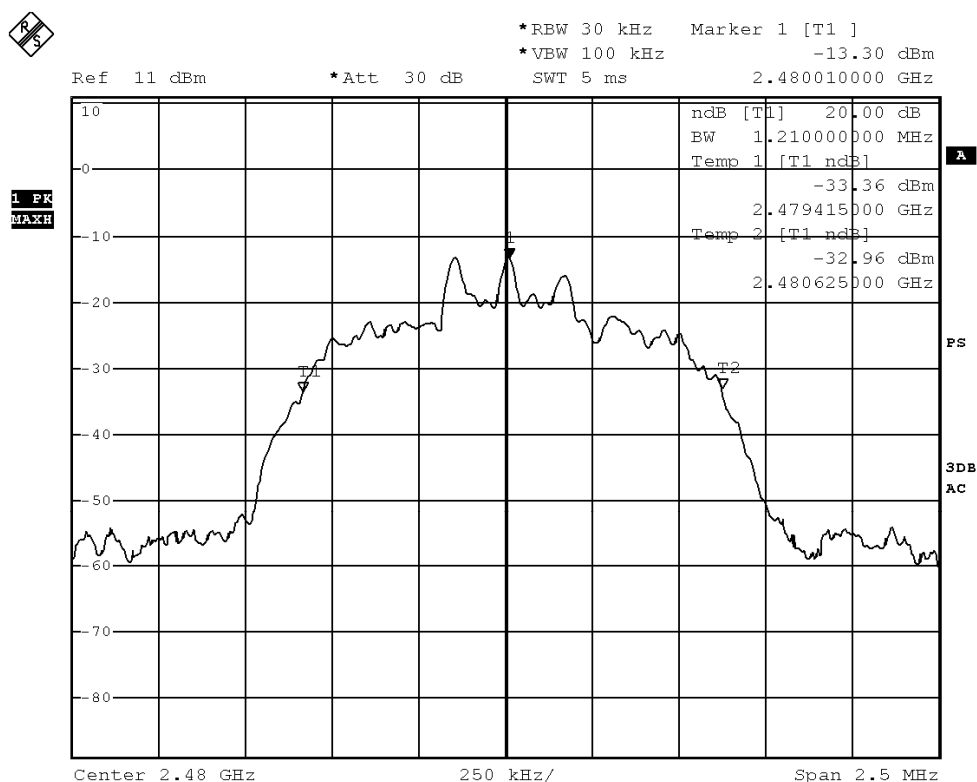
Date: 2015-05-30

Page 58 of 96

No.: MH191506

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.210	Within 2400-2483.5

(Highest Operating Frequency) - (8DPSK)



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Page 59 of 96

No.: MH191506

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.

Limit:

The measured minimum bandwidth $\times \frac{2}{3} = 1.22\text{MHz} \times \frac{2}{3} = 813.3\text{kHz}$

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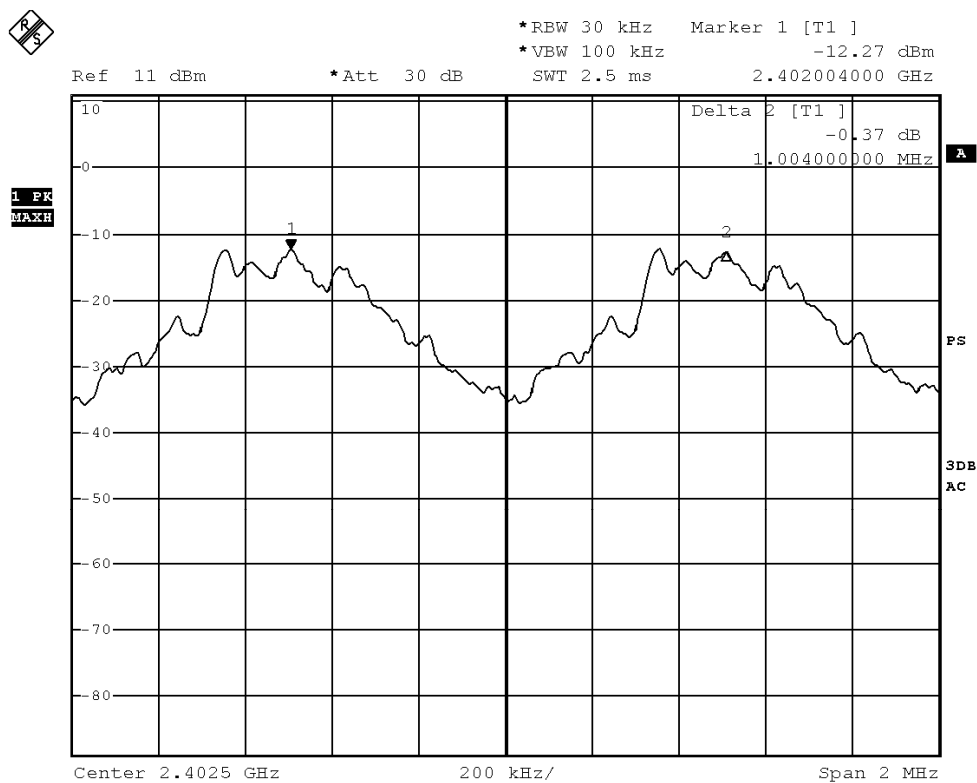
Date: 2015-05-30

Page 60 of 96

No.: MH191506

Channel separation = 1MHz (>813.3kHz) (GFSK)

Channel 1 – Channel 2, Pass



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Date: 23.MAY.2015 13:29:08

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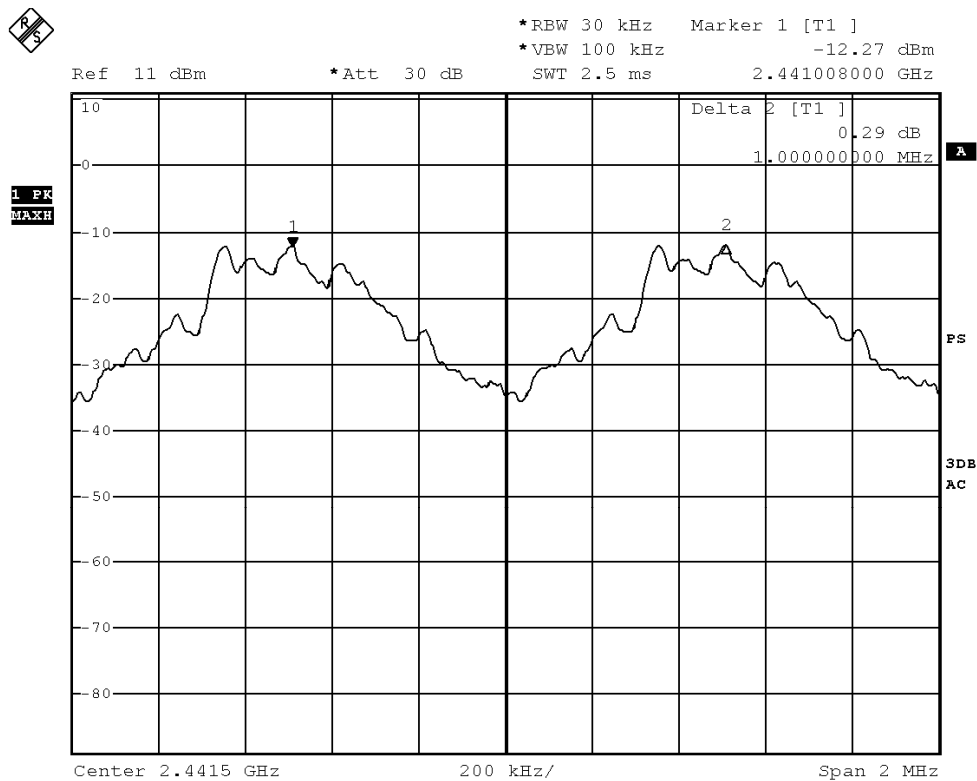
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Page 61 of 96

No.: MH191506

Channel 40 – Channel 41, Pass



BMP

Date: 23.MAY.2015 13:28:15

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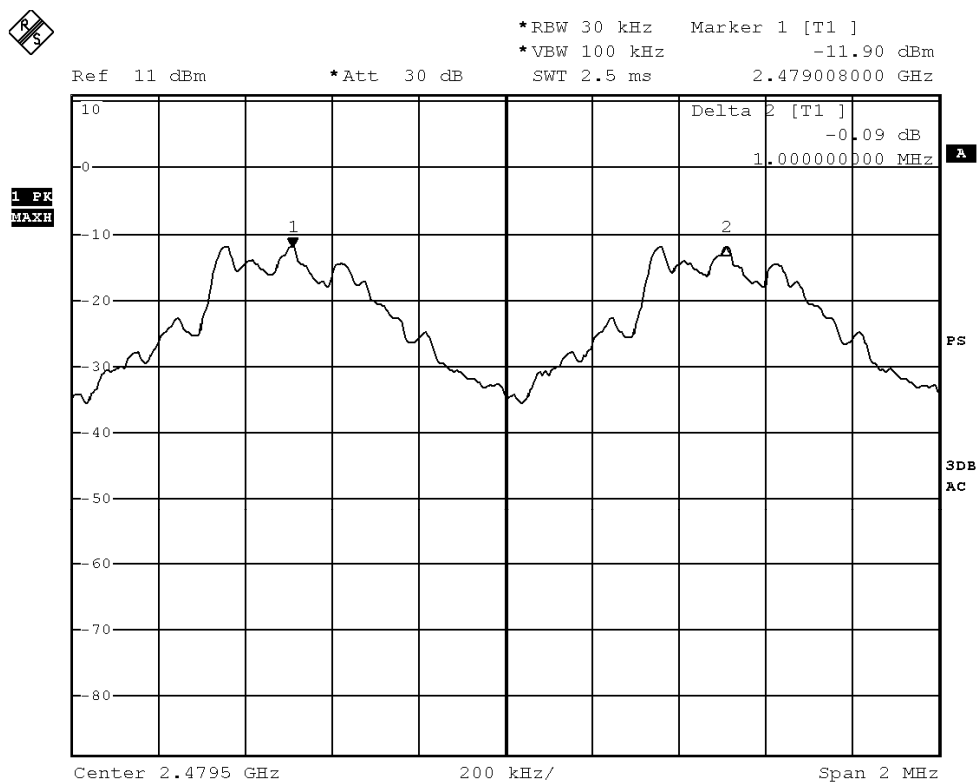
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Page 62 of 96

No.: MH191506

Channel 78 – Channel 79, Pass



BMP

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Page 63 of 96

Channel separation = 1MHz (>813.3kHz) ($\pi/4$ - DQPSK)

Ref 11 dBm *Att 30 dB SWT 5 ms 2.402005000 GHz

Delta 2 [T1]
-0.09 dB
1.005000000 MHz

PS
3DB
AC

Center 2.4025 GHz 250 kHz/ Span 2.5 MHz

Date: 23.MAY.2015 13:30:59

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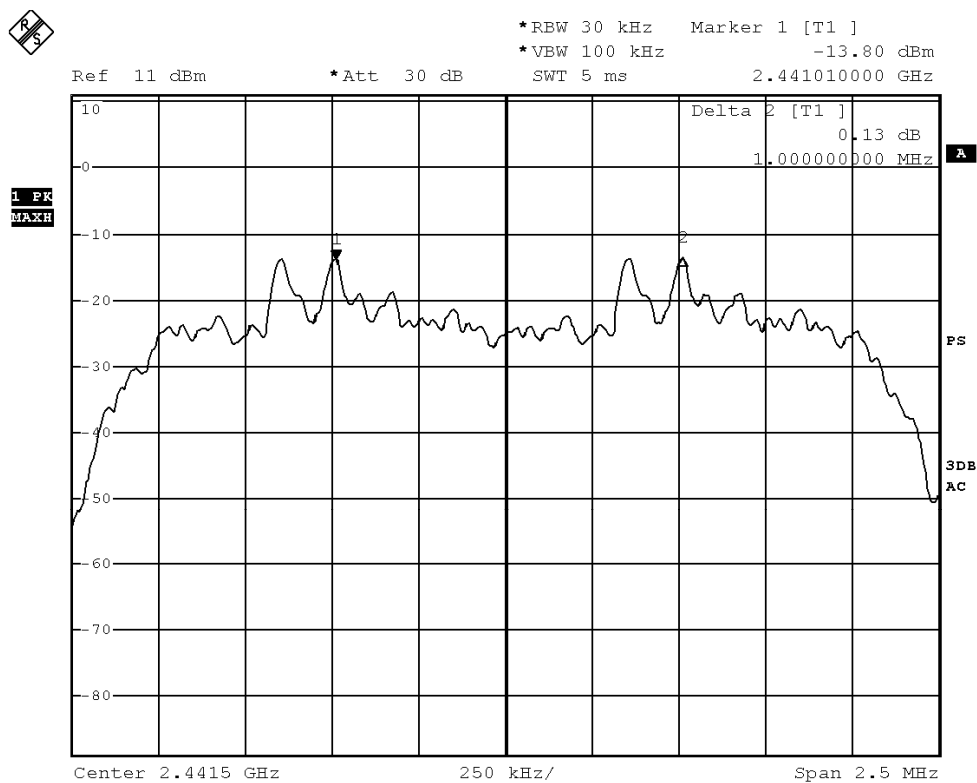
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Page 64 of 96

No.: MH191506

Channel 40 – Channel 41, Pass



BMP

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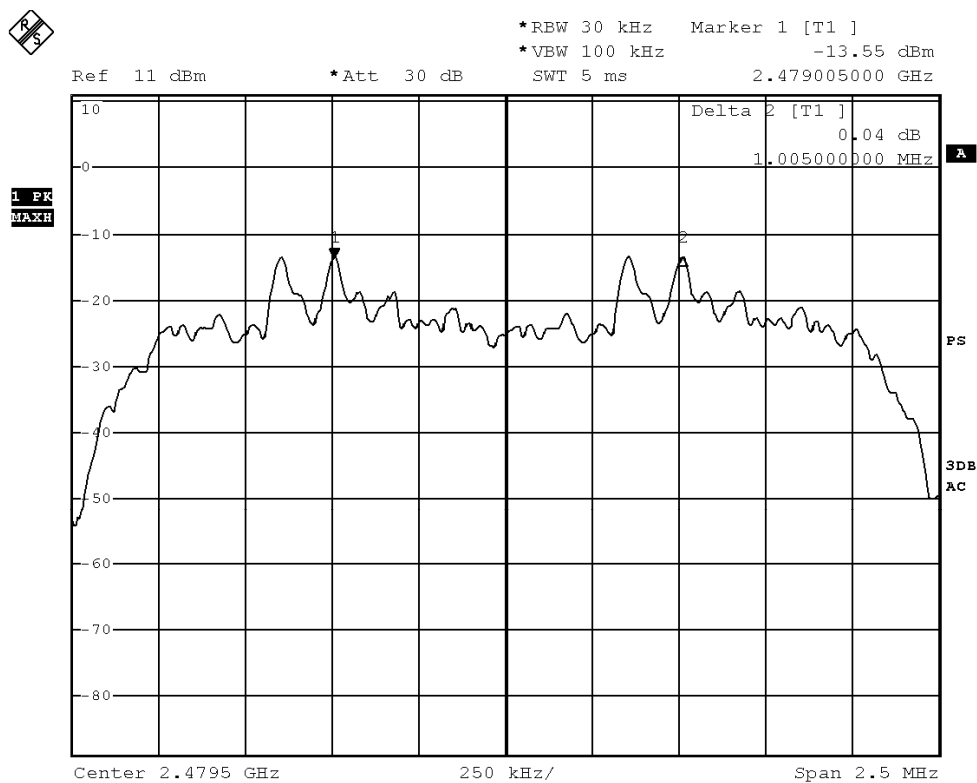
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Date: 2015-05-30

Page 65 of 96

No.: MH191506

Channel 78 – Channel 79, Pass



BMP

Date: 23.MAY.2015 13:32:59

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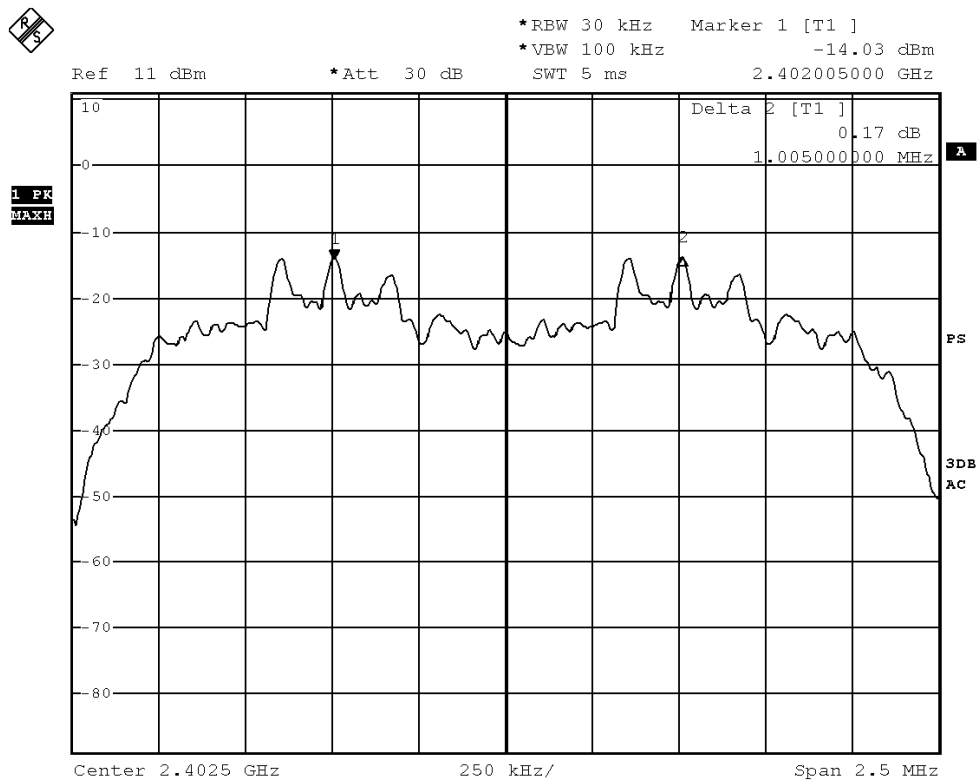
Date: 2015-05-30

Page 66 of 96

No.: MH191506

Channel separation = 1MHz (>813.3kHz) (8DPSK)

Channel 1 – Channel 2, Pass



BMP

Date: 23.MAY.2015 13:36:08

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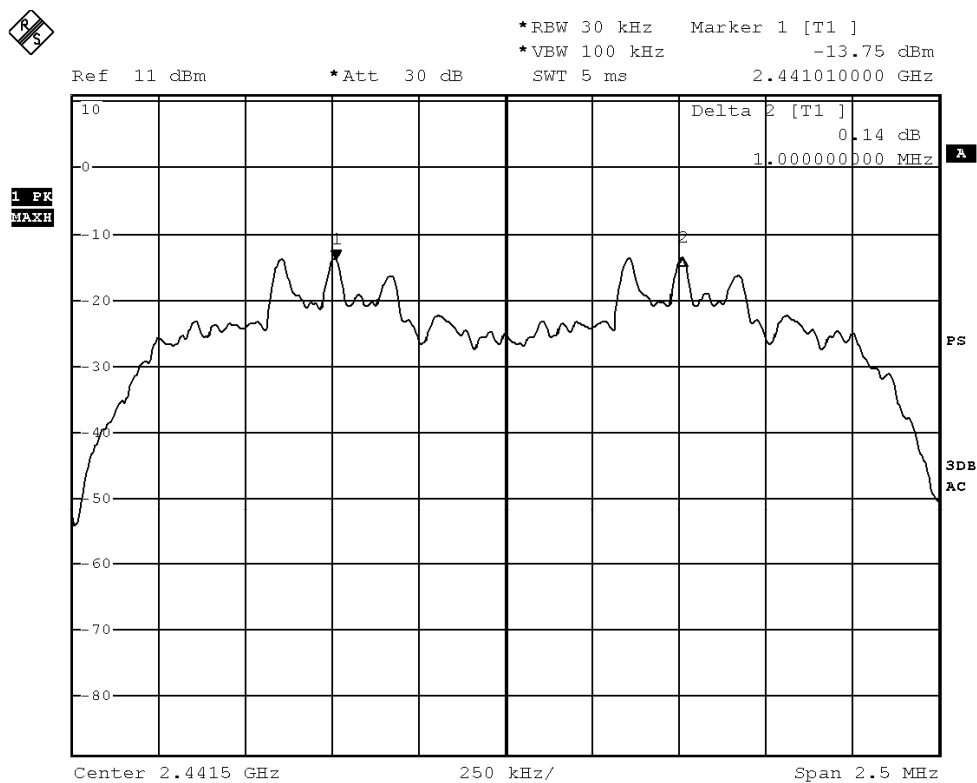
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Page 67 of 96

No.: MH191506

Channel 40– Channel 41, Pass



BMP

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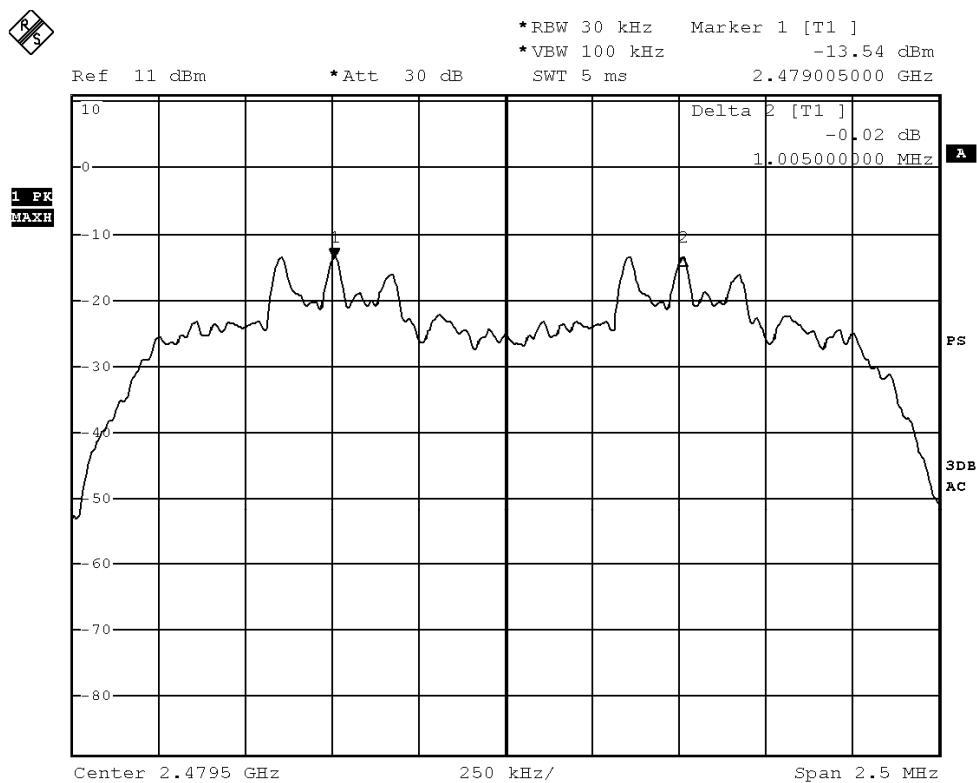
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Date: 2015-05-30

Page 68 of 96

No.: MH191506

Channel 78 – Channel 79, Pass



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Page 69 of 96

No.: MH191506

3.1.7 Band Edges Measurement

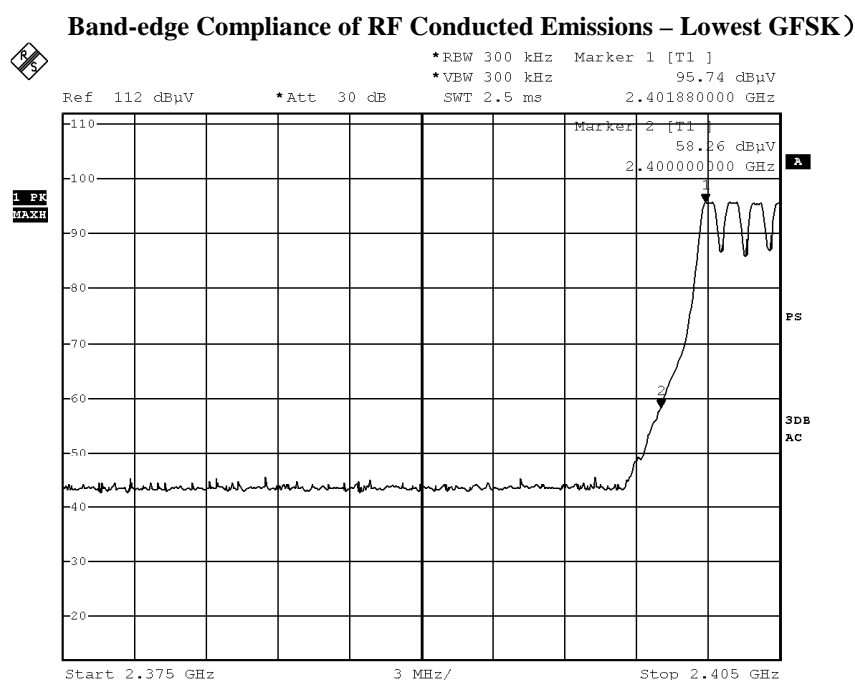
Band-edge Compliance of RF Conducted Emissions Measurement:

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.

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

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	37.48



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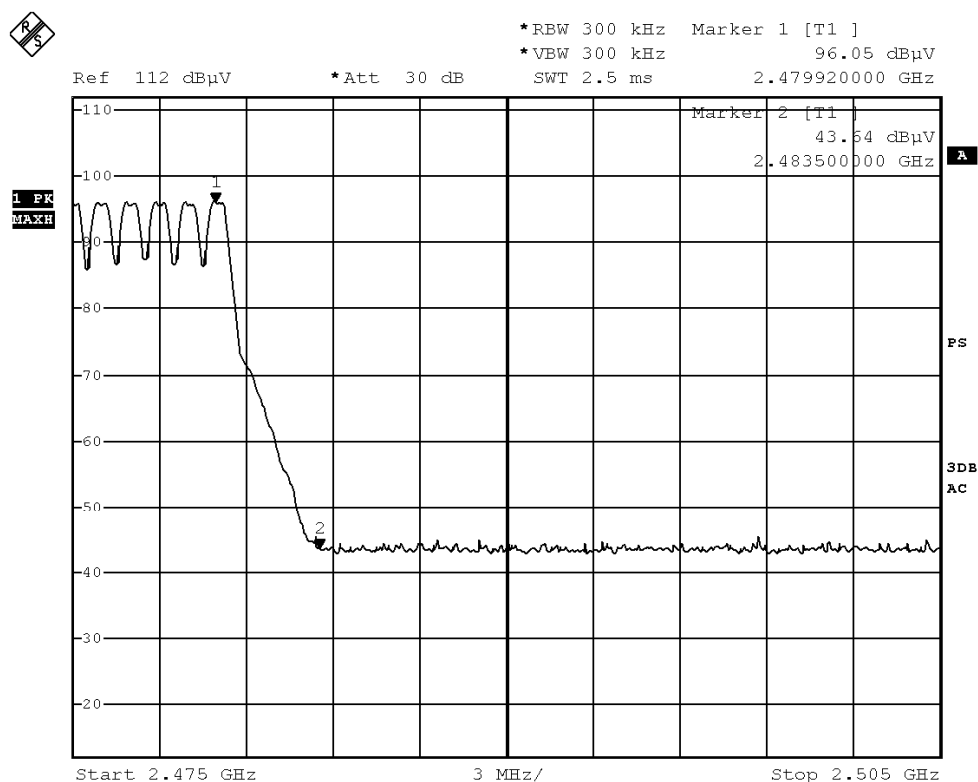
Page 70 of 96

No.: MH191506

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2483.5 - Highest Fundamental (2480)	52.41

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



BMP

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Page 71 of 96

No.: MH191506

Band-edge Compliance of RF Conducted Emissions Measurement:

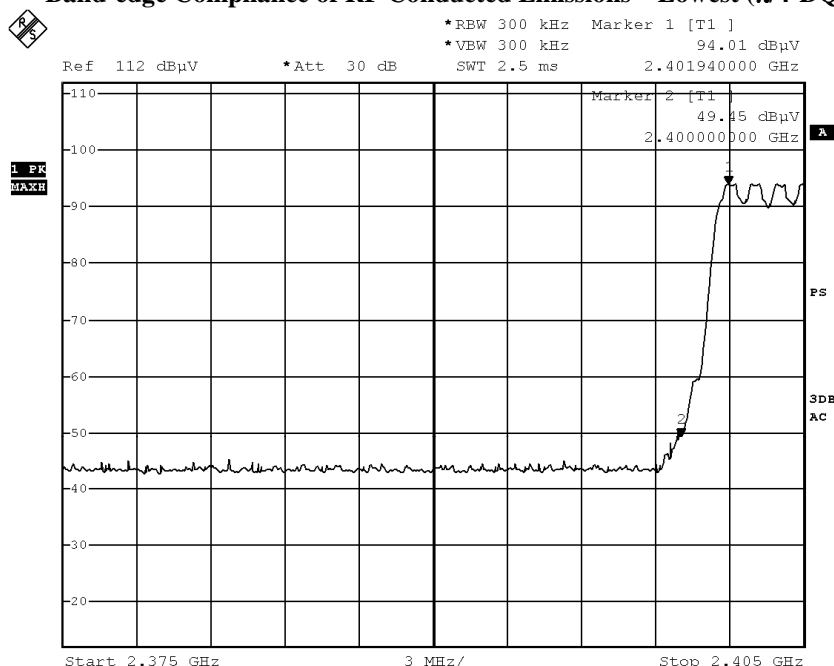
Limit :

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.

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

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2400 – Lowest Fundamental (2402)	44.56

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



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Page 72 of 96

No.: MH191506

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2483.5 - Highest Fundamental (2480)	51.79

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

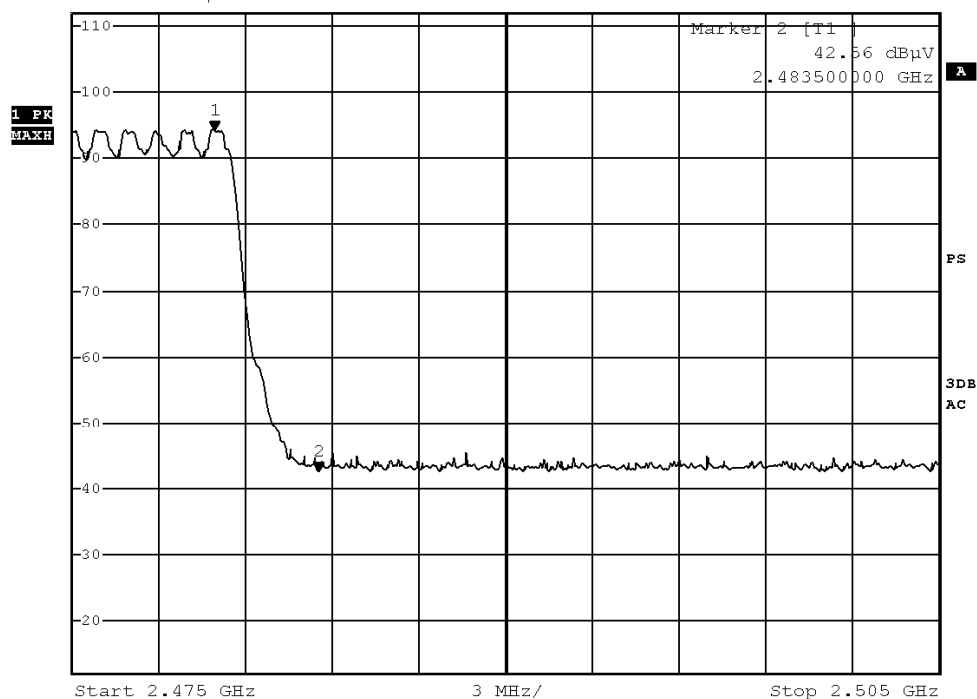


*RBW 300 kHz Marker 1 [T1]
*VBW 300 kHz 94.35 dBμV
SWT 2.5 ms 2.479920000 GHz

Ref 112 dBμV

*Att 30 dB

2.479920000 GHz



BMP

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STC Test Report

Date: 2015-05-30

Page 73 of 96

No.: MH191506

Band-edge Compliance of RF Conducted Emissions Measurement:

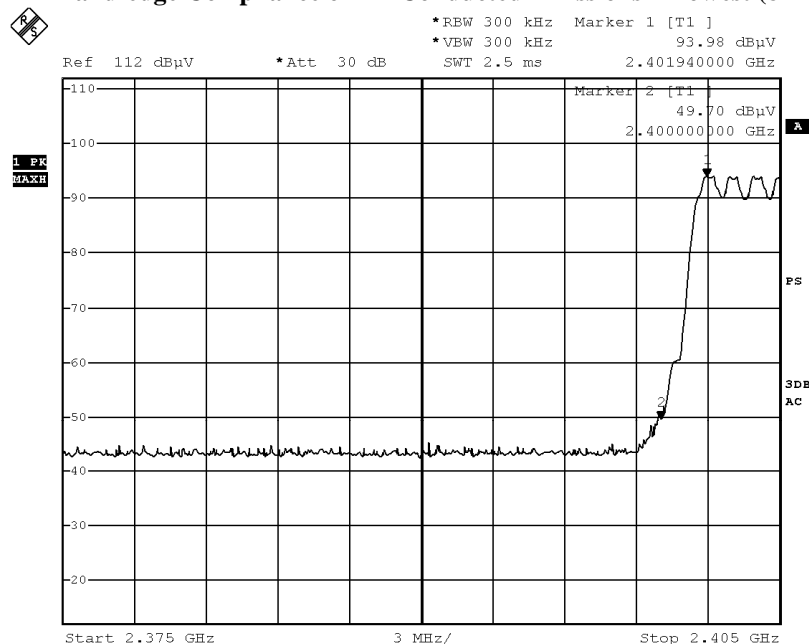
Limit :

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.

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

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2400 – Lowest Fundamental (2402)	44.28

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



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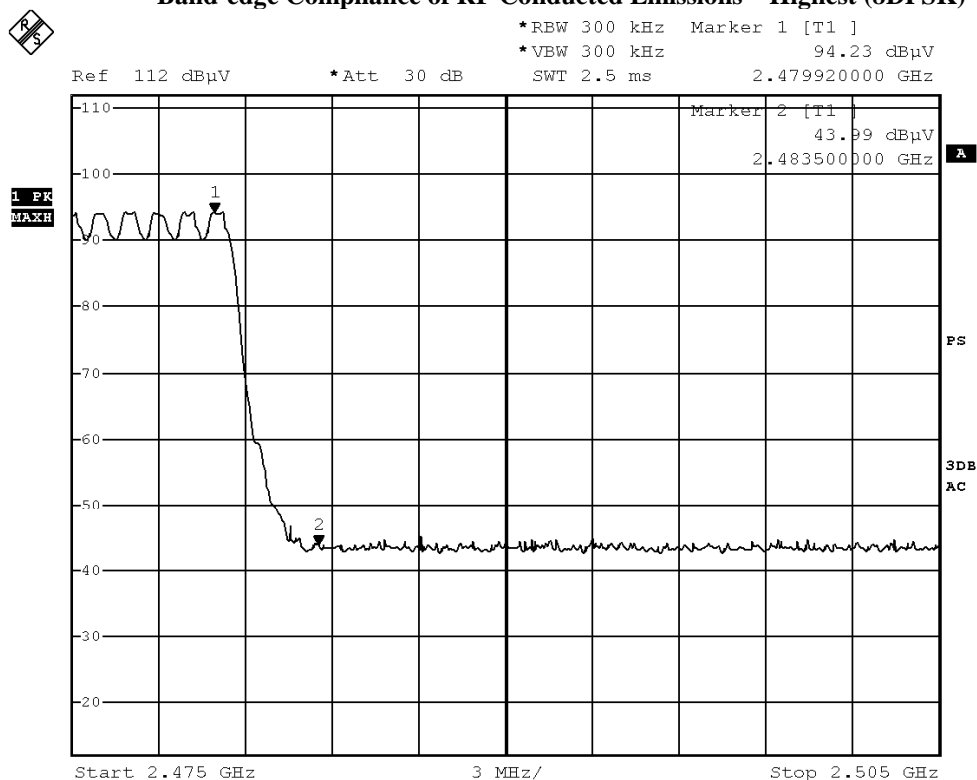
Page 74 of 96

No.: MH191506

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2483.5 - Highest Fundamental (2480)	50.24

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



BMP

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Date: 2015-05-30

Page 75 of 96

No.: MH191506

Band-edge Compliance of RF 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: Band-edge Compliance of RF Radiated Emissions –Lowest (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	19.7	36.8	56.5	74.0	17.5	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	6.6	36.8	43.4	54.0	10.6	Vertical

Result: Band-edge Compliance of RF Radiated Emissions –Highest (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	18.9	36.4	55.3	74.0	18.7	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	4.3	36.4	40.7	54.0	13.3	Horizontal

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Page 76 of 96

No.: MH191506

Band-edge Compliance of RF 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: Band-edge Compliance of RF Radiated Emissions –Lowest ($\pi/4$ -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	20.4	36.8	57.2	74.0	16.8	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	6.6	36.8	43.4	54.0	10.6	Vertical

Result: Band-edge Compliance of RF Radiated Emissions -Highest ($\pi/4$ -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	19.6	36.4	56.0	74.0	18.0	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	5.7	36.4	42.1	54.0	11.9	Horizontal

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STC Test Report

Date: 2015-05-30

Page 77 of 96

No.: MH191506

Band-edge Compliance of RF 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: Band-edge Compliance of RF Radiated Emissions –Lowest (8DPSK)

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	20.0	36.8	56.8	74.0	17.2	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	5.9	36.8	42.7	54.0	11.3	Vertical

Result: Band-edge Compliance of RF Radiated Emissions –Highest (8DPSK)

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	19.2	36.4	55.6	74.0	18.4	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	5.4	36.4	41.8	54.0	12.2	Horizontal

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Date: 2015-05-30

Page 78 of 96

No.: MH191506

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.

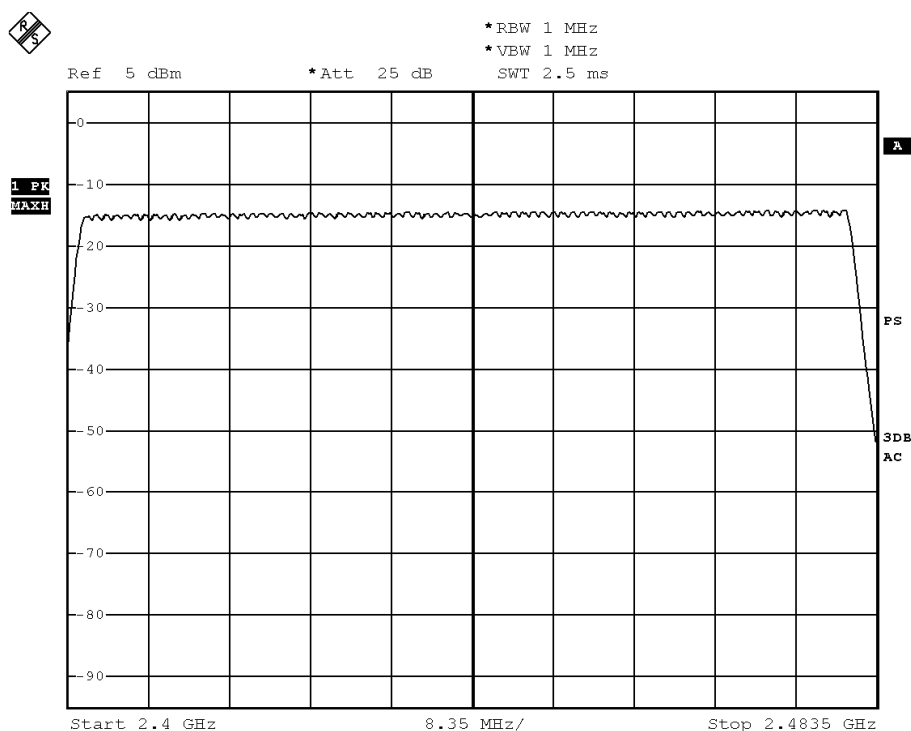
No requirements for Digital Transmission System.

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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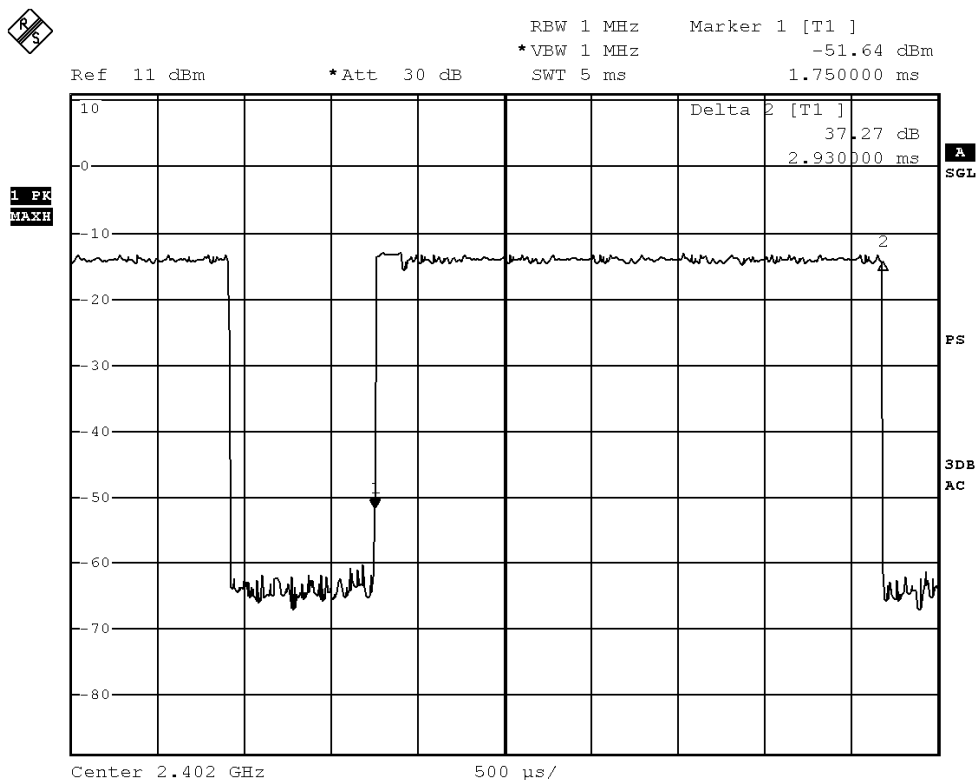
Page 79 of 96

No.: MH191506

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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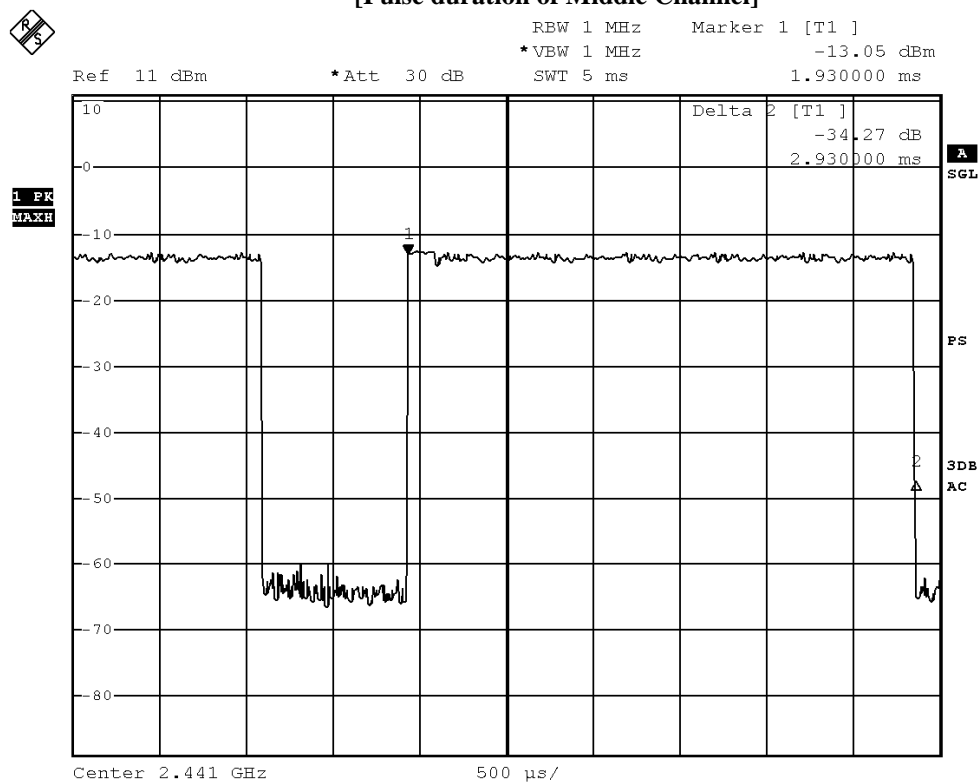
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Date: 2015-05-30

Page 80 of 96

No.: MH191506

Fig. B
[Pulse duration of Middle Channel]



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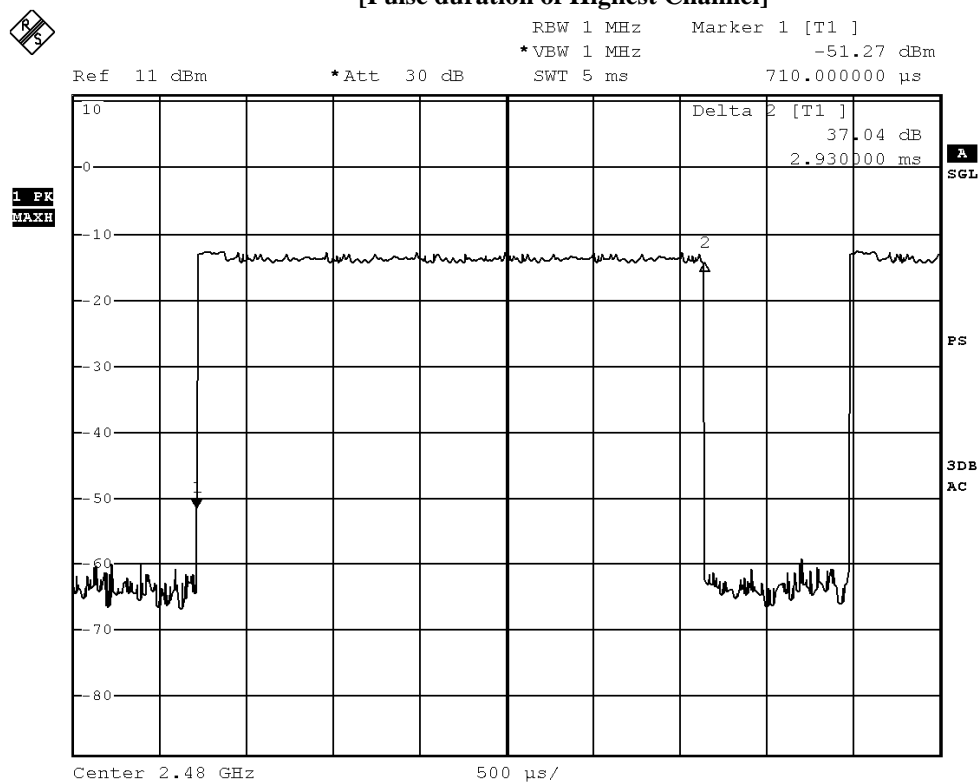
STC Test Report

Date: 2015-05-30

Page 81 of 96

No.: MH191506

Fig. C
[Pulse duration of Highest Channel]



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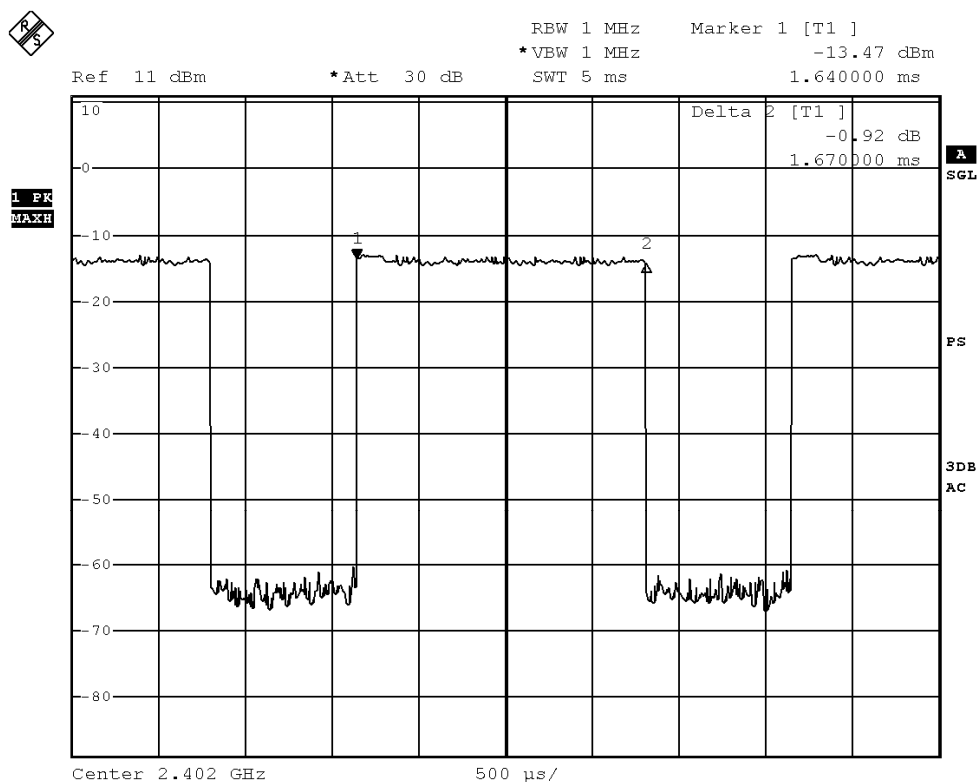
Page 82 of 96

No.: MH191506

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]



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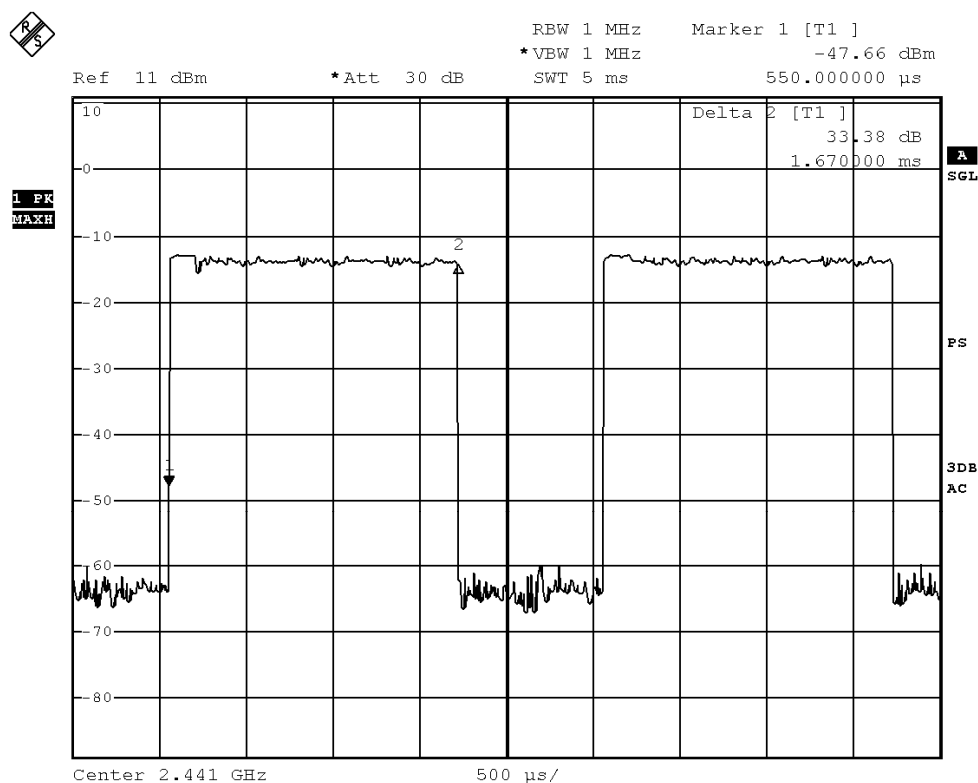
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Date: 2015-05-30

Page 83 of 96

No.: MH191506

Fig. E
[Pulse duration of Middle Channel]



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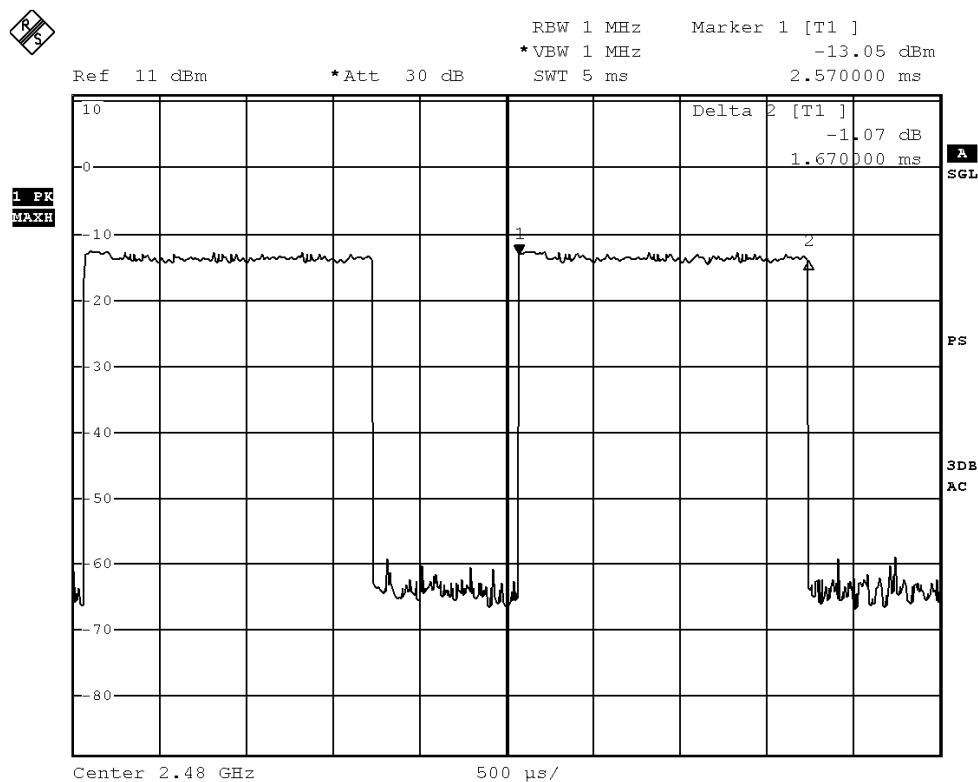
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Page 84 of 96

No.: MH191506

Fig. F
[Pulse duration of Highest Channel]



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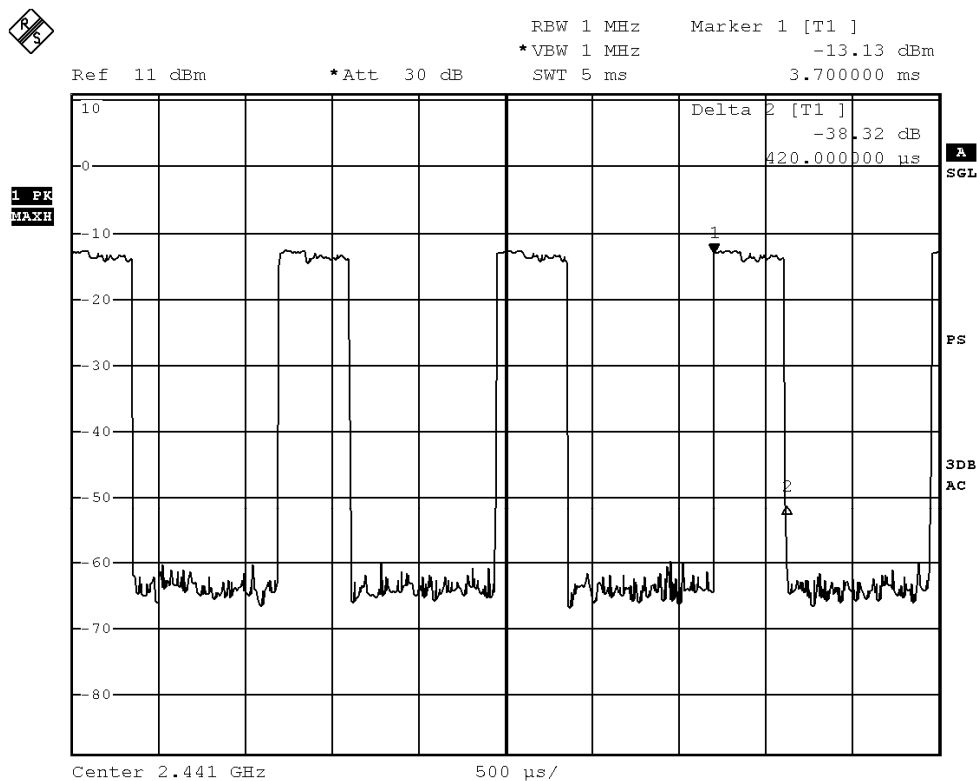
Page 85 of 96

No.: MH191506

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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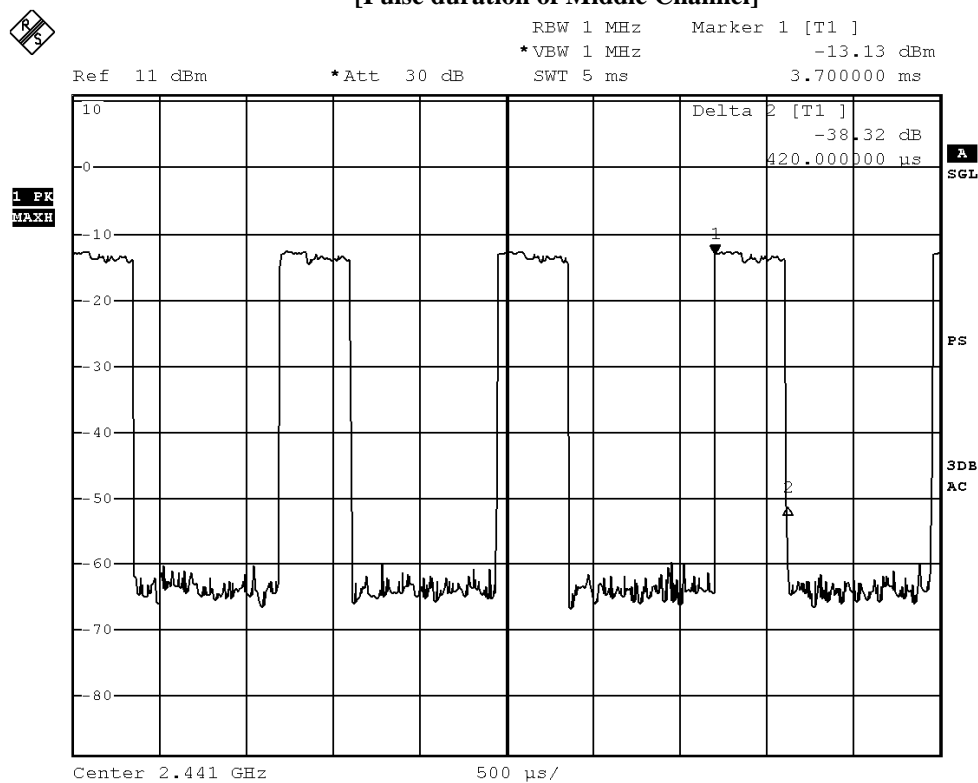
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Date: 2015-05-30

Page 86 of 96

No.: MH191506

Fig. H
[Pulse duration of Middle Channel]



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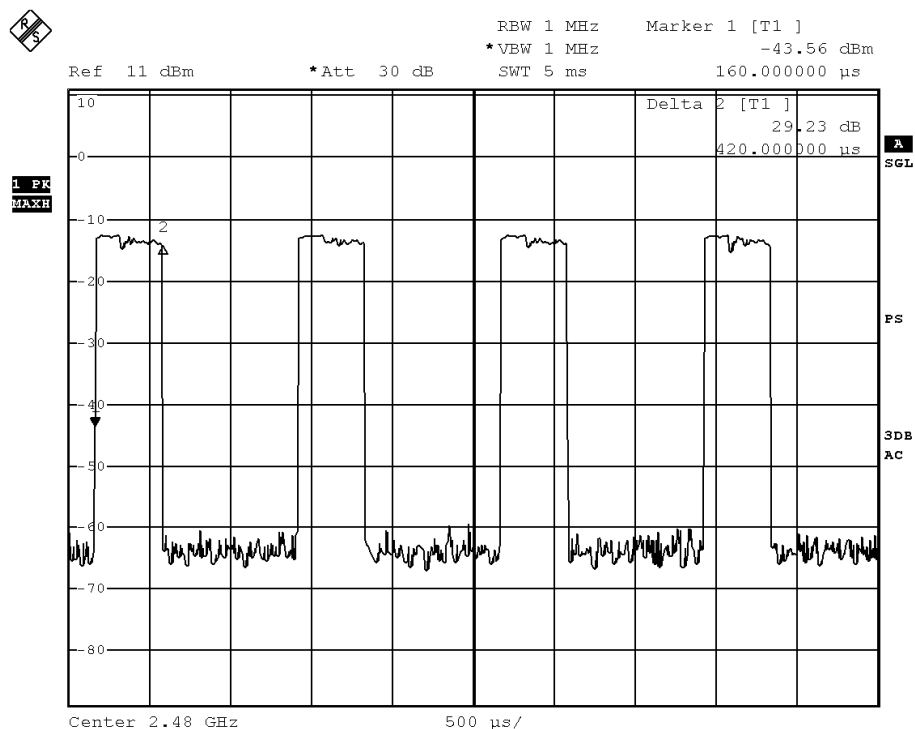
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Date: 2015-05-30

Page 87 of 96

No.: MH191506

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	2.930	0.312	0.400	Complies
DH5	2441	2.930	0.312	0.400	Complies
DH5	2480	2.930	0.312	0.400	Complies
DH3	2402	1.670	0.268	0.400	Complies
DH3	2441	1.670	0.268	0.400	Complies
DH3	2480	1.670	0.268	0.400	Complies
DH1	2402	0.420	0.134	0.400	Complies
DH1	2441	0.420	0.134	0.400	Complies
DH1	2480	0.420	0.134	0.400	Complies

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Date: 2015-05-30

Page 88 of 96

No.: MH191506

3.1.9 Channel Centre Frequency

Requirements:

Frequency hopping system in the 2400-2483.5MHz band shall use at least 79 (Channel 0 to 78) 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 = 0,...,78 (Channel separation = 1MHz)

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Date: 2015-05-30

Page 89 of 96

No.: MH191506

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: 2015-05-30

Page 90 of 96

No.: MH191506

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 Meander line antenna. There is no external antenna, the antenna gain = -2.22dBi. User is unable to remove or changed the Antenna.

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Date: 2015-05-30

Page 91 of 96

No.: MH191506

3.1.12 RF Exposure

Test Requirement:	FCC 47CFR 15.247(i)
Test Date:	2015-05-23
Mode of Operation:	Tx mode

Requirements:

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

According to KDB447498 D01 General RF Exposure Guidance v05, unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition.

Test Results:

RF Exposure Evaluation

The Maximum conducted output power = 0.809 mW (at frequency = 2.441 GHz)

It's Conducted source-based time-averaging output power = 0.795 mW (at frequency = 2.441 GHz)

Since the SAR test exclusion thresholds for 2450MHz at test separation distances ≤ 5 mm = 10mW and the Conducted source-based time-averaging output power is less than 10mW.

Therefore, the SAR evaluation can be exempted.

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STC Test Report

Date: 2015-05-30

Page 92 of 96

No.: MH191506

Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM299	DOUBLE-RIDGED WAVEGUIDE HORN ANTENNA	ETS-LINDGREN	3115	00114120	2014/01/15	2016/01/25
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2014/01/23	2016/01/23
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM216	MINI MAST SYSTEM	EMCO	2075	00026842	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2014/09/29	2015/09/29
EM320	BICONILOG ANTENNA	ETS-LINDGREN	3142D	00094856	2014/08/06	2016/08/06
EM022	LOOP ANTENNA	EMCO	6502	1189-2424	2014/01/15	2016/01/15
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2014/05/26	2015/05/26
RE01	RF CABLE	N/A	N/A	N/A	2014-9-28	2015-9-27
RE02	RF CABLE	N/A	N/A	N/A	2014-9-28	2015-9-27

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM232	LISN	SCHAFFNER	NNB41	04/100082	2014/12/08	2015/12/08
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2014/05/26	2015/05/26
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2015/01/14	2016/01/14
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2012/02/03	2017/02/03

Remarks:-

N/A Not Applicable or Not Available

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Page 93 of 96

No.: MH191506

Appendix B

Photographs of EUT

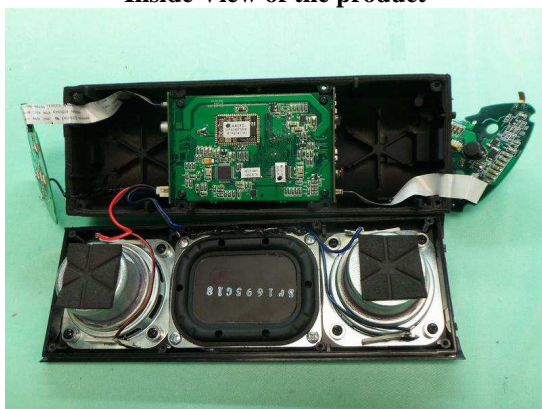
Front View of the product



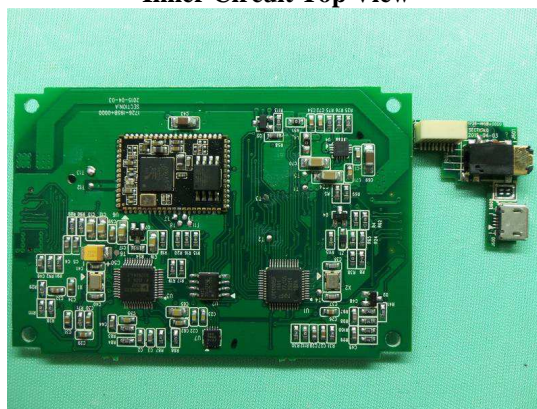
Rear View of the product



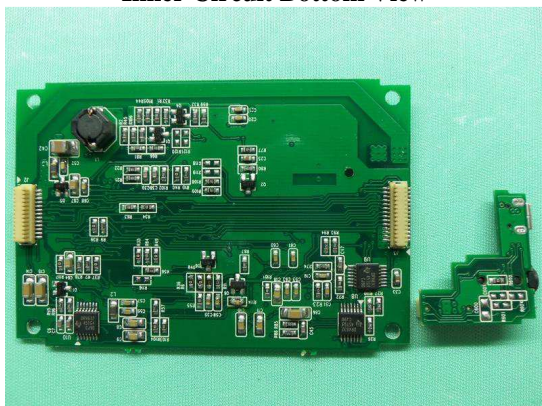
Inside View of the product



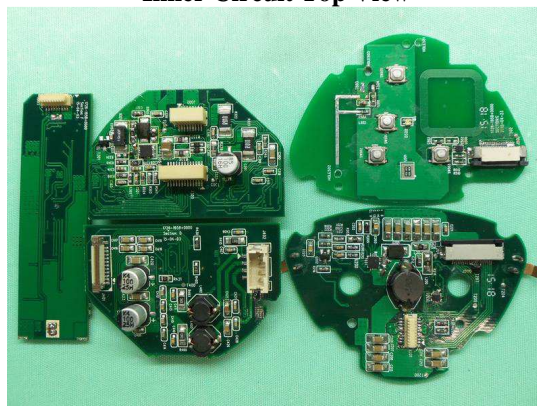
Inner Circuit Top View



Inner Circuit Bottom View



Inner Circuit Top View



Photographs of EUT

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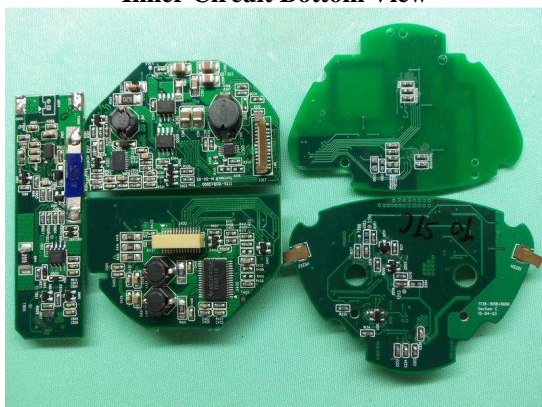
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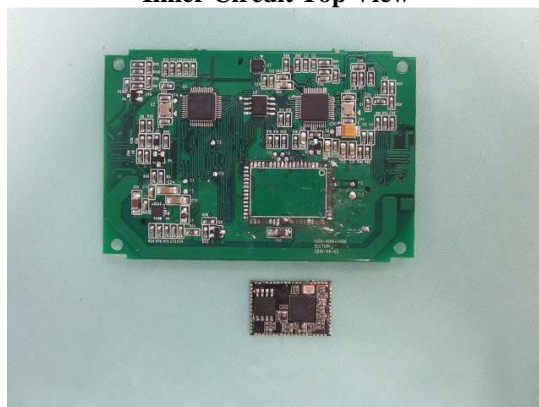
Page 94 of 96

No.: MH191506

Inner Circuit Bottom View



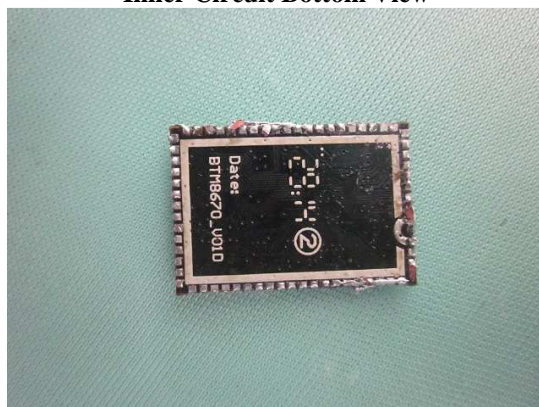
Inner Circuit Top View



Inner Circuit Top View



Inner Circuit Bottom View



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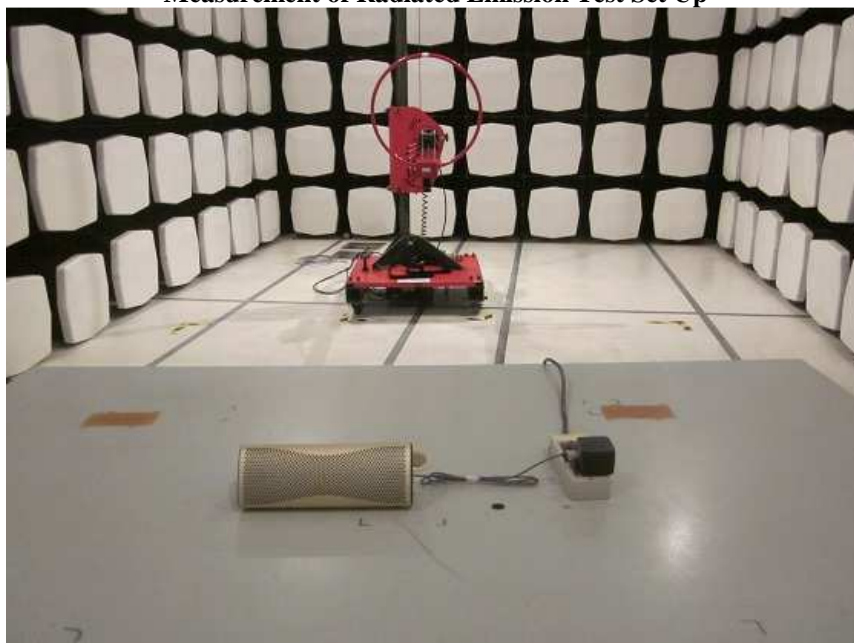
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Page 95 of 96

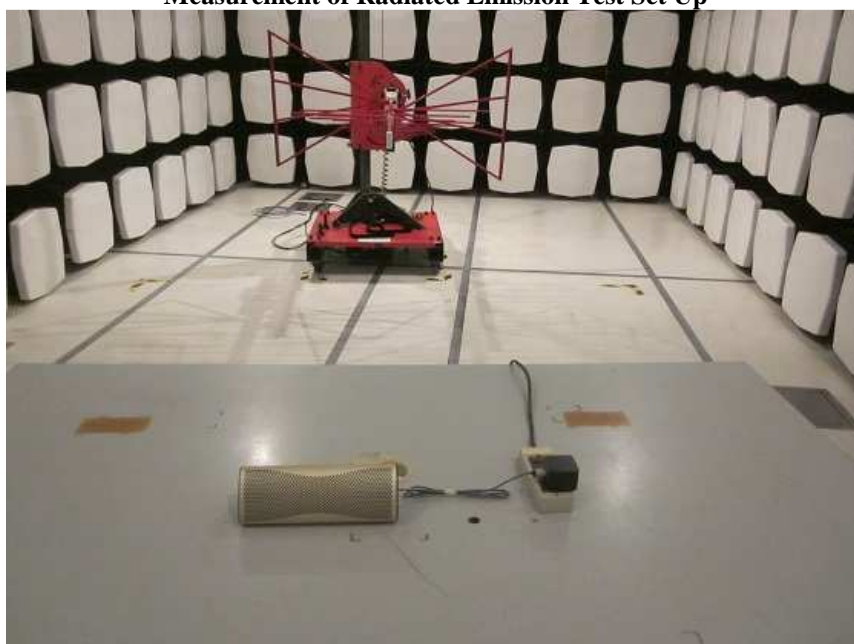
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Photographs of EUT

Measurement of Radiated Emission Test Set Up



Measurement of Radiated Emission Test Set Up



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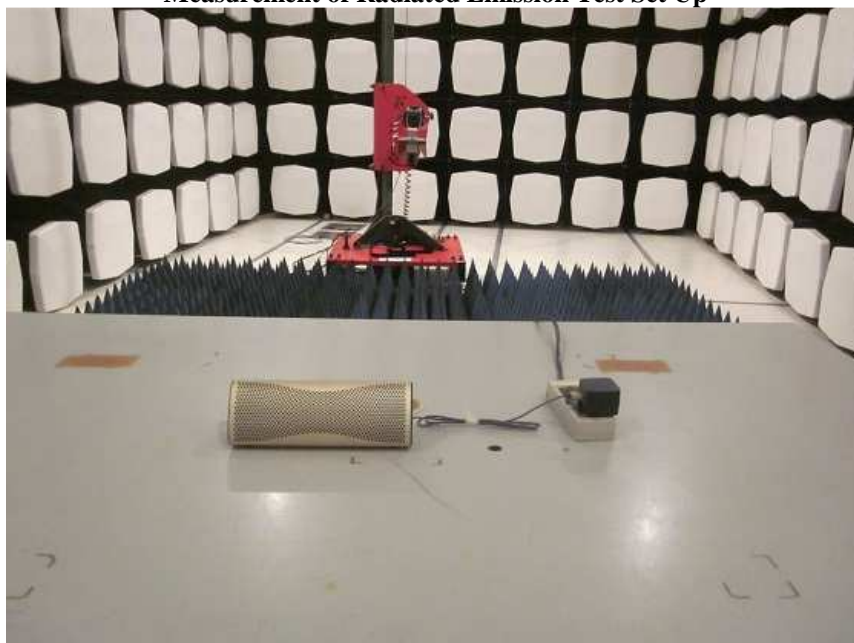
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Page 96 of 96

No.: MH191506

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Measurement of Radiated Emission Test Set Up



Measurement of Conducted Emission Test Set Up



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