



STC Test Report

Date : 2012-12-12

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No. : MH187520

Applicant (C01494): Hip Shing Electronics Ltd.
Units 1, 2 & 3, 20/F., New Treasure Centre, 10., Ng Fong
Street, San Po Kong, Kowloon, Hong Kong

Manufacturer: Dongguan Zhi Cheng Electronic Products Co., Ltd.
China, Dongguanshi, Tangxia, Ping San 188 Ind. Zone

Description of Sample(s): Product: Cambridge SoundWorks Ambiance
Touch World Radio
Brand Name: SoundWorks
Model Number: CW0380a
FCC ID: BZAAVPCW0380A

Date Sample(s) Received: 2012-11-20

Date Tested: 2012-11-22 to 2012-12-06

Investigation Requested: Perform ElectroMagnetic Interference measurement in
accordance with FCC 47CFR [Codes of Federal Regulations]
Part 15: 2011 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): ---

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.

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1.0 General Details

1.1 Test Laboratory

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

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

Product: Cambridge SoundWorks Ambiance Touch World Radio
Manufacturer: Dongguan Zhi Cheng Electronic Products Co., Ltd.
Brand Name: SoundWorks
Model Number: CW0380a
Input Voltage: 18Vd.c. with Jack
The AC/DC adaptor was provided by the applicant with following details:
Brand name: GPE; Model no.: GPE602-180330D; Input: 100-240Va.c. 50/60Hz 1.5A;
Output: 18Vd.c. 3300mA 59.4W.

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a Cambridge SoundWorks Ambiance Touch World Radio of Hip Shing Electronics Ltd., it is Audio System, modulation by IC; and type is frequency hopping speed spectrum Modulation.

1.3 Date of Order

2012-11-20

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2012-11-22 to 2012-12-06

1.6 Country of Origin

China

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1.7 RF Module Details

Module Model Number:	WI-BT0916
Module FCC ID:	
Module Transmission Type:	Bluetooth V2.1+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:	PCB Layout Inverted F
Antenna Length:	18x4mm
Antenna Gain:	1.5dBi

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2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2011 Regulations 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
Output Power of Fundamental Emissions	FCC 47CFR 15.247(b)(1)	ANSI C63.4:2009	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RF Conducted Spurious Emission	FCC 47CFR 15.247(c)	N/A	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 Operating Channel	FCC 47CFR 15.247(a)(2)(b)(1)	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Band-edge compliance of Conducted Emission	FCC 47CFR 15.247(c)	N/A	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	FCC 47CFR 15.247(a)(1)(iii)	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20dB Bandwidth	FCC 47CFR 15.247(a)(2)	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hopping Channel Separation	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"/>

Note: N/A – Not Applicable

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2.3 Table for Test Modes

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

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

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

Test Items	Mode	Data Rate
Max. Conducted Output Power	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps
Hopping Channel Separation	8DPSK	3MBps
Number of Hopping Frequency	8DPSK	3MBps
Dwell Time	DH1 / DH3 / DH5	3MBps
Radiated Emissions Below 1GHz	GFSK	1MBps
Radiated Emission Above 1GHz	GFSK	1MBps
Band Edge Emissions	GFSK / $\pi/4$ -DQPSK / 8DPSK	1MBps / 2MBps / 3MBps

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3.0 Test Results

3.1 Emission

3.1.1 Maximum Peak Output Power

Test Requirement:	FCC 47CFR 15.247(b)(1)
Test Method:	N/A
Test Date:	2012-11-26
Mode of Operation:	Bluetooth Communication mode

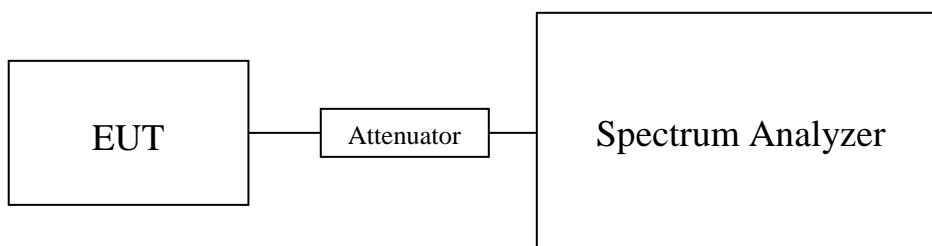
Test Method:

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 Watt.

Spectrum Analyzer Setting:

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

Test Setup:



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Limits for Peak Output Power of Fundamental & Harmonics Emissions [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 Maximum conducted output power

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000095

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000092

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000088

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000091

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2442	0.000089

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000090

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000087

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2442	0.000088

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000089

Limit: 0.125W (125mW)

Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB
1GHz to 25GHz 1.7dB

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3.1.2 Radiated Spurious Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.4:2009
Test Date:	2012-11-26 to 2012-12-06
Mode of Operation:	Tx mode / Bluetooth Communication mode

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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Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)

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

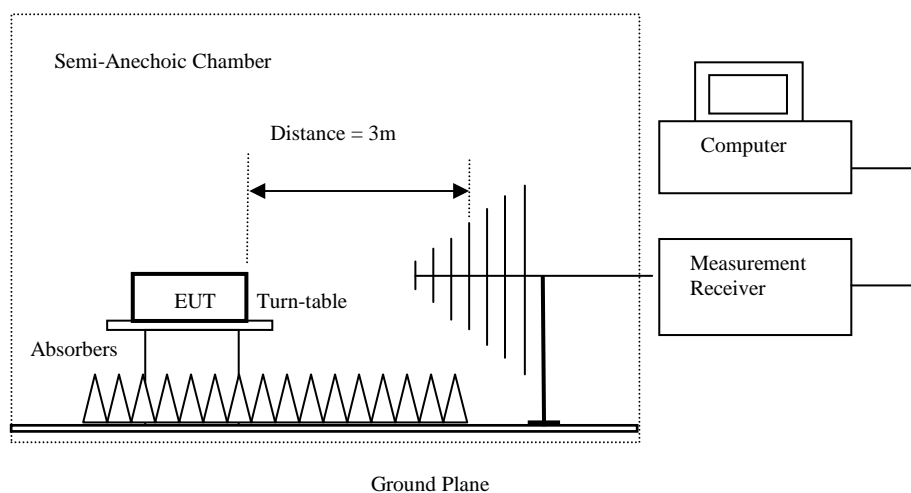
30MHz – 1GHz (QP)

RBW: 120kHz
VBW: 120kHz
Sweep: Auto
Span: Fully capture the emissions being measured
Trace: Max. hold

Above 1GHz (Pk & Av)

RBW: 3MHz
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.

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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
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						
Average Value						
Frequency	Measured Level	Correction Factor	Field Strength	Field Strength	Limit	E-Field Polarity
MHz	dB μV	dB/m	dB $\mu\text{V/m}$	$\mu\text{V/m}$	$\mu\text{V/m}$	
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						
Average Value						
Frequency	Measured Level	Correction Factor	Field Strength	Field Strength	Limit	E-Field Polarity
MHz	dB μV	dB/m	dB $\mu\text{V/m}$	$\mu\text{V/m}$	$\mu\text{V/m}$	
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	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dB μV	dB/m	dB $\mu\text{V/m}$	dB $\mu\text{V/m}$	dB $\mu\text{V/m}$	
4804.0	9.1	41.5	50.6	74.0	23.4	Horizontal
4804.0	12.2	41.5	53.7	74.0	20.3	Vertical
7206.0	6.6	48.8	55.4	74.0	18.6	Horizontal
7206.0	4.1	48.8	52.9	74.0	21.1	Vertical

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

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	-3.2	41.5	38.3	54.0	15.7	Horizontal
4804.0	-2.9	41.5	38.6	54.0	15.4	Vertical
7206.0	-8.1	48.8	40.7	54.0	13.3	Horizontal
7206.0	-10.1	48.8	38.7	54.0	15.3	Vertical

Result of Tx mode (2441.0 MHz) (GFSK mode) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Average 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 (2441.0 MHz) (GFSK mode) (30MHz – 1000MHz): PASS

Field Strength of Spurious Emissions Average 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						

Result of Tx mode (2441.0 MHz) (GFSK mode) (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	13.4	41.4	54.8	74.0	19.2	Horizontal
4882.0	12.0	41.4	53.4	74.0	20.6	Vertical
7323.0	4.9	48.7	53.6	74.0	20.4	Horizontal
7323.0	3.9	48.7	52.6	74.0	21.4	Vertical

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

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	-1.9	41.4	39.5	54.0	14.5	Horizontal
4882.0	-3.3	41.4	38.1	54.0	15.9	Vertical
7323.0	-11.4	48.7	37.3	54.0	16.7	Horizontal
7323.0	-11	48.7	37.7	54.0	16.3	Vertical

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

Field Strength of Spurious Emissions Average 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) (GFSK mode) (30MHz – 1000MHz): PASS

Field Strength of Spurious Emissions Average 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						

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Result of Tx mode (2480.0 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
4960.0	13.7	41.4	55.1	74.0	18.9	Horizontal
4960.0	12.9	41.4	54.3	74.0	19.7	Vertical
7440.0	3.3	48.6	51.9	74.0	22.1	Horizontal
7440.0	3.5	48.6	52.1	74.0	21.9	Vertical

Result of Tx mode (2480.0 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
4960.0	-2.0	41.4	39.4	54.0	14.6	Horizontal
4960.0	-1.7	41.4	39.7	54.0	14.3	Vertical
7440.0	-11.0	48.6	37.6	54.0	16.4	Horizontal
7440.0	-9.9	48.6	38.7	54.0	15.3	Vertical

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Result of Tx mode (2402.0 MHz) ($\pi/4$ -DQPSK mode) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/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 Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/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) (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	7.8	41.5	49.3	74.0	24.7	Horizontal
4804.0	11.6	41.5	53.1	74.0	20.9	Vertical
7206.0	5.8	48.8	54.6	74.0	19.4	Horizontal
7206.0	4.5	48.8	53.3	74.0	20.7	Vertical

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 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	-4.5	41.5	37.0	54.0	17.0	Horizontal
4804.0	-0.8	41.5	40.7	54.0	13.3	Vertical
7206.0	-8.2	48.8	40.6	54.0	13.4	Horizontal
7206.0	-8.5	48.8	40.3	54.0	13.7	Vertical

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

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/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) ($\pi/4$ -DQPSK mode) (30MHz – 1000MHz): PASS

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/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 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
4882.0	12.3	41.4	53.7	74.0	20.3	Horizontal
4882.0	11.5	41.4	52.9	74.0	21.1	Vertical
7323.0	3.7	48.7	52.4	74.0	21.6	Horizontal
7323.0	2.9	48.7	51.6	74.0	22.4	Vertical

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 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
4882.0	-1.9	41.4	39.5	54.0	14.5	Horizontal
4882.0	-3.5	41.4	37.9	54.0	16.1	Vertical
7323.0	-10.3	48.7	38.4	54.0	15.6	Horizontal
7323.0	-12.1	48.7	36.6	54.0	17.4	Vertical

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Result of Tx mode (2480.0 MHz) ($\pi/4$ -DQPSK mode) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/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 (2480.0 MHz) ($\pi/4$ -DQPSK mode) (30MHz – 1000MHz): PASS

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/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 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
4960.0	14.1	41.4	55.5	74.0	18.5	Horizontal
4960.0	12.4	41.4	53.8	74.0	20.2	Vertical
7440.0	4.1	48.6	52.3	74.0	21.7	Horizontal
7440.0	3.7	48.6	51.9	74.0	22.1	Vertical

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 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	-1.9	41.4	39.5	54.0	14.5	Horizontal
4960.0	-3.3	41.4	38.1	54.0	15.9	Vertical
7440.0	-11.1	48.6	37.5	54.0	16.5	Horizontal
7440.0	-12.1	48.6	36.5	54.0	17.5	Vertical

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Result of Tx mode (2402.0 MHz) (8DPSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/m	E-Field Polarity
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 Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/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 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	8.8	41.5	50.3	74.0	23.7	Horizontal
4804.0	12.6	41.5	54.1	74.0	19.9	Vertical
7206.0	7.5	48.8	56.3	74.0	17.7	Horizontal
7206.0	4.1	48.8	52.9	74.0	21.1	Vertical

Result of Tx mode (2402.0 MHz) (8DPSK) (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	-3.8	41.5	37.7	54.0	16.3	Horizontal
4804.0	-1.0	41.5	40.5	54.0	13.5	Vertical
7206.0	-7.4	48.8	41.4	54.0	12.6	Horizontal
7206.0	-10.5	48.8	38.3	54.0	15.7	Vertical

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Result of Tx mode (2441.0 MHz) (8DPSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/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 Average Value						
Frequency MHz	Measured Level dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit μ V/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 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
4882.0	13.3	41.4	54.7	74.0	19.3	Horizontal
4882.0	11.1	41.4	52.5	74.0	21.5	Vertical
7323.0	4.8	48.7	53.5	54.0	0.5	Horizontal
7323.0	2.9	48.7	51.6	54.0	2.4	Vertical

Result of Tx mode (2441.0 MHz) (8DPSK) (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
4882.0	-1.7	41.4	39.7	54.0	14.3	Horizontal
4882.0	-3.5	41.4	37.9	54.0	16.1	Vertical
7323.0	-10.1	48.7	38.6	54.0	15.4	Horizontal
7323.0	-13.5	48.7	35.2	54.0	18.8	Vertical

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

Field Strength of Spurious Emissions Average 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 Average 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						

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	13.5	41.4	54.9	74.0	19.1	Horizontal
4960.0	13.1	41.4	54.5	74.0	19.5	Vertical
7440.0	5.8	48.6	54.4	74.0	19.6	Horizontal
7440.0	3.0	48.6	51.6	74.0	22.4	Vertical

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Result of Tx mode (2480.0 MHz) (8DPSK) (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
4960.0	-1.9	41.4	39.5	54.0	14.5	Horizontal
4960.0	-4.3	41.4	37.1	54.0	16.9	Vertical
7440.0	-9.1	48.6	39.5	54.0	14.5	Horizontal
7440.0	-10.7	48.6	37.9	54.0	16.1	Vertical

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 : 30MHz to 1GHz 4.9dB
1GHz to 6GHz 4.02dB
6GHz to 18GHz 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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Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

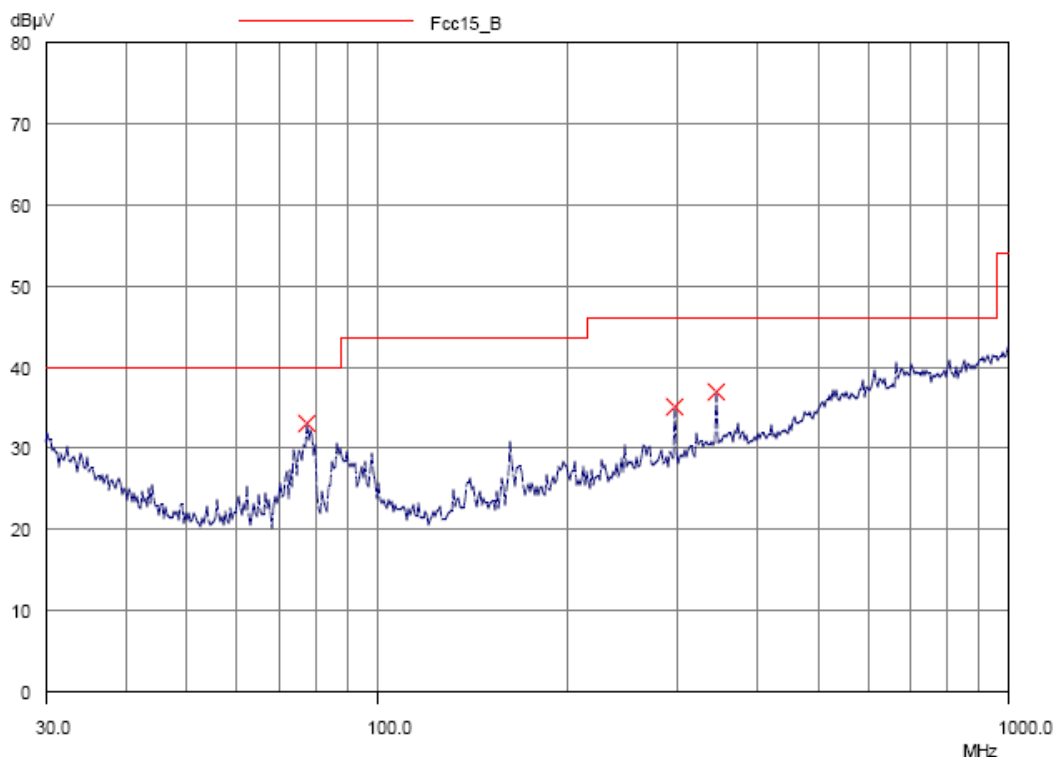
Frequency Range	Quasi-Peak Limits
[MHz]	[$\mu\text{V/m}$]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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 (30MHz – 1GHz): Pass

Please refer to the following table for result details

Horizontal



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Result of Bluetooth Communication mode (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
77.8	Horizontal	33.2	40.0	45.7	100
294.9	Horizontal	35.3	46.0	58.2	200
344.1	Horizontal	37.0	46.0	70.8	200

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

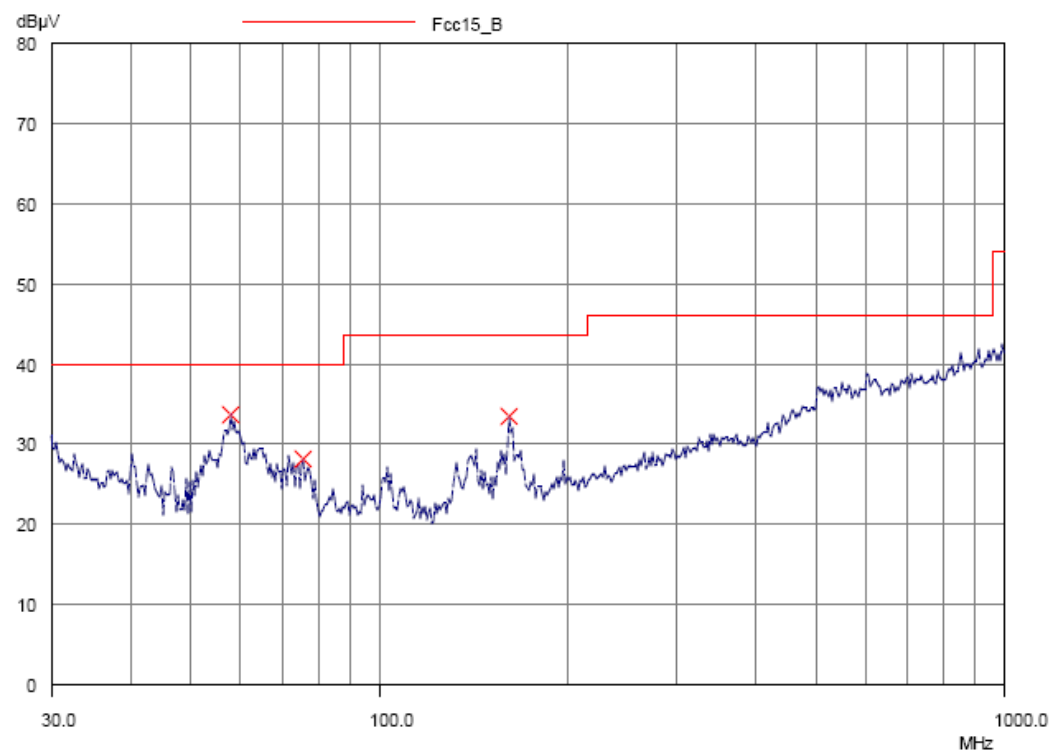
Frequency Range	Quasi-Peak Limits
[MHz]	[μ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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

Result of Bluetooth Communication mode (30MHz – 1GHz): Pass

Please refer to the following table for result details

Vertical



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Result of Bluetooth Communication mode (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
58.1	Vertical	33.7	40.0	48.4	100
75.8	Vertical	28.2	40.0	25.7	100
162.3	Vertical	33.5	43.5	47.3	150

Remarks:

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty	:	30MHz to 1GHz	4.9dB
		1GHz to 6GHz	4.02dB
		6GHz to 18GHz	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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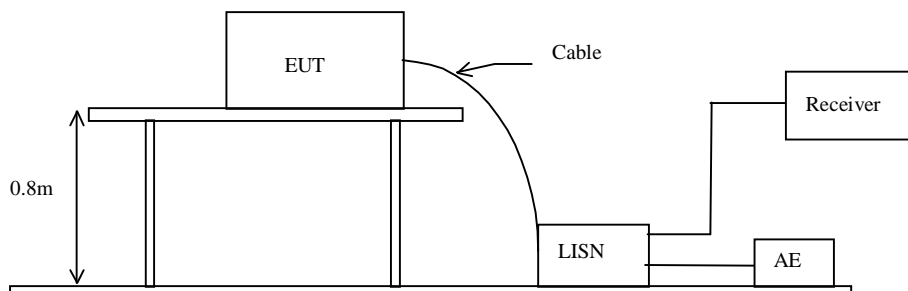
3.1.3 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.4:2009
Test Date:	2012-11-22
Mode of Operation:	Bluetooth communication mode
Test Voltage:	117V a.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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Limit for Conducted Emissions (FCC 47 CFR 15.207):

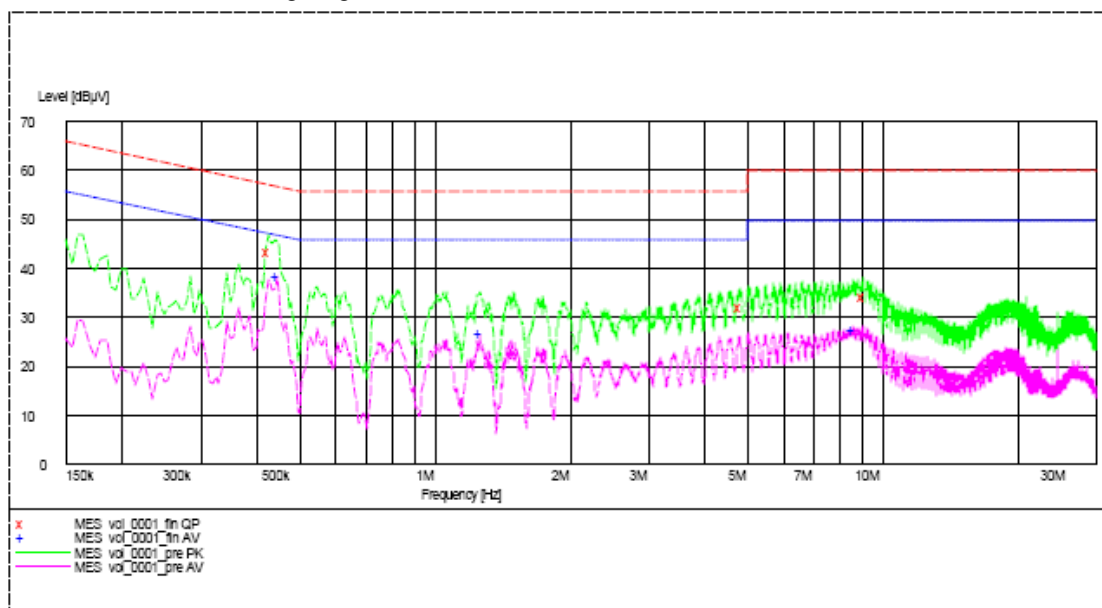
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* 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.

Results of Bluetooth communication mode(BT Paired with iPod touch) (L): PASS

Please refer to the following diagram for individual results.



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Results of Bluetooth communication mode (BT Paired with iPod touch) (L): PASS

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	0.445	-*-	-*-	38.5	47.0
Live	1.265	-*-	-*-	26.8	46.0
Live	8.620	-*-	-*-	27.5	50.0
Live	0.425	43.6	57.0	-*-	-*-
Live	4.815	32.0	56.0	-*-	-*-
Live	9.045	34.1	60.0	-*-	-*-

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Limit for Conducted Emissions (FCC 47 CFR 15.207):

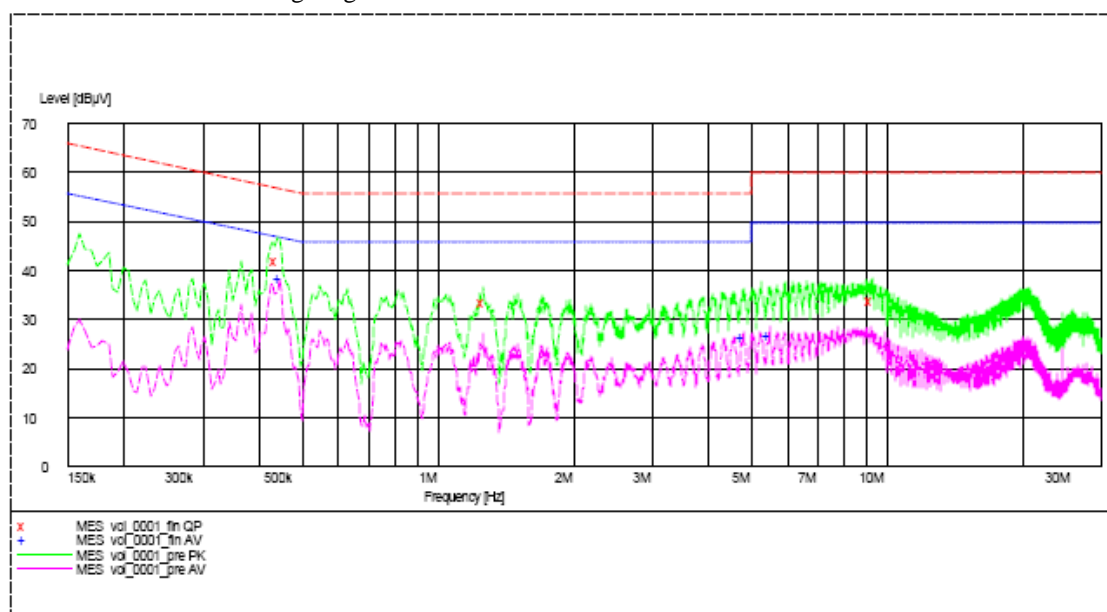
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* 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.

Results of Bluetooth communication mode (BT Paired with iPod touch) (N): PASS

Please refer to the following diagram for individual results.



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Results of Bluetooth communication mode (BT Paired with iPod touch) (N): PASS

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	0.445	-*-	-*-	38.5	47.0
Neutral	4.795	-*-	-*-	26.4	46.0
Neutral	5.490	-*-	-*-	26.9	50.0
Neutral	0.440	42.0	57.0	-*-	-*-
Neutral	1.265	33.5	56.0	-*-	-*-
Neutral	9.285	34.0	60.0	-*-	-*-

Remarks:

Calculated measurement uncertainty : 3.25dB

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

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3.1.4 20dB Bandwidth Measurement

Test Requirement:	FCC 47CFR 15.247(a)(1)
Test Method:	ANSI C63.4:2009
Test Date:	2012-11-24
Mode of Operation:	Bluetooth 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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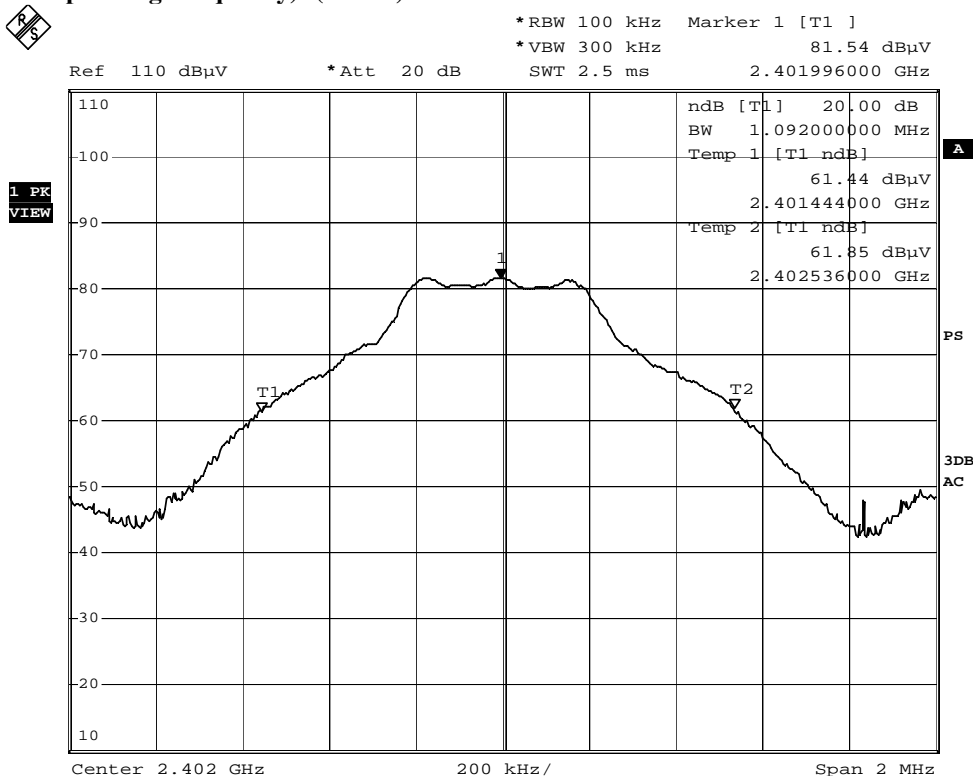
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.092	Within 2400-2483.5

(Lowest Operating Frequency)- (GFSK)



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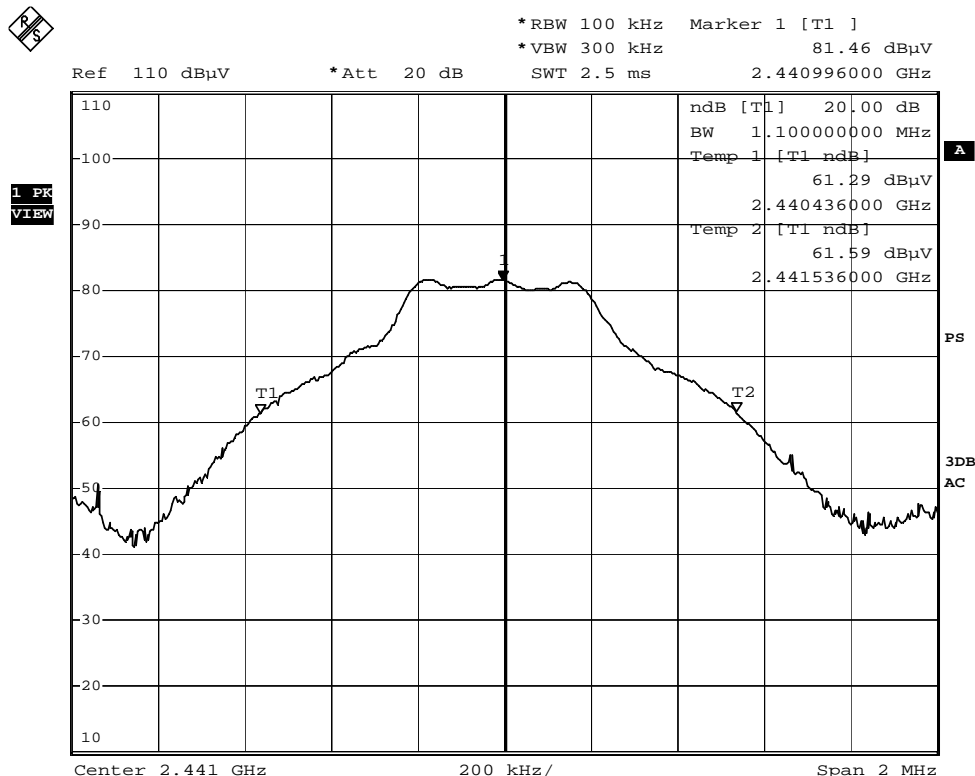
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.100	Within 2400-2483.5

(Middle Operating Frequency)- (GFSK)



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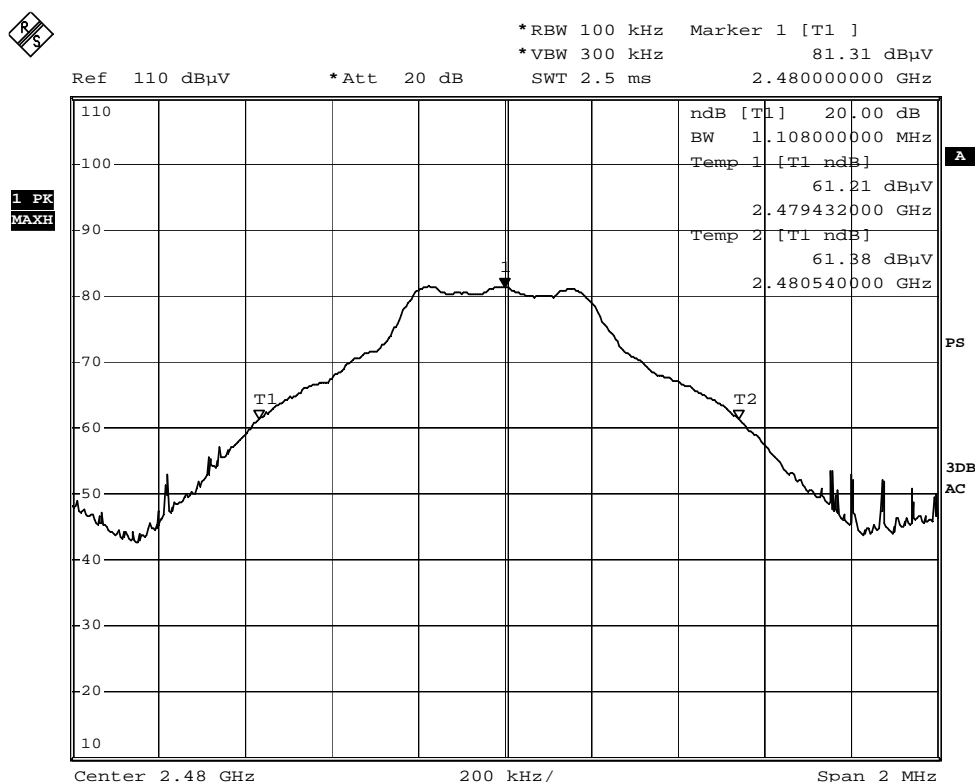
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.108	Within 2400-2483.5

(Highest Operating Frequency)- (GFSK)



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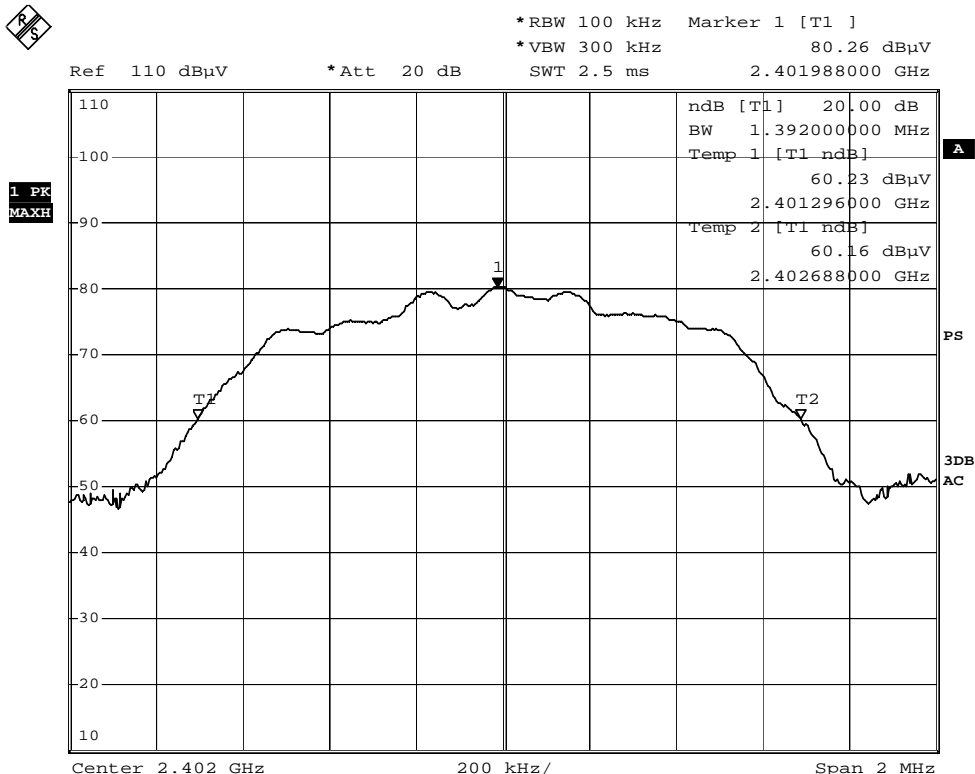
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.392	Within 2400-2483.5

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



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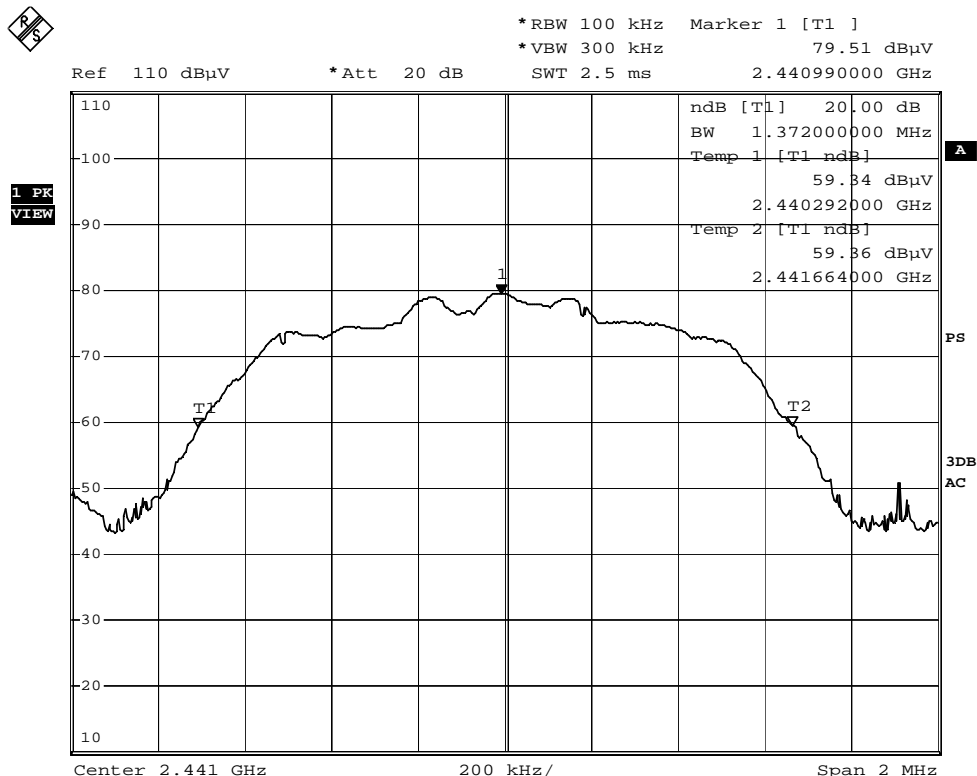
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.372	Within 2400-2483.5

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



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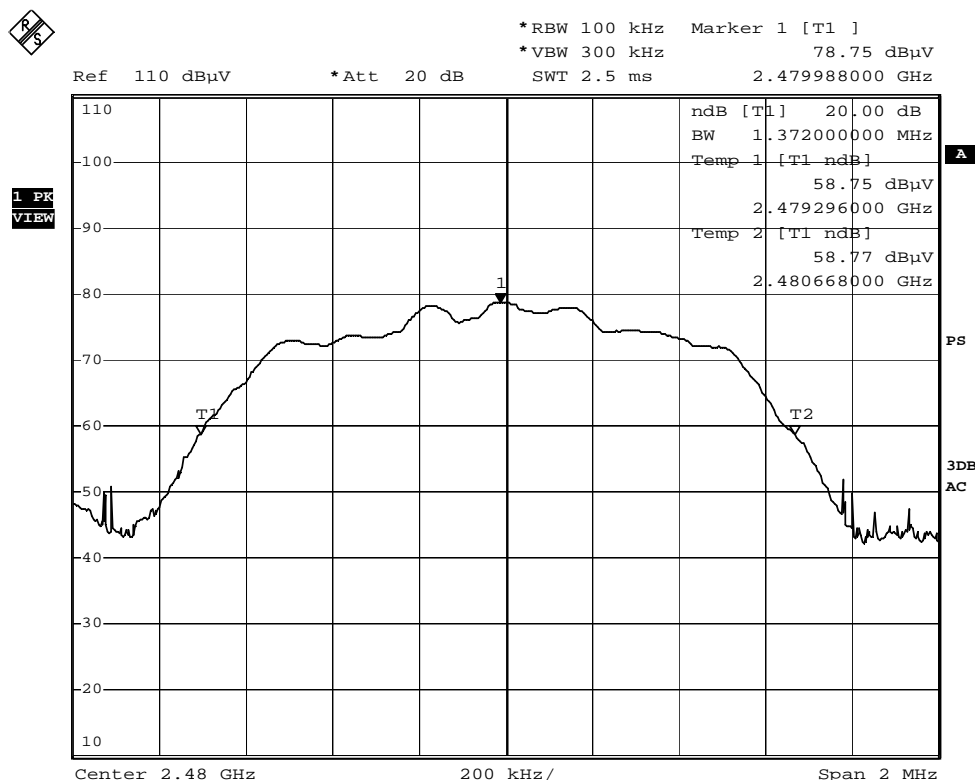
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.372	Within 2400-2483.5

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



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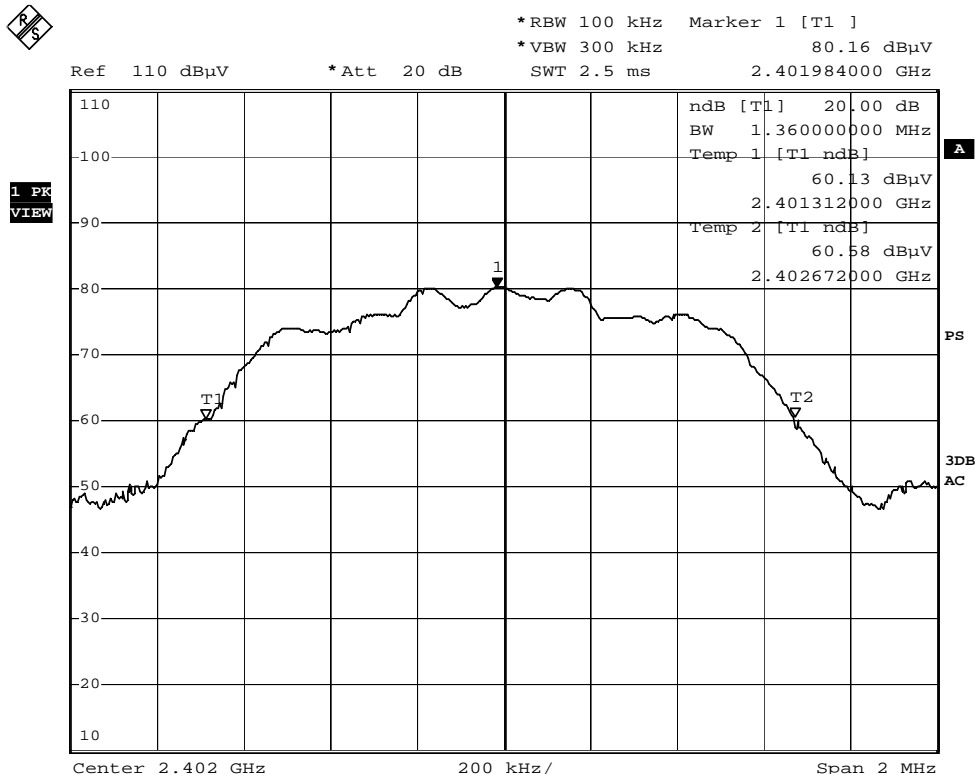
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.360	Within 2400-2483.5

(Lowest Operating Frequency)- (8DPSK)



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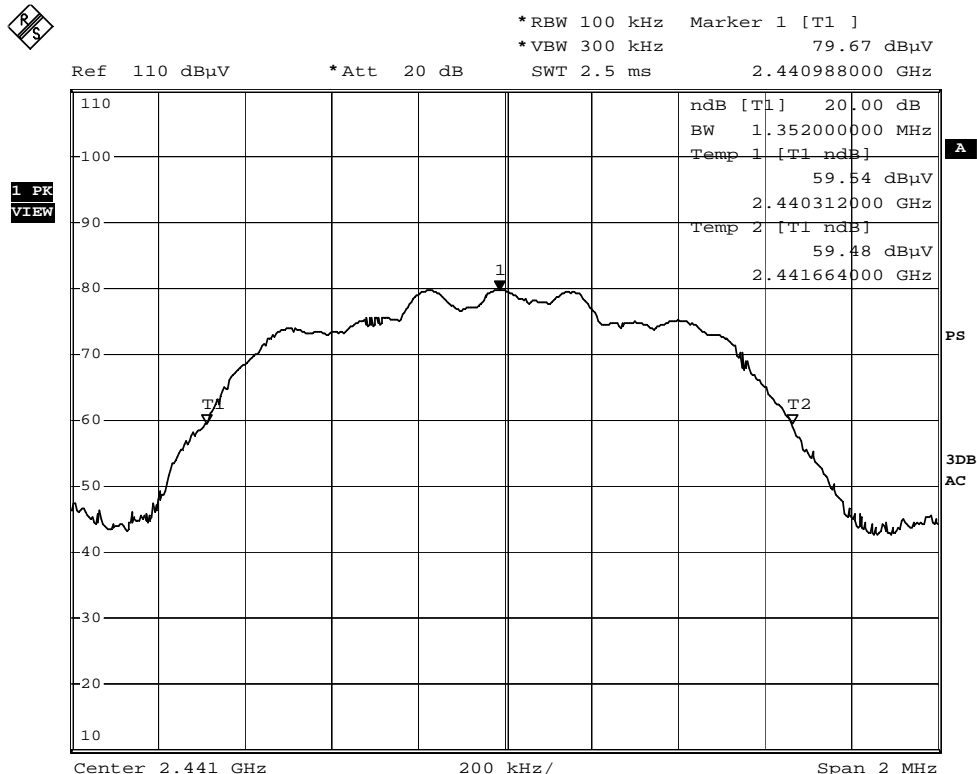
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Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.352	Within 2400-2483.5

(Middle Operating Frequency)- (8DPSK)



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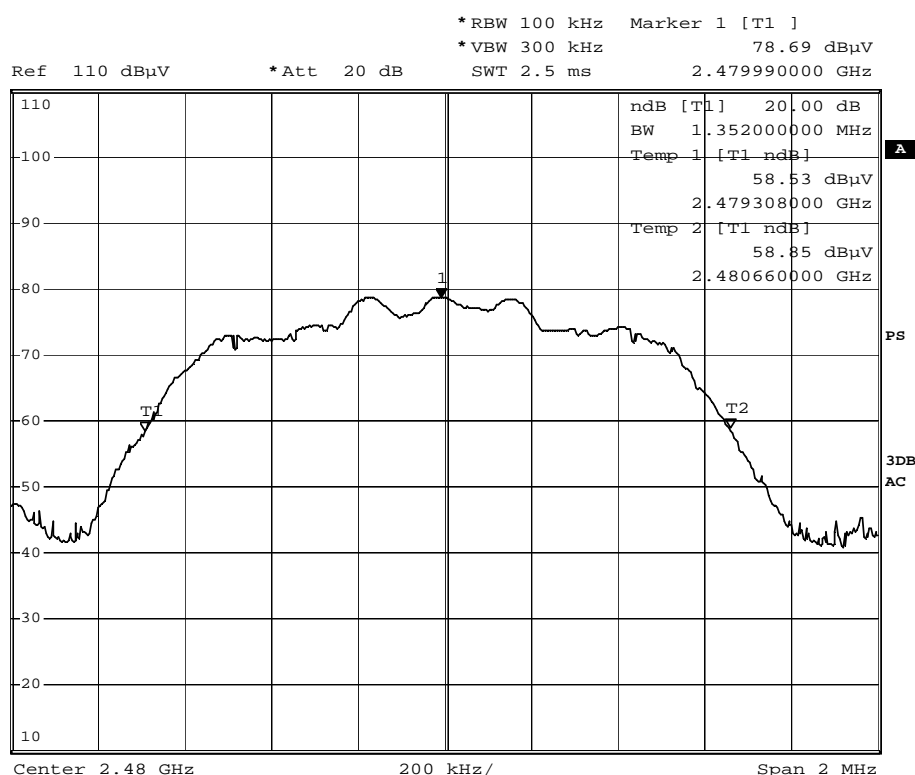
No. : MH187520

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.352	Within 2400-2483.5

(Highest Operating Frequency)- (8DPSK)



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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)

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 * 2/3 = 1.092MHz * 2/3 = 728kHz



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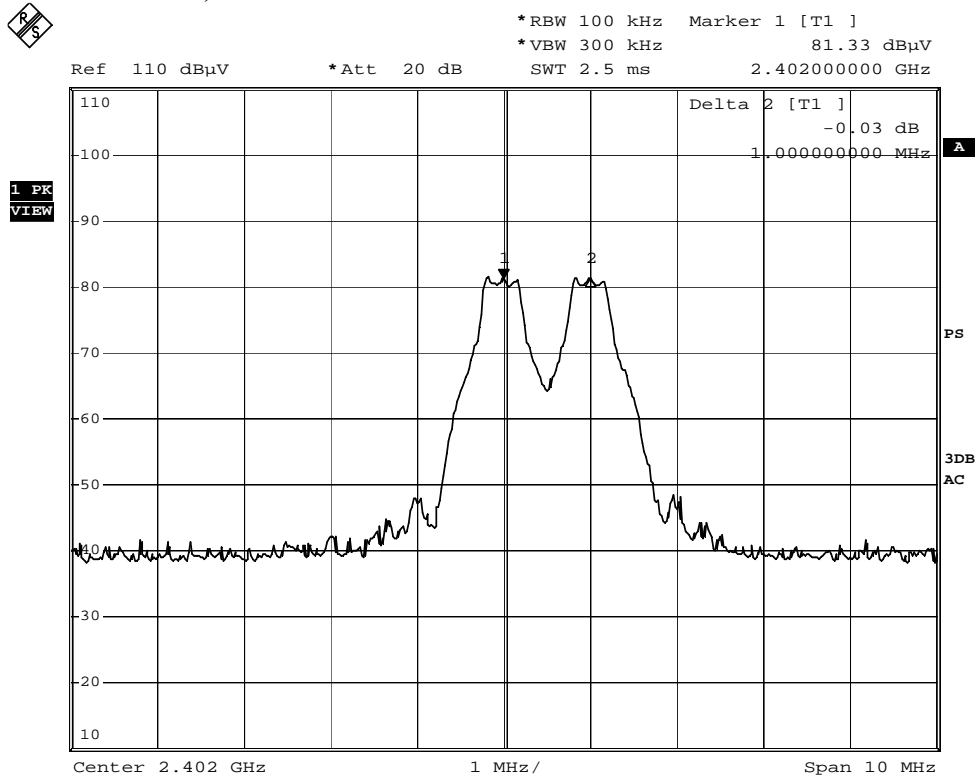
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Channel separation = 1MHz (>728kHz) (GFSK)

Channel 0 – Channel 1, Pass



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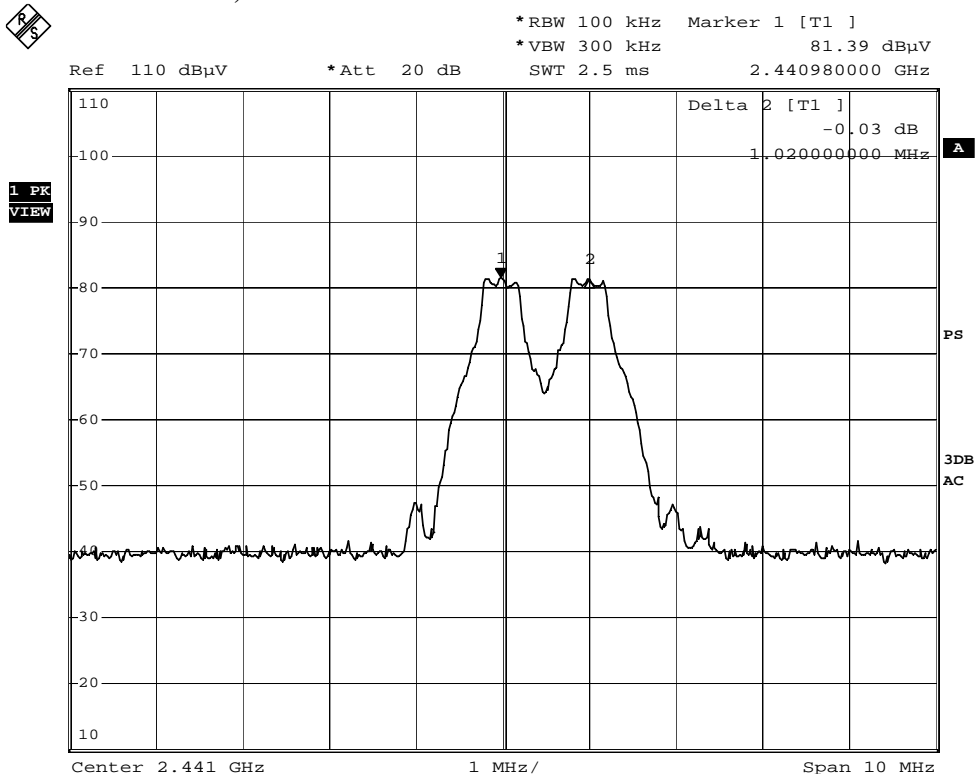
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Channel 39 – Channel 40, Pass



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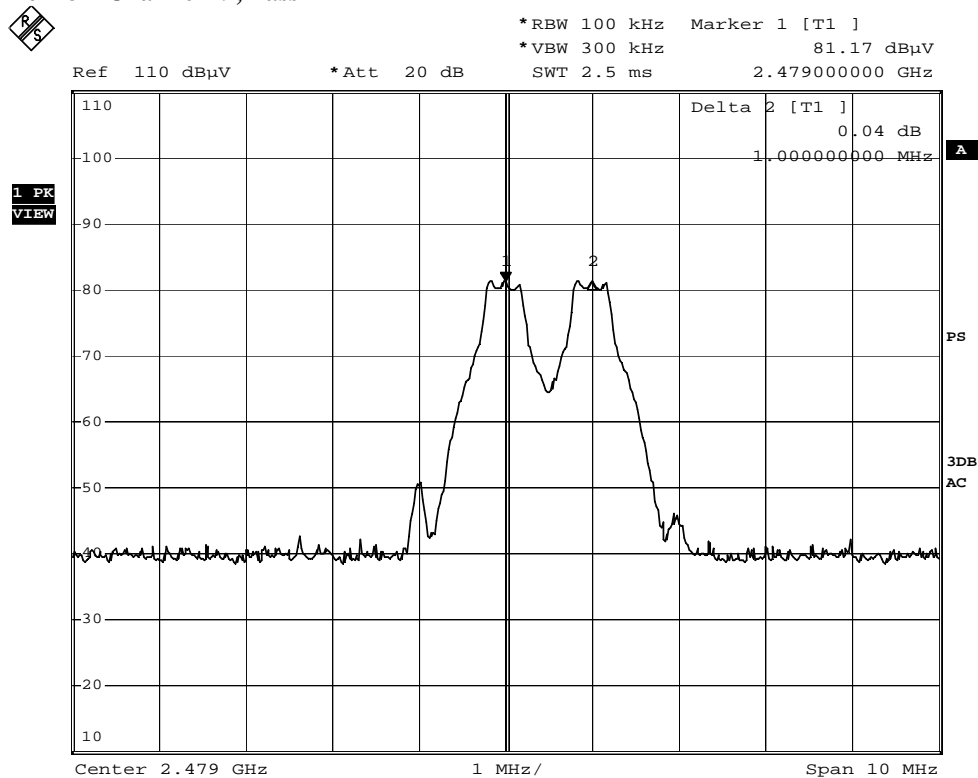
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Channel 78 – Channel 79, Pass



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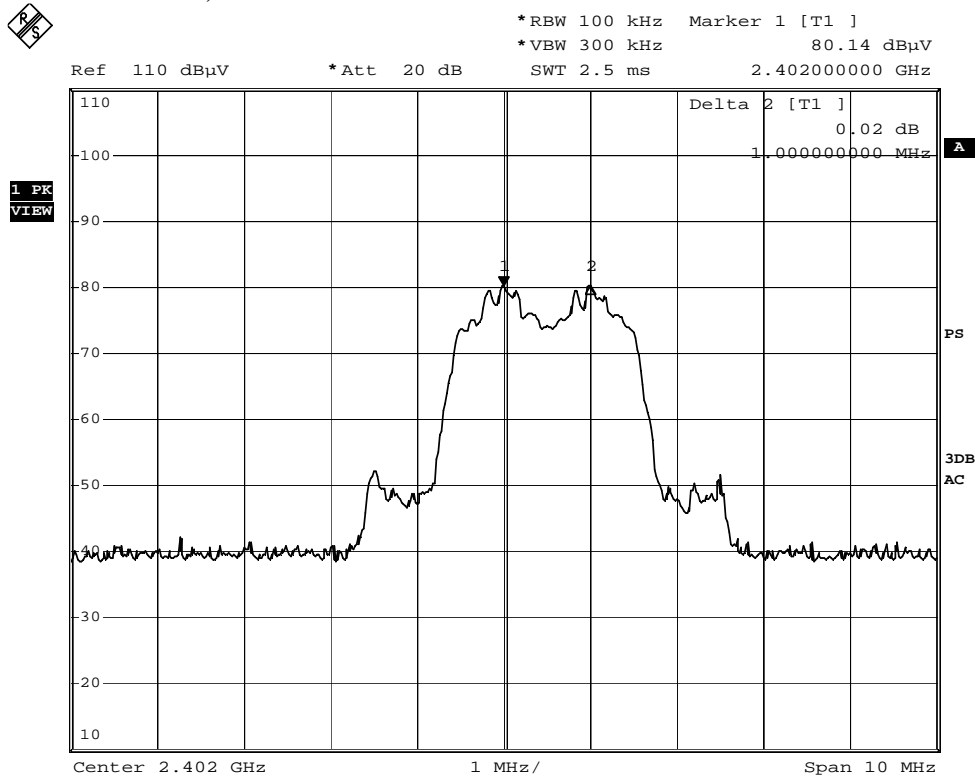
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Channel separation = 1MHz (>728kHz) ($\pi/4$ DQPSK)

Channel 0 – Channel 1, Pass



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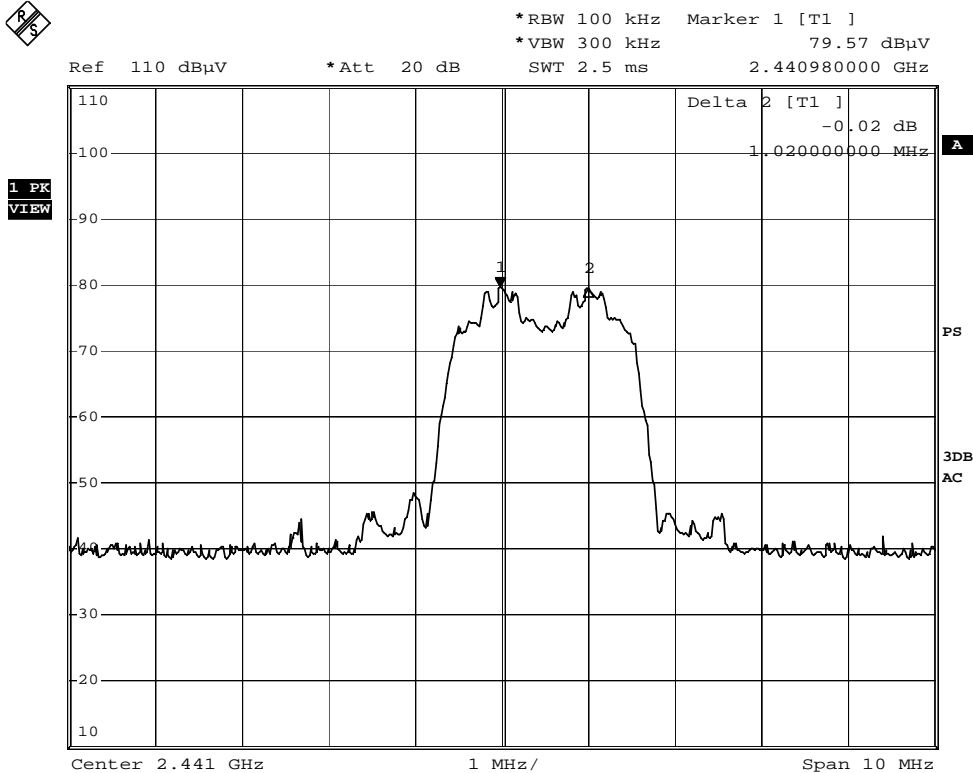
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Channel 39 – Channel 40, Pass



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Channel 78 – Channel 79, Pass



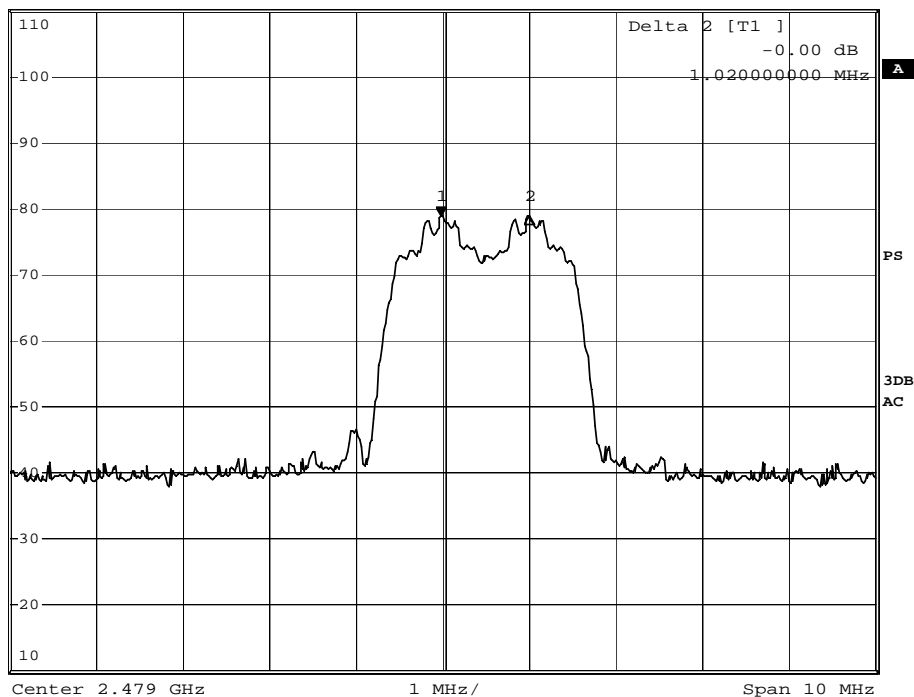
*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 78.92 dBμV
SWT 2.5 ms 2.478980000 GHz

Ref 110 dBμV

*Att 20 dB

SWT 2.5 ms

2.478980000 GHz



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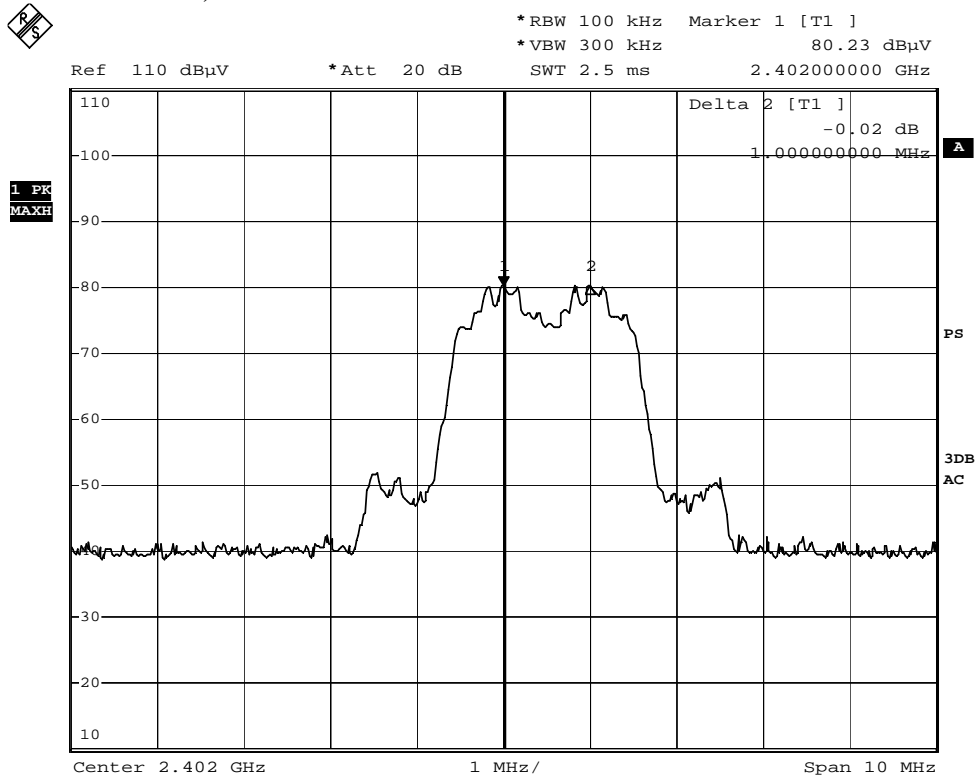
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Channel separation = 1MHz (>728kHz) (8DPSK)

Channel 0 – Channel 1, Pass



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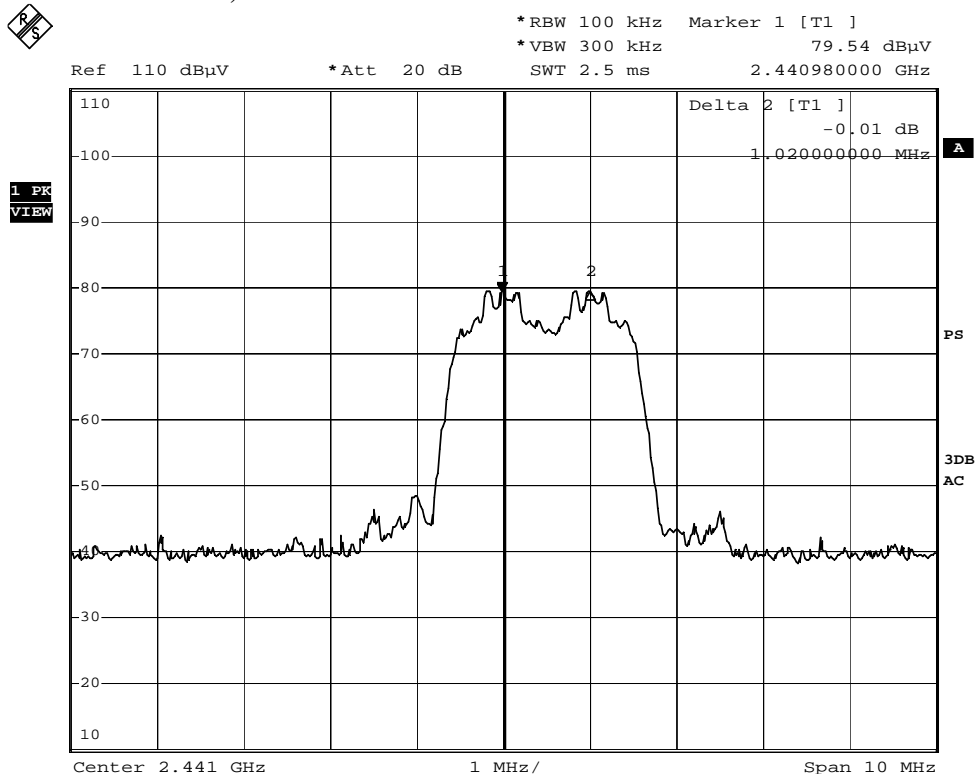
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Channel 39 – Channel 40, Pass



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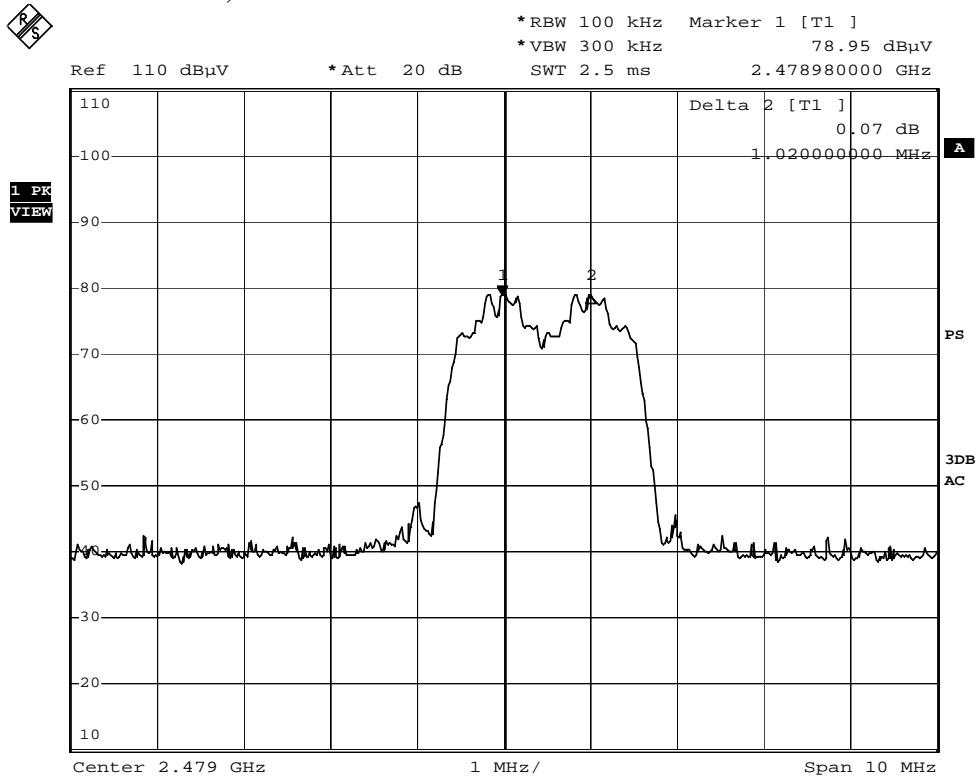
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Channel 78 – Channel 79, Pass



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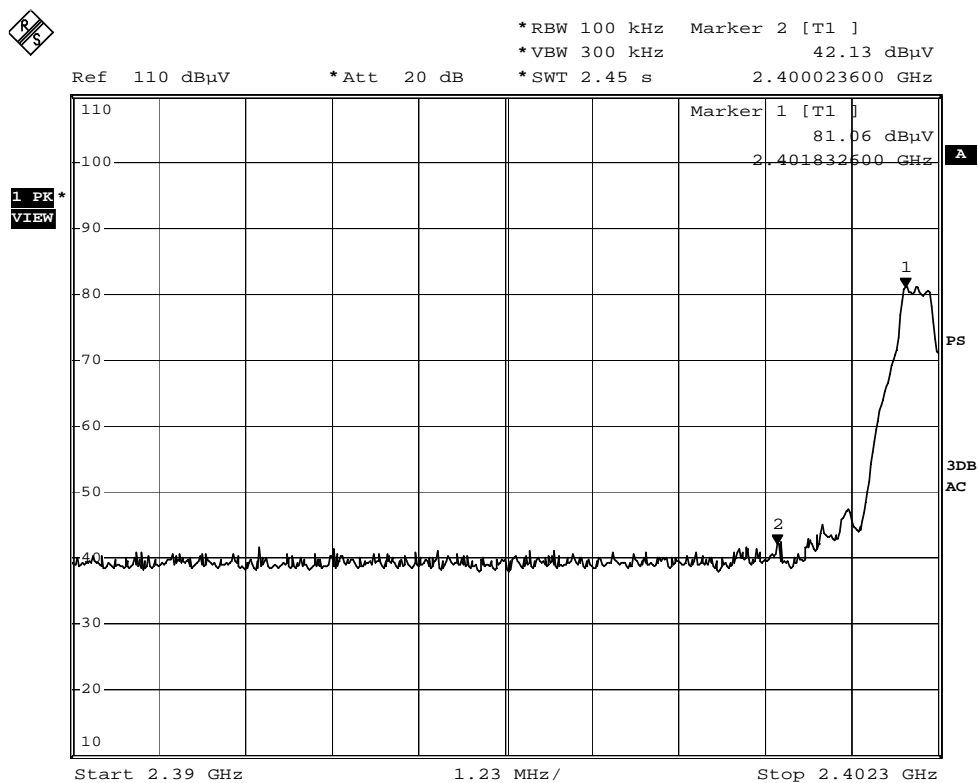
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Band-edge Compliance of RF Emissions – Lowest (GFSK)



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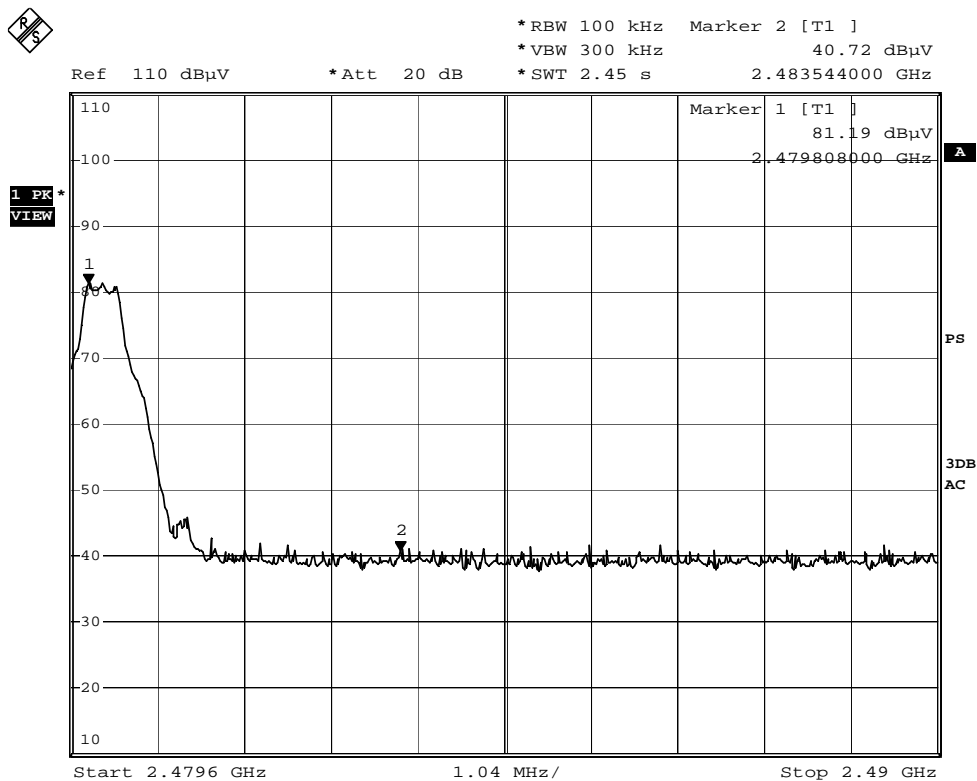
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Band-edge Compliance of RF Emissions – Highest (GFSK)



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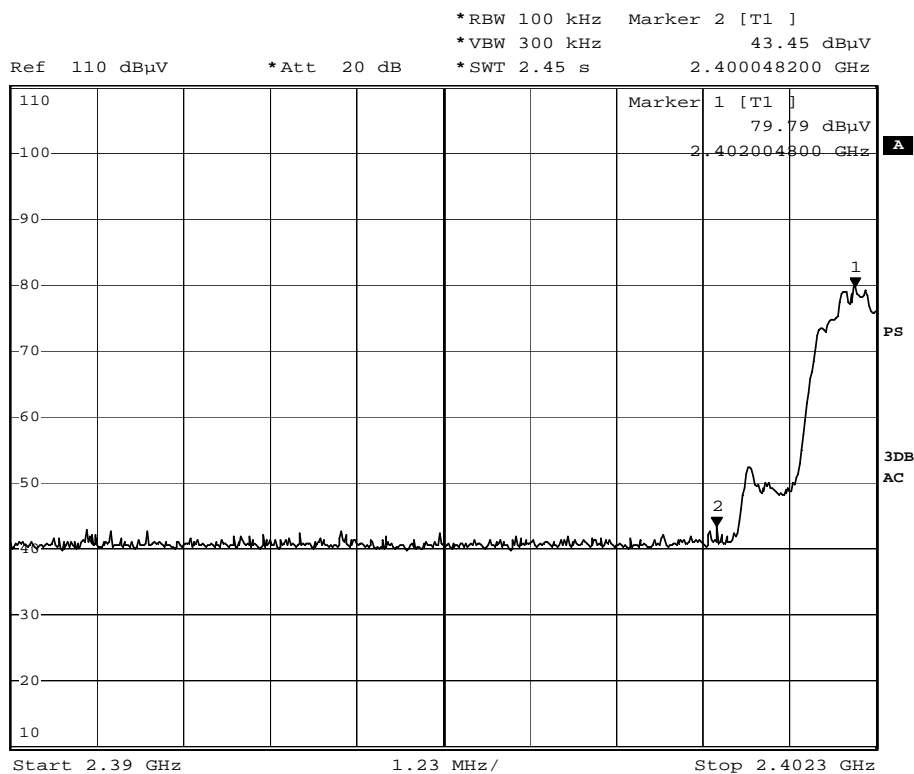
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Band-edge Compliance of RF Emissions – Lowest ($\pi/4$ DQPSK)



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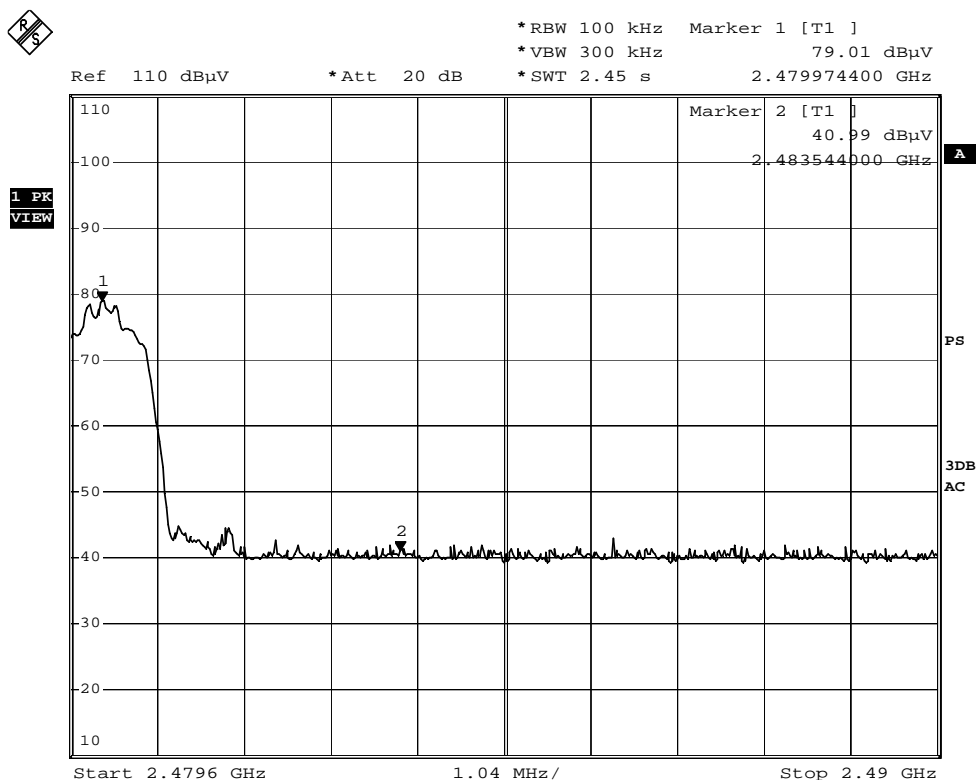
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Band-edge Compliance of RF Emissions – Highest ($\pi/4$ DQPSK)



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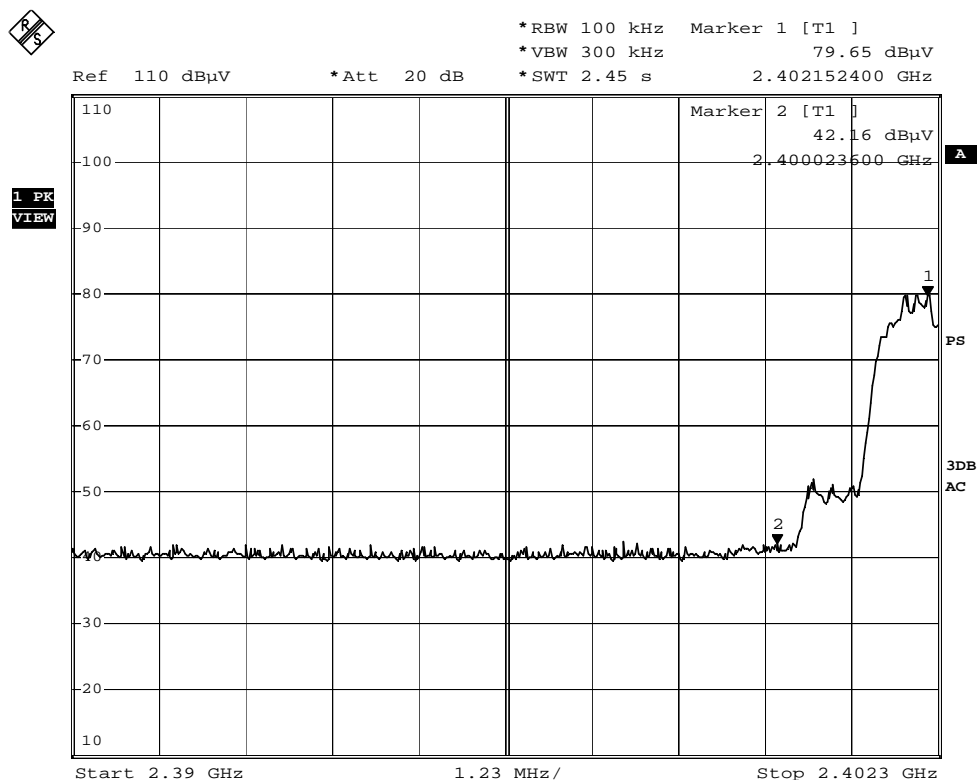
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Band-edge Compliance of RF Emissions – Lowest (8DPSK)



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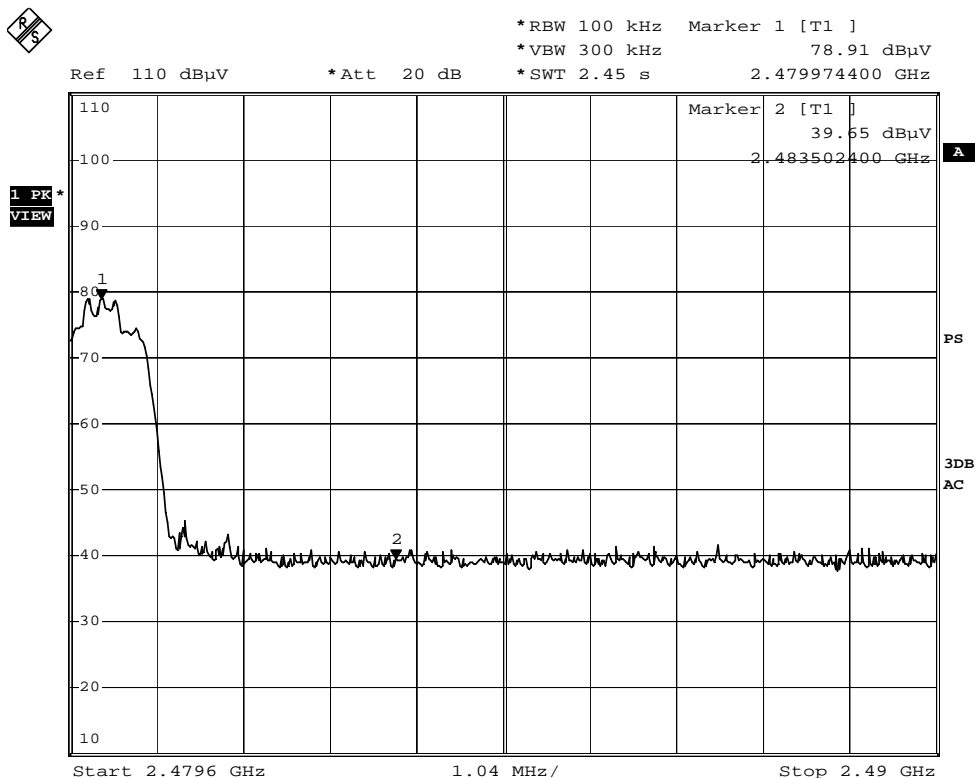
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Band-edge Compliance of RF Emissions – Highest (8DPSK)



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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:

The EUT has 1 [Inverted-F Antenna (PCB layout)] which is permanently attached to the main unit and attached on PCB board, the antenna gain = 1.5dBi. All component install on inside of EUT. User unable to remove or changed the Antenna.

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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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Occupancy Time (Dwell time)

Requirements:

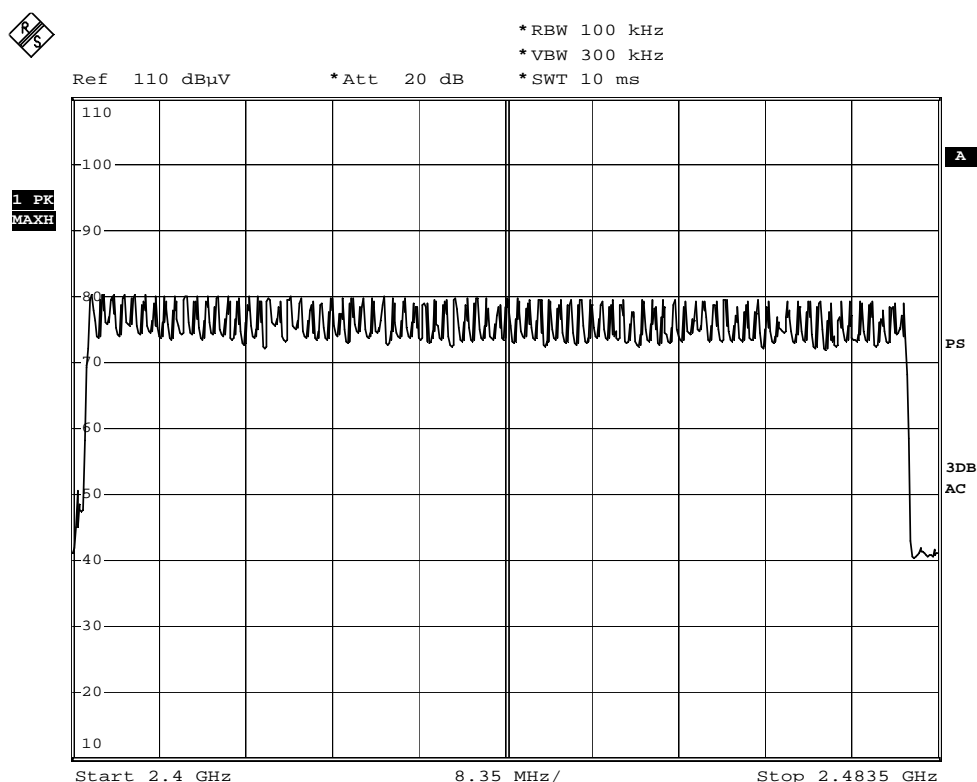
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channel employed.
No requirements for Digital Transmission System.

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 Channels



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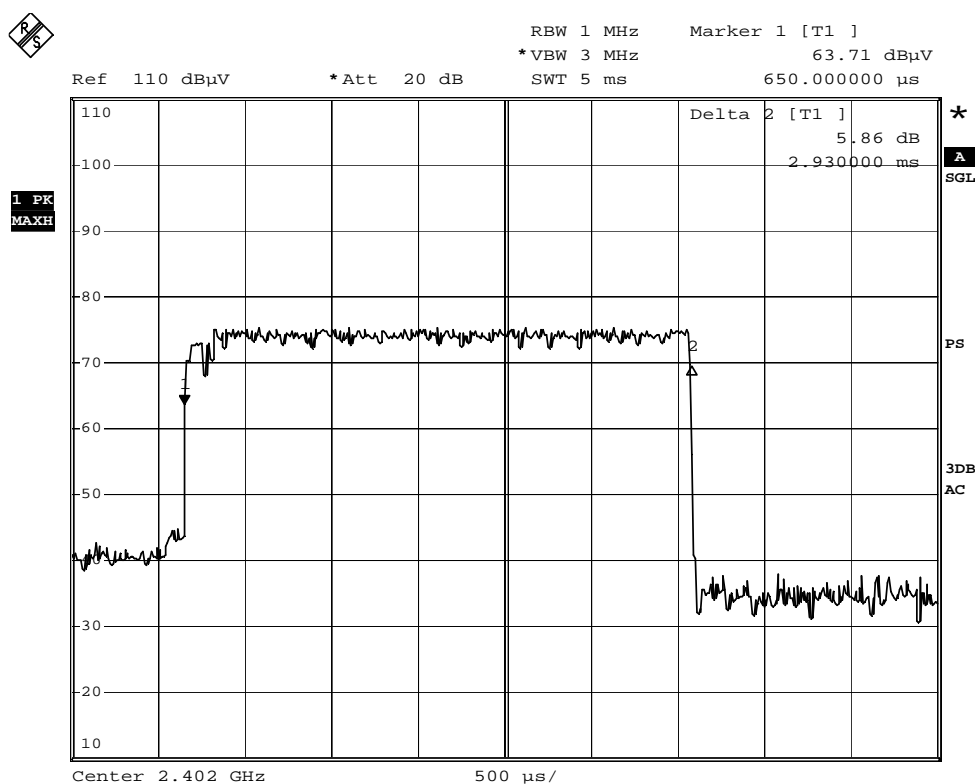
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DH5 Packet:

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

Fig. A
[Pulse duration of Lowest Channel]



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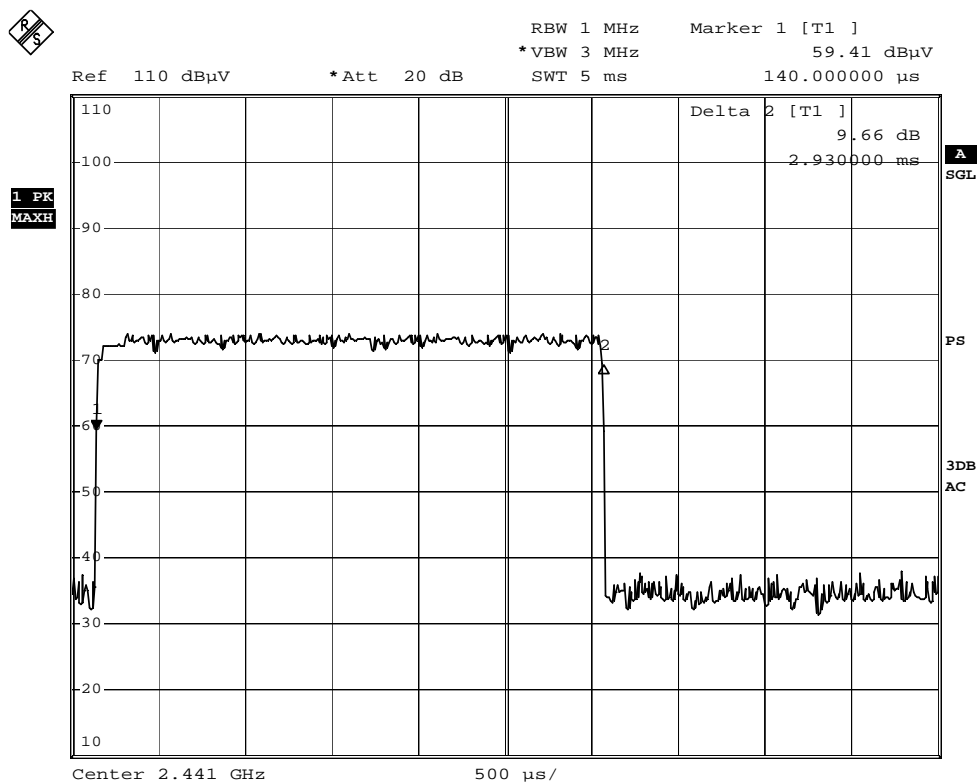
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Fig. B
[Pulse duration of Middle Channel]



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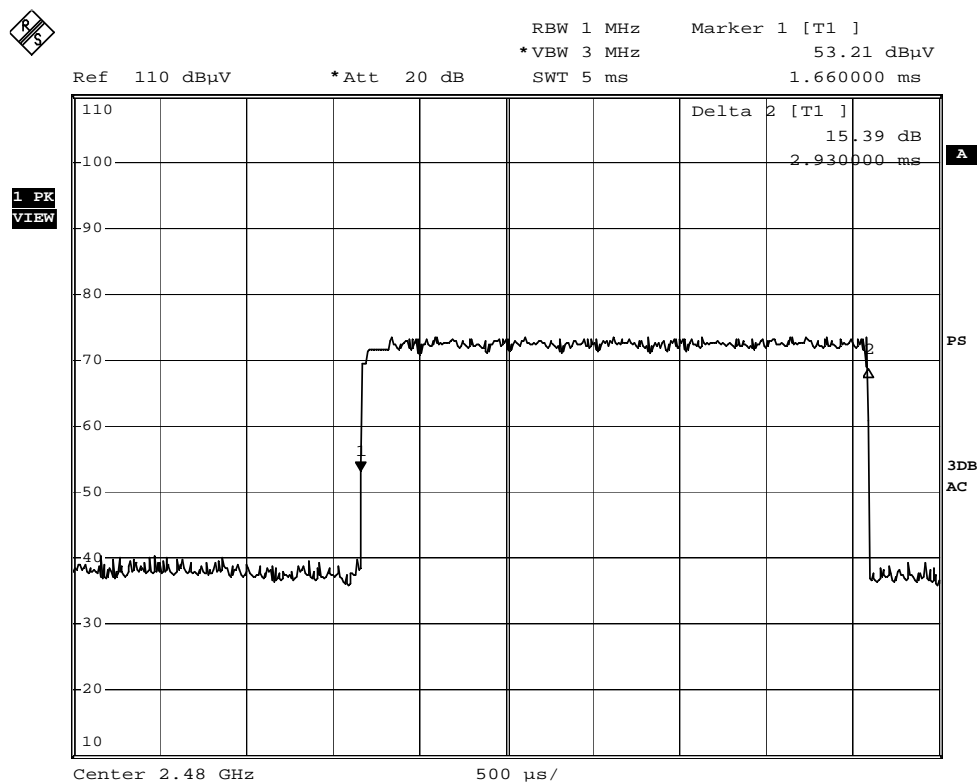
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Fig. C
[Pulse duration of Highest Channel]



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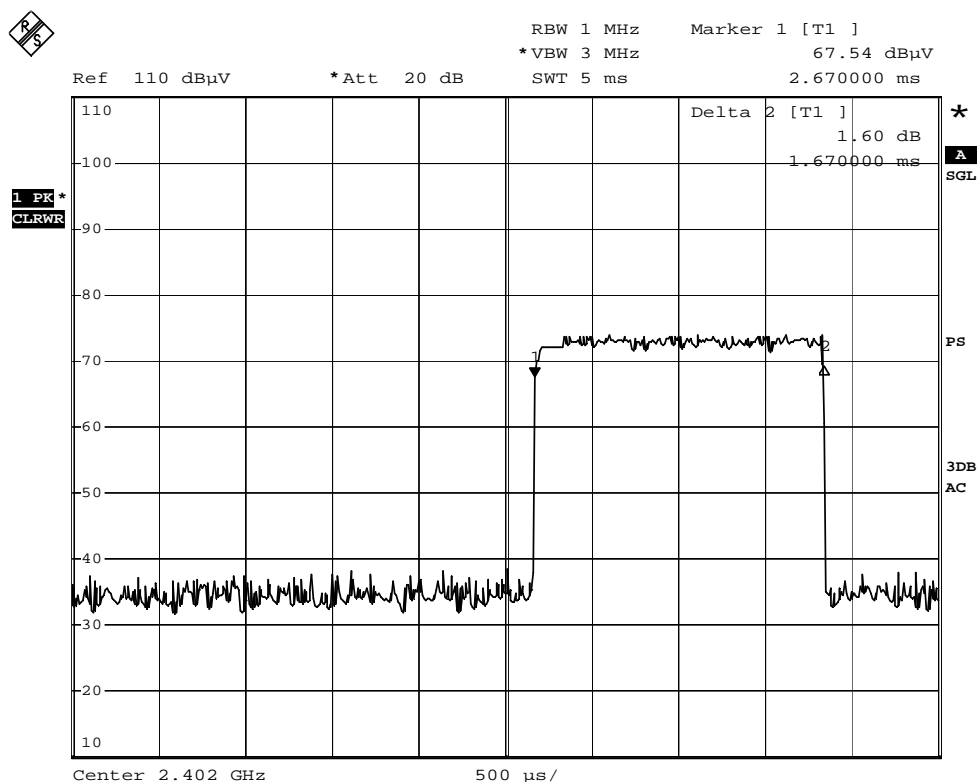
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DH3 Packet:

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

Fig. D
[Pulse duration of Lowest Channel]



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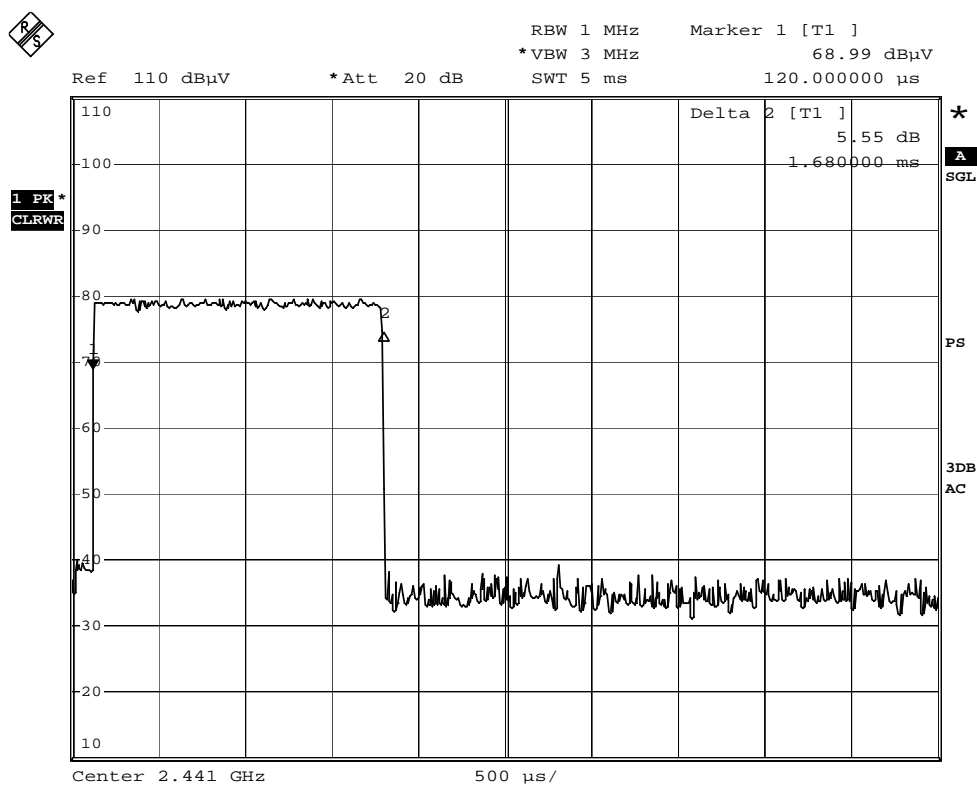
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Fig. E
[Pulse duration of Middle Channel]



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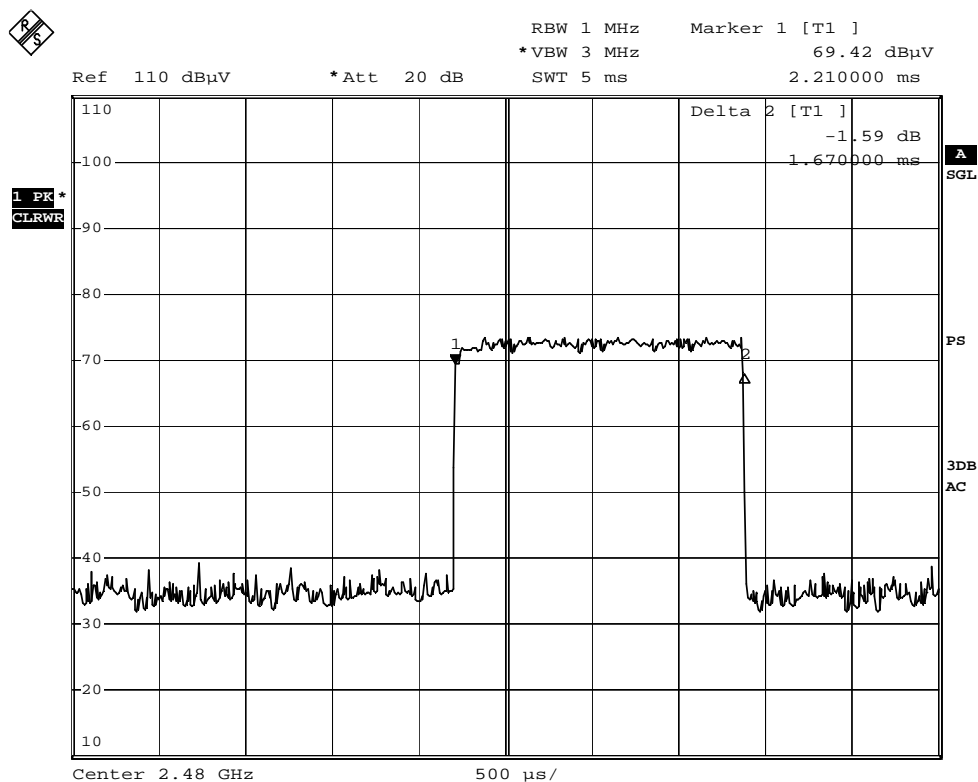
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Fig. F
[Pulse duration of Highest Channel]



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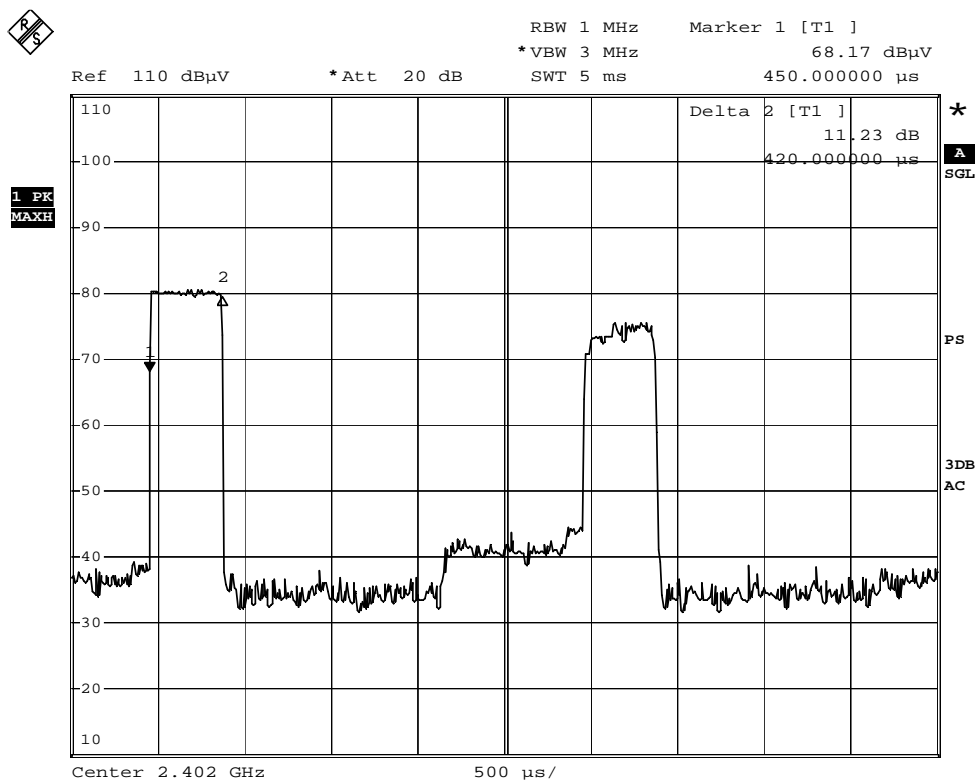
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DH1 Packet:

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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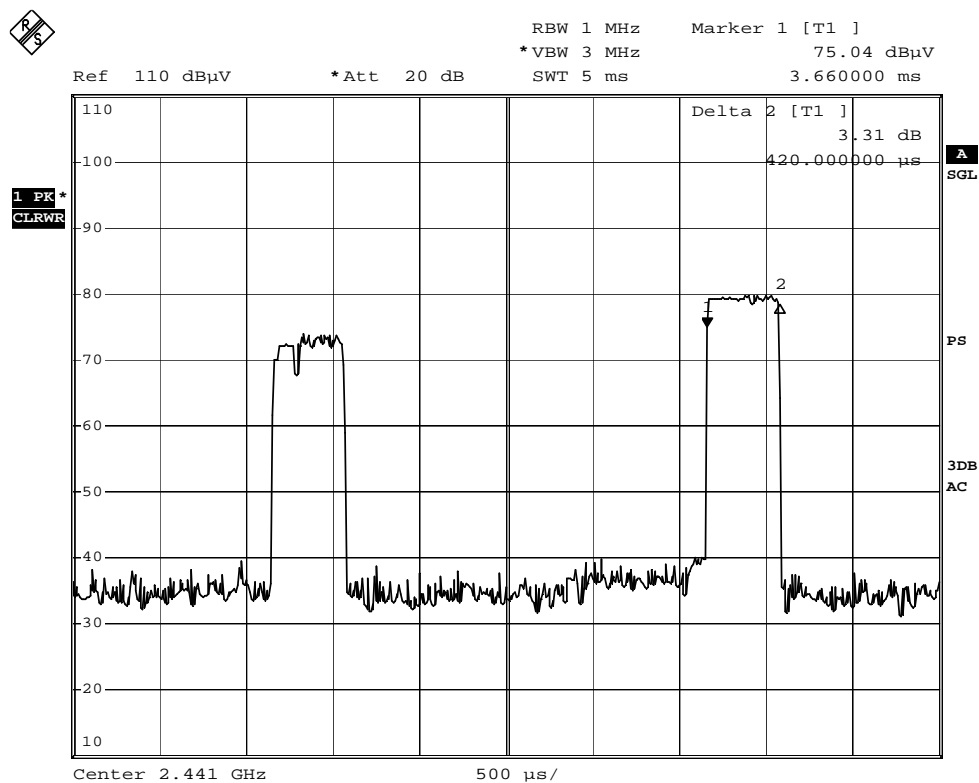
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Fig. H
[Pulse duration of Middle Channel]



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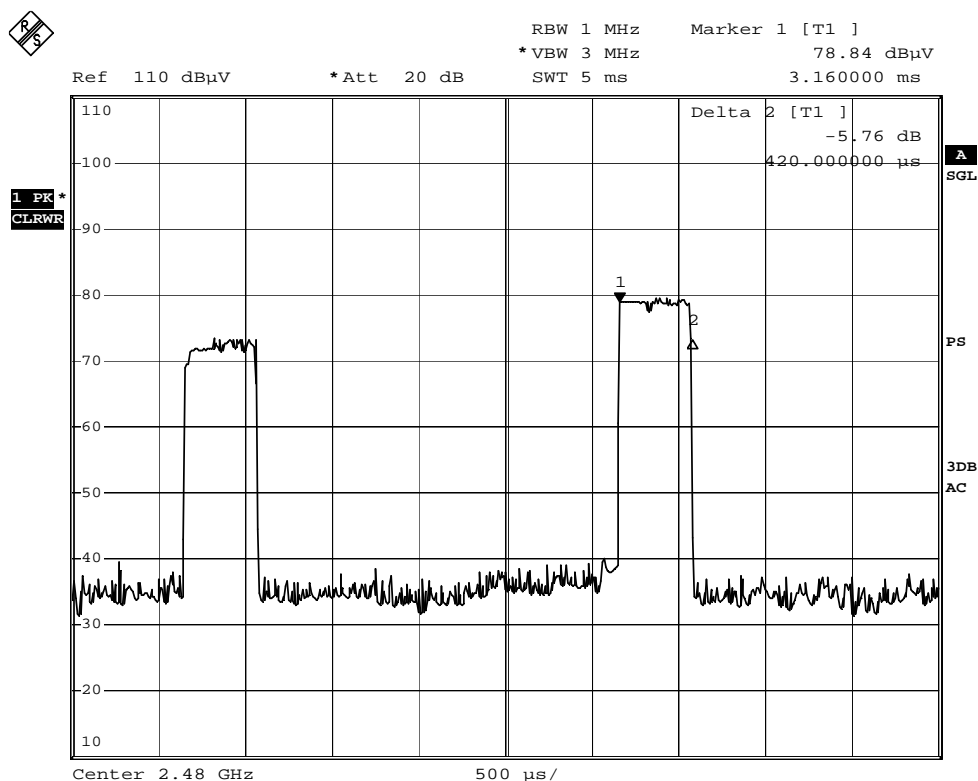
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Fig. I
[Pulse duration of Highest Channel]



Time of occupancy (Dwell Time):

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Results
DH5	2402	2.930	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	1.680	0.269	0.400	Complies
DH3	2442	1.680	0.269	0.400	Complies
DH3	2480	1.670	0.267	0.400	Complies
DH1	2402	0.420	0.134	0.400	Complies
DH1	2442	0.420	0.134	0.400	Complies
DH1	2480	0.420	0.134	0.400	Complies

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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
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	--	2012/10/25	2013/10/25
EM174	BICONILOG ANTENNA	EMCO	3142B	1671	2012/05/31	2014/05/31
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2012/05/03	2013/05/03
EM299	DOUBLE-RIDGED WAVEGUIDE HORN ANTENNA	ETS-LINDGREN	3115	00114120	2012/01/25	2014/01/25
EM022	LOOP ANTENNA	EMCO	6502	1189-2424	2011/09/14	2013/09/14
EM293	MXA SIGNAL ANALYZER	AGILENT TECHNOLOGIES	MY50510152	N/A	2011/11/10	2012/11/10
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2012/01/24	2014/01/24

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM197	LISN	EMCO	4825/2	1193	2012/05/16	2013/05/16
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2012/05/03	2013/05/03
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2012/01/27	2013/01/27
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2012/01/27	2013/01/27

Appendix B

Ancillary Equipment

ITEM NO.	DESCRIPTION	MODEL NO.	FCC ID	REMARK
1	iPod Touch	A1367	BCG-E2407	N/A

Remarks:-

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

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Appendix B

Photographs of EUT

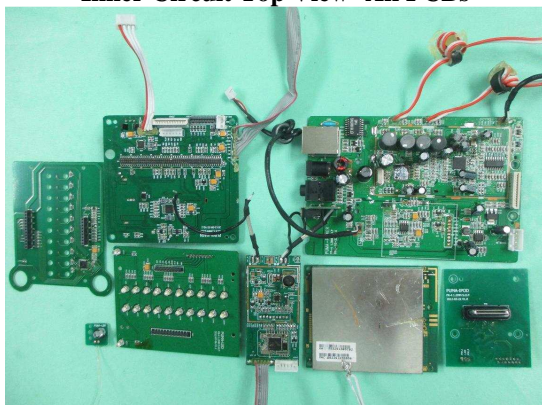
Front View of the product



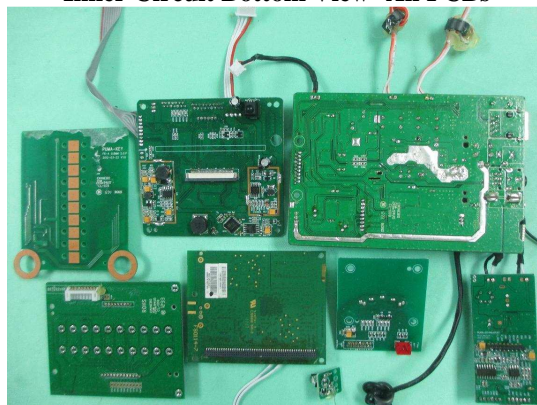
Rear View of the product



Inner Circuit Top View- All PCBs



Inner Circuit Bottom View- All PCBs



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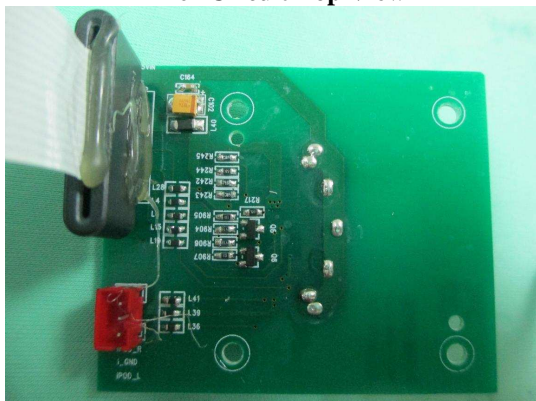
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Photographs of EUT

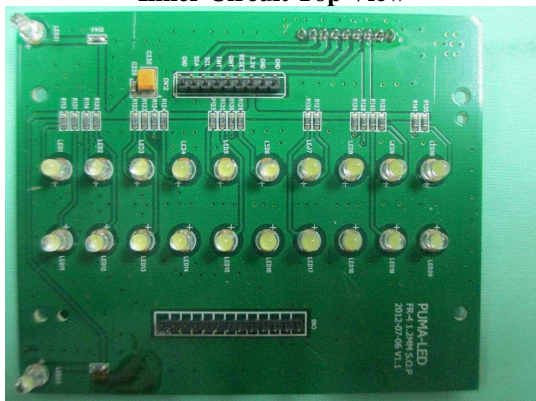
Inner Circuit Top View



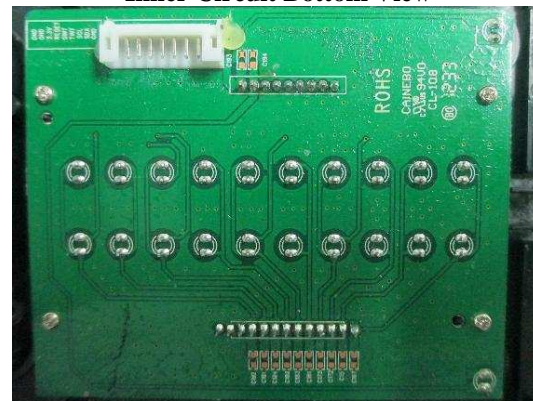
Inner Circuit Bottom View



Inner Circuit Top View



Inner Circuit Bottom View



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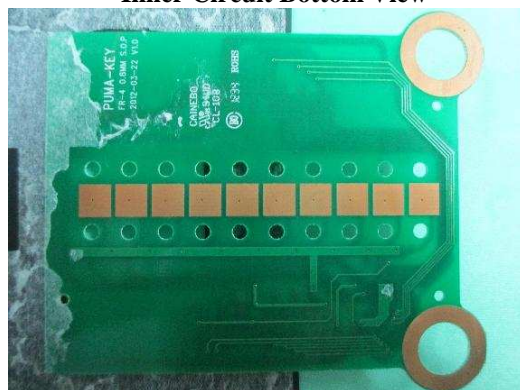
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Photographs of EUT

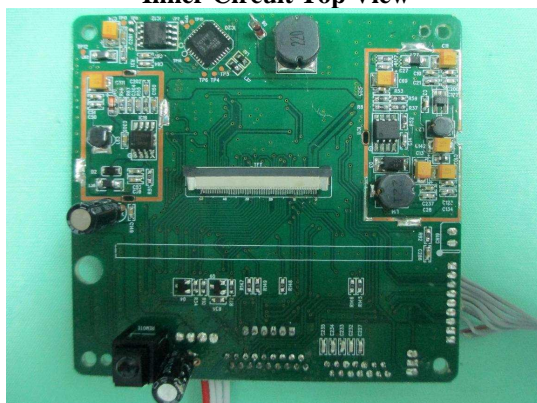
Inner Circuit Top View



Inner Circuit Bottom View



Inner Circuit Top View



Inner Circuit Bottom View



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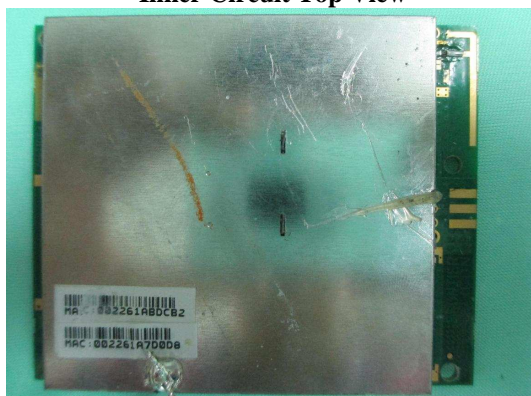
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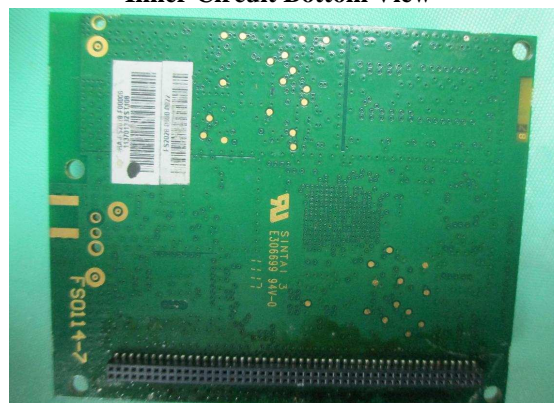
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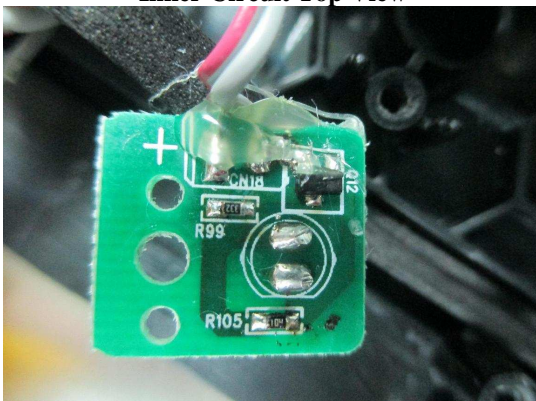
Inner Circuit Top View



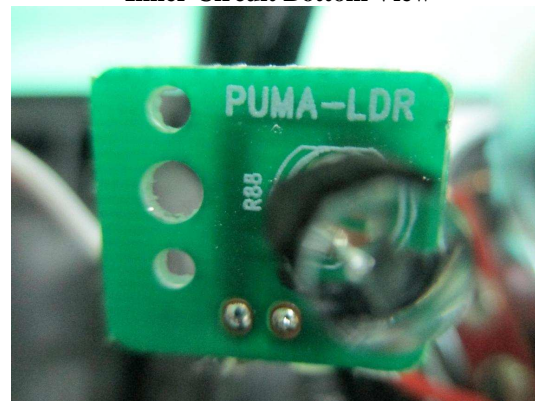
Inner Circuit Bottom View



Inner Circuit Top View



Inner Circuit Bottom View



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Photographs of EUT

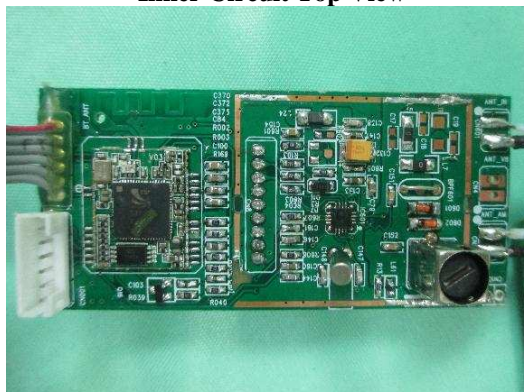
Inner Circuit Top View



Inner Circuit Bottom View



Inner Circuit Top View



Inner Circuit Bottom View



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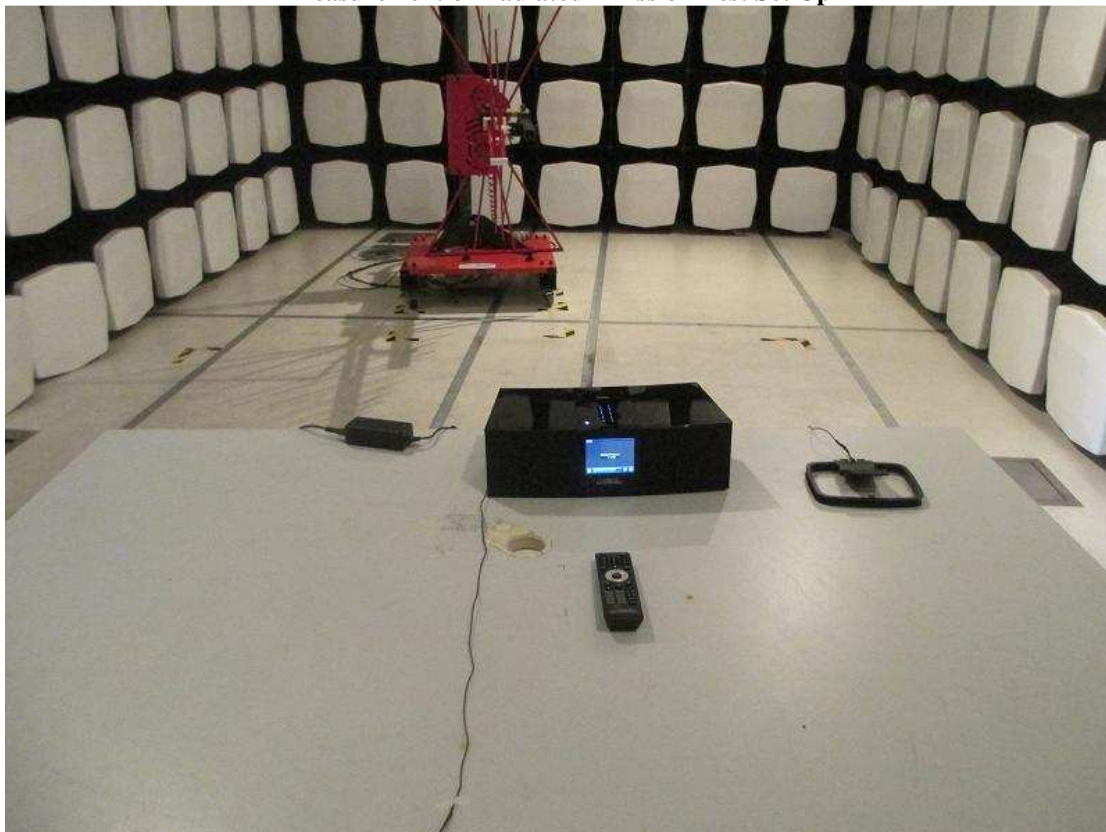
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Photographs of EUT

Measurement of Radiated Emission Test Set Up



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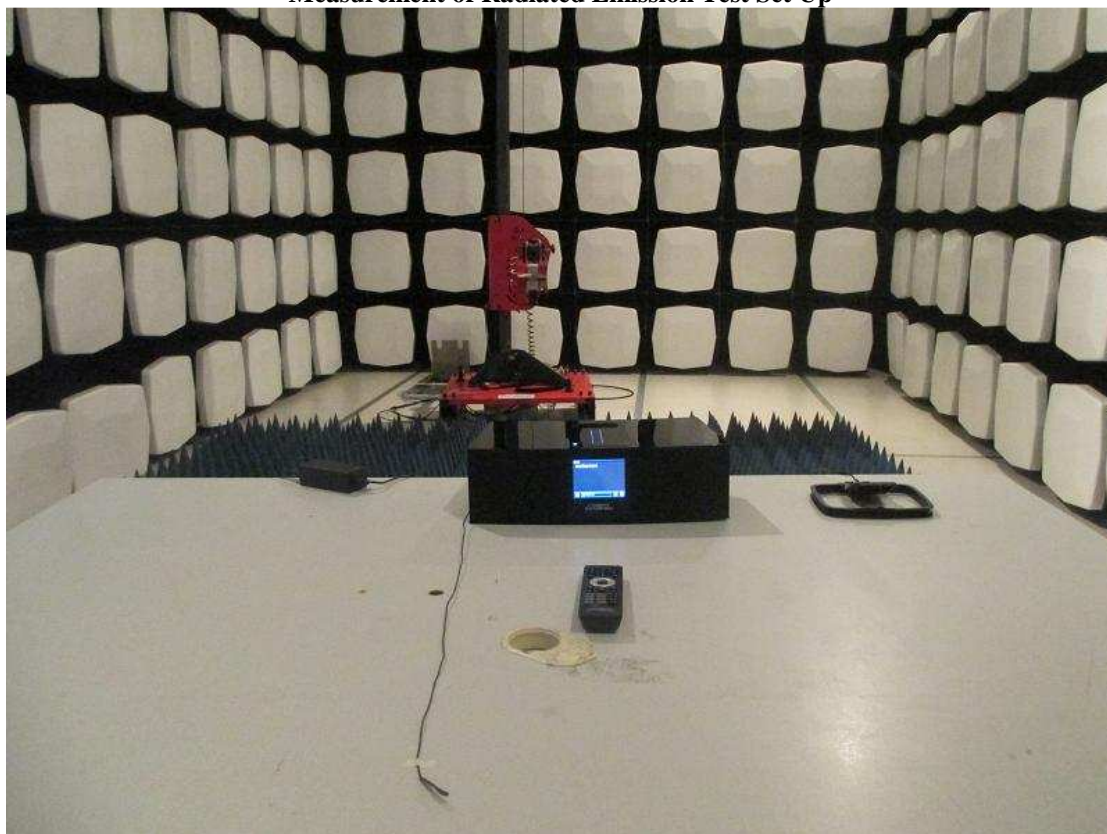
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Photographs of EUT

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Photographs of EUT

Measurement of Conducted Emission Test Set Up



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