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TEST REPORT

Report No.: 16081719HKG-001

Studio Banana SL

Application
For
Certification
(Original Grant)
(FCC ID: 2AERB-BATBAND01US)
(IC: 22705-BATBAND01CA)

Transceiver

Prepared and Checked by:

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Date: April 28, 2017

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GENERAL INFORMATION

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Manufacturer:	Acoustic Arc International Ltd.
Manufacturer Address:	Unit 110-112, 1/F., Philips Electronics Bldg., No.5 Science Park East Avenue, Hong Kong Science Park, Shatin, New Territories, Hong Kong.
Brand Name:	Batband
FCC Model:	Batband 1.0
IC PMN:	Batband 1.0
IC HVIN:	Batband 1.0
Type of EUT:	Transceiver
Description of EUT:	Wireless Bone Conduction Headphones
Serial Number:	N/A
FCC ID / IC:	2AERB-BATBAND01US / 22705-BATBAND01CA
Date of Sample Submitted:	August 31, 2016
Date of Test:	August 31, 2016 to April 20, 2017
Report No.:	16081719HKG-001
Report Date:	April 28, 2017
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

TEST SPECIFICATION	REFERENCE	RESULTS
Radiated Emission Radiated Emission on the Bandedge	15.249, 15.209 / RSS-210 B.10, RSS-210 4.4	Pass
Radiated Emission in Restricted Bands	15.205 / RSS-210 4.1	Pass

The equipment under test is found to be complying with the following standards:

FCC Part 15, October 1, 2015 Edition

RSS-210 Issue 9, August 2016

RSS-Gen Issue 4, November 2014

- Note: 1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.
2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

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1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is Batband (wireless headphone with 2.4GHz Bluetooth) that exhibits Bluetooth 4.0 BLE and Bluetooth 3.0 features. The EUT can accept wireless audio signal via external Bluetooth mobile device after pairing (such as smartphone). The EUT is powered by 3.7VDC internal rechargeable battery and/or USB port (5VDC). When the EUT is charging via USB port, the EUT has no RF emission.

Bluetooth portion:

For Bluetooth 4.0 BLE mode, it occupies a frequency range from 2402MHz to 2480MHz (40 channels with channel spacing of 2MHz). It transmits via GFSK modulation.

For Bluetooth 3.0 mode, it occupies a frequency range from 2402MHz to 2480MHz (79 channels with channel spacing of 1MHz). It transmits via GFSK modulation.

Antenna Type: Internal, Integral

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transceiver.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). All radiated measurements were performed in an 3m Chamber. Preliminary scans were performed in the 3m Chamber only to determine worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the “**Justification Section**” of this Application.

1.4 Test Facility

The 3m Chamber facility used to collect the radiated data is located at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong. This test facility and site measurement data have been placed on file with the FCC and IC No. 2042V-1.

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2.0 **System Test Configuration**

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The device was powered by 3.7VDC rechargeable battery and/or USB port (5VDC). When the EUT is charging via USB port, the EUT has no RF emission.

For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The unit was operated standalone and placed in the center of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the wooden turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

The EUT exercise program (if any) used during radiated testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

2.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

2.5 Support Equipment List and Description

N/A.

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3.0 Emission Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any), Average Factor (optional) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG - AV$$

where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB
- AV = Average Factor in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

$$FS = RR + LF$$

where

- FS = Field Strength in dB μ V/m
- RR = RA - AG - AV in dB μ V
- LF = CF + AF in dB

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB are added. The amplifier gain of 29 dB and average factor of 5 dB are subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V/m	
AF = 7.4 dB	RR = 18.0 dB μ V
CF = 1.6 dB	LF = 9.0 dB
AG = 29.0 dB	
AV = 5.0 dB	
FS = RR + LF	
FS = 18 + 9 = 27 dB μ V/m	

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(27 \text{ dB}\mu\text{V/m})/20] = 22.4 \mu\text{V/m}$$

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 2442.000 MHz

For electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgment: Passed by 0.4 dB

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 1

Radiated Emissions

Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2402.000	98.0	33	29.4	94.4	24	70.4	94.0	-23.6
H	4804.000	51.3	33	34.9	53.2	24	29.2	54.0	-24.8
H	7206.000	44.0	33	37.9	48.9	24	24.9	54.0	-29.1
H	9608.000	40.8	33	40.4	48.2	24	24.2	54.0	-29.8
H	12010.000	43.0	33	40.5	50.5	24	26.5	54.0	-27.5
H	14412.000	44.4	33	40.0	51.4	24	27.4	54.0	-26.6

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2402.000	98.0	33	29.4	94.4	114.0	-19.6
H	4804.000	51.3	33	34.9	53.2	74.0	-20.8
H	7206.000	44.0	33	37.9	48.9	74.0	-25.1
H	9608.000	40.8	33	40.4	48.2	74.0	-25.8
H	12010.000	43.0	33	40.5	50.5	74.0	-23.5
H	14412.000	44.4	33	40.0	51.4	74.0	-22.6

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 2

Radiated Emissions

Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2442.000	98.2	33	29.4	94.6	24	70.6	94.0	-23.4
H	4884.000	50.9	33	34.9	52.8	24	28.8	54.0	-25.2
H	7326.000	43.6	33	37.9	48.5	24	24.5	54.0	-29.5
H	9768.000	40.5	33	40.4	47.9	24	23.9	54.0	-30.1
H	12210.000	43.1	33	40.5	50.6	24	26.6	54.0	-27.4
H	14652.000	46.1	33	38.4	51.5	24	27.5	54.0	-26.5

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2442.000	98.2	33	29.4	94.6	114.0	-19.4
H	4884.000	50.9	33	34.9	52.8	74.0	-21.2
H	7326.000	43.6	33	37.9	48.5	74.0	-25.5
H	9768.000	40.5	33	40.4	47.9	74.0	-26.1
H	12210.000	43.1	33	40.5	50.6	74.0	-23.4
H	14652.000	46.1	33	38.4	51.5	74.0	-22.5

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 3

Radiated Emissions

Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2480.000	98.0	33	29.4	94.4	24	70.4	94.0	-23.6
H	4960.000	50.5	33	34.9	52.4	24	28.4	54.0	-25.6
H	7440.000	43.1	33	37.9	48.0	24	24.0	54.0	-30.0
H	9920.000	40.3	33	40.4	47.7	24	23.7	54.0	-30.3
H	12400.000	42.9	33	40.5	50.4	24	26.4	54.0	-27.6
H	14880.000	45.9	33	38.4	51.3	24	27.3	54.0	-26.7

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2480.000	98.0	33	29.4	94.4	114.0	-19.6
H	4960.000	50.5	33	34.9	52.4	74.0	-21.6
H	7440.000	43.1	33	37.9	48.0	74.0	-26.0
H	9920.000	40.3	33	40.4	47.7	74.0	-26.3
H	12400.000	42.9	33	40.5	50.4	74.0	-23.6
H	14880.000	45.9	33	38.4	51.3	74.0	-22.7

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Transmitting (Bluetooth 4.0 BLE)

Table 4

Radiated Emissions

Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2402.000	97.0	33	29.4	93.4	0	93.4	94.0	-0.6
H	4804.000	51.1	33	34.9	53.0	0	53.0	54.0	-1.0
H	7206.000	43.9	33	37.9	48.8	0	48.8	54.0	-5.2
H	9608.000	40.8	33	40.4	48.2	0	48.2	54.0	-5.8
H	12010.000	42.7	33	40.5	50.2	0	50.2	54.0	-3.8
H	14412.000	44.4	33	40.0	51.4	0	51.4	54.0	-2.6

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2402.000	97.0	33	29.4	93.4	114.0	-20.6
H	4804.000	51.1	33	34.9	53.0	74.0	-21.0
H	7206.000	43.9	33	37.9	48.8	74.0	-25.2
H	9608.000	40.8	33	40.4	48.2	74.0	-25.8
H	12010.000	42.7	33	40.5	50.2	74.0	-23.8
H	14412.000	44.4	33	40.0	51.4	74.0	-22.6

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Transmitting (Bluetooth 4.0 BLE)

Table 5

Radiated Emissions

Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2440.000	97.2	33	29.4	93.6	0	93.6	94.0	-0.4
H	4880.000	50.9	33	34.9	52.8	0	52.8	54.0	-1.2
H	7320.000	43.5	33	37.9	48.4	0	48.4	54.0	-5.6
H	9760.000	40.0	33	40.4	47.4	0	47.4	54.0	-6.6
H	12200.000	43.1	33	40.5	50.6	0	50.6	54.0	-3.4
H	14640.000	45.8	33	38.4	51.2	0	51.2	54.0	-2.8

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2440.000	97.2	33	29.4	93.6	114.0	-20.4
H	4880.000	50.9	33	34.9	52.8	74.0	-21.2
H	7320.000	43.5	33	37.9	48.4	74.0	-25.6
H	9760.000	40.0	33	40.4	47.4	74.0	-26.6
H	12200.000	43.1	33	40.5	50.6	74.0	-23.4
H	14640.000	45.8	33	38.4	51.2	74.0	-22.8

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Transmitting (Bluetooth 4.0 BLE)

Table 6

Radiated Emissions

Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2480.000	97.0	33	29.4	93.4	0	93.4	94.0	-0.6
H	4960.000	50.5	33	34.9	52.4	0	52.4	54.0	-1.6
H	7440.000	43.1	33	37.9	48.0	0	48.0	54.0	-6.0
H	9920.000	40.0	33	40.4	47.4	0	47.4	54.0	-6.6
H	12400.000	42.9	33	40.5	50.4	0	50.4	54.0	-3.6
H	14880.000	45.8	33	38.4	51.2	0	51.2	54.0	-2.8

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2480.000	97.0	33	29.4	93.4	114.0	-20.6
H	4960.000	50.5	33	34.9	52.4	74.0	-21.6
H	7440.000	43.1	33	37.9	48.0	74.0	-26.0
H	9920.000	40.0	33	40.4	47.4	74.0	-26.6
H	12400.000	42.9	33	40.5	50.4	74.0	-23.6
H	14880.000	45.8	33	38.4	51.2	74.0	-22.8

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Studio Banana S.L

Date of Test: April 20, 2017

Model: Batband 1.0

Worst-Case Operating Mode: Bluetooth Audio Playing

Table 7
Radiated Emissions
Pursuant to FCC Part 15 Section 15.209 / RSS-210 4.4 Requirement

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
H	219.998	34.2	16	17.0	35.2	46.0	-10.8
H	224.000	39.4	16	18.0	41.4	46.0	-4.6
H	228.000	38.6	16	18.0	40.6	46.0	-5.4
H	252.008	37.8	16	20.0	41.8	46.0	-4.2
H	256.010	37.2	16	21.0	42.2	46.0	-3.8
H	260.012	36.8	16	21.0	41.8	46.0	-4.2
H	296.022	35.4	16	22.0	41.4	46.0	-4.6
H	308.026	34.5	16	23.0	41.5	46.0	-4.5
H	311.906	34.8	16	23.0	41.8	46.0	-4.2
H	316.028	34.4	16	23.0	41.4	46.0	-4.6

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

4.0 **Equipment Photographs**

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

5.0 **Product Labelling**

For electronics filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

6.0 **Technical Specifications**

For electronic filing, the block diagram and schematic of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

7.0 **Instruction Manual**

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States and Canada.

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8.0 **Miscellaneous Information**

The miscellaneous information includes details of the test procedure and measured bandwidth / calculation of factor such as pulse desensitization and averaging factor (calculation and timing diagram).

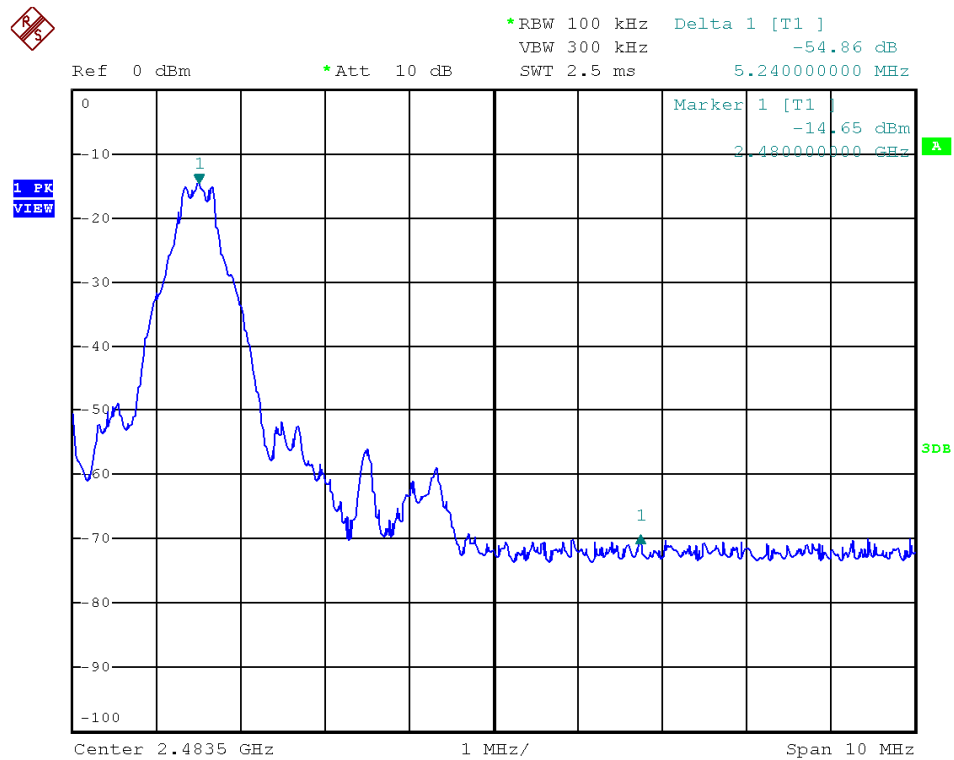
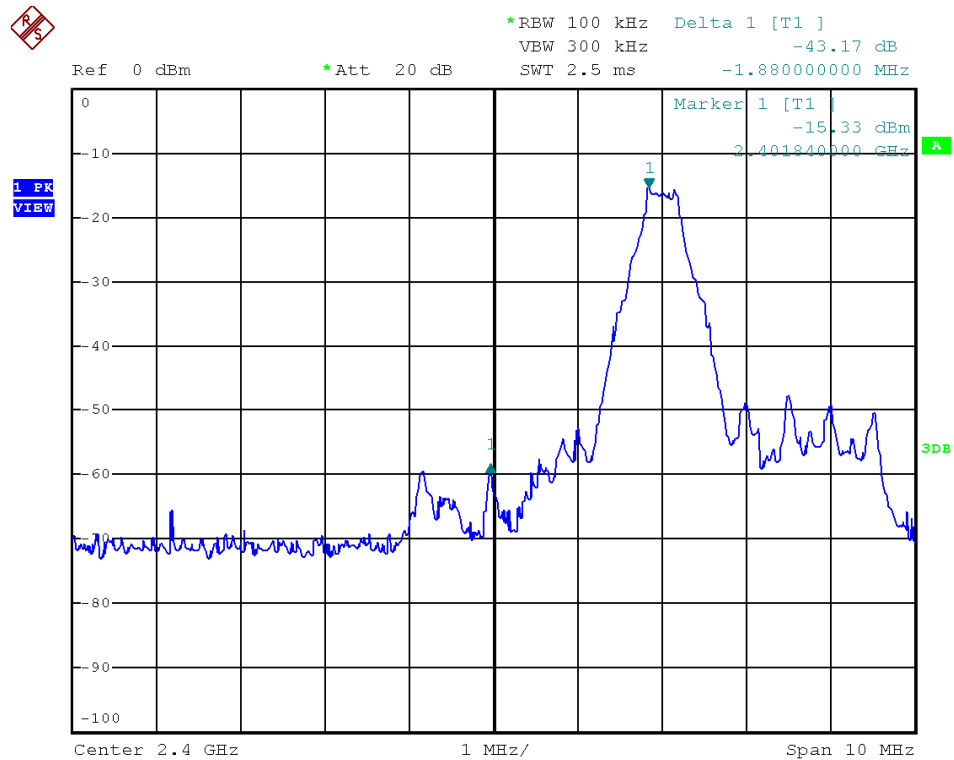
8.1 Radiated Emission on the Bandedge

From the following plots, they show that the fundamental emissions are confined in the specified band (2400MHz to 2483.5MHz). In case of the fundamental emissions are within two standard bandwidths from the bandedge, the delta measurement technique is used for determining bandedge compliance. Standard bandwidth is the bandwidth specified by ANSI C63.10 (2013) for frequency being measured.

Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50dB below the level of the fundamental or to the general radiated emissions limits in Section 15.209 / RSS-210 4.4, whichever is the lesser attenuation, which meet the requirement of part 15.249(d) / RSS-210 B.10.

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Peak Measurement (Bluetooth 3.0)



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Peak Measurement (Bluetooth 3.0)

Bandedge compliance is determined by applying marker-delta method, i.e. (Bandedge Plot).

Lower bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=94.4 dB μ V/m - 43.2 dB

=51.2 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=70.4 dB μ V/m - 43.2 dB

=27.2 dB μ V/m

Upper bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=94.4 dB μ V/m - 54.9 dB

=39.5 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

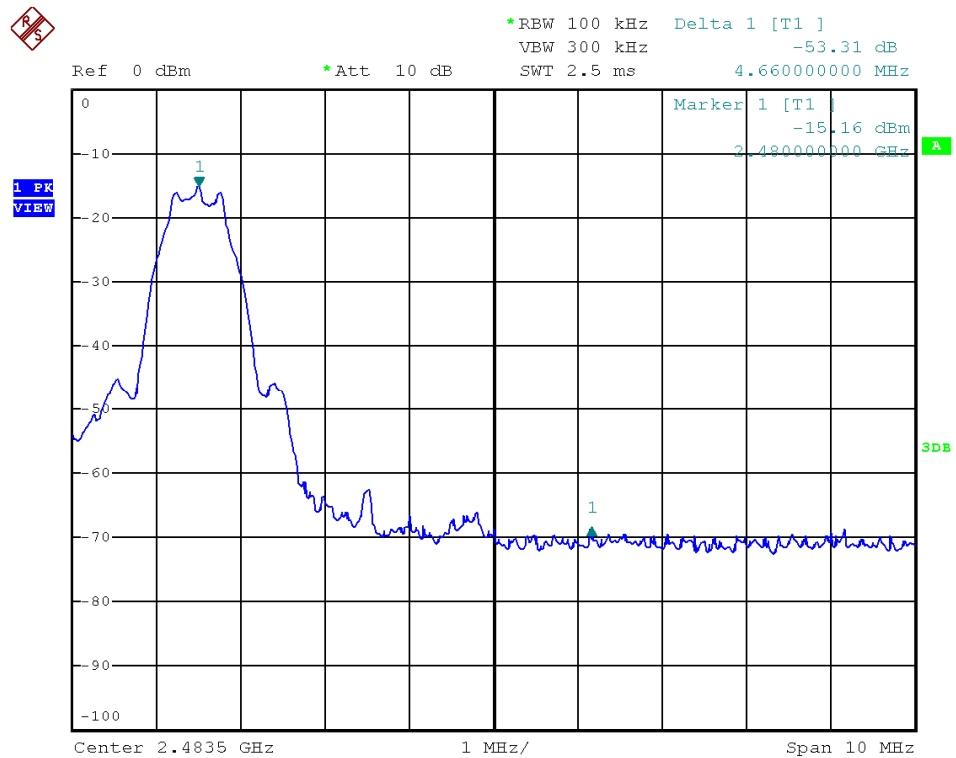
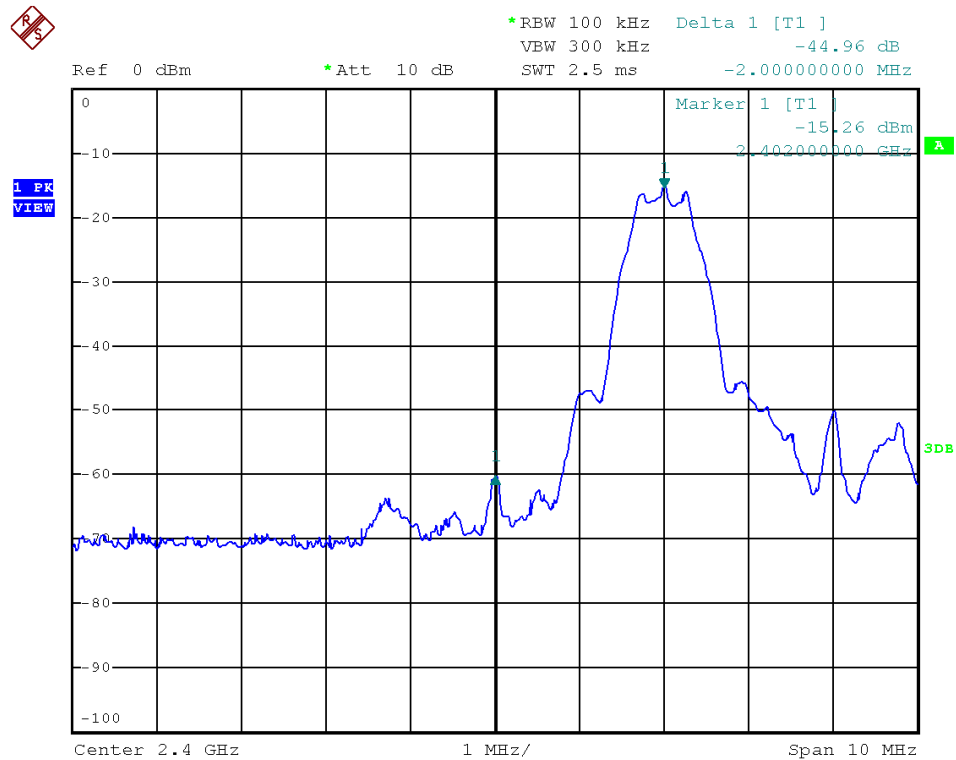
=70.4 dB μ V/m - 54.9 dB

=15.5 dB μ V/m

The resultant field strength meets the general radiated emission limit in Section 15.209 / RSS-210 4.4, which does not exceed 74 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

INTERTEK TESTING SERVICES

Peak Measurement (Bluetooth 4.0 BLE)



INTERTEK TESTING SERVICES

Peak Measurement (Bluetooth 4.0 BLE)

Bandedge compliance is determined by applying marker-delta method, i.e. (Bandedge Plot).

Lower bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=93.4 dB μ V/m - 44.0 dB

=49.4 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=93.4 dB μ V/m - 44.0 dB

=49.4 dB μ V/m

Upper bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=93.4 dB μ V/m - 53.1 dB

=40.3 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=93.4 dB μ V/m – 53.1 dB

=40.3 dB μ V/m

The resultant field strength meets the general radiated emission limit in Section 15.209 / RSS-210 4.4, which does not exceed 74 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

INTERTEK TESTING SERVICES

8.2 Discussion of Pulse Desensitization

(Bluetooth 3.0)

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 625µs for a digital "1" bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

(Bluetooth 4.0 BLE)

Pulse desensitivity is not applicable for this device. Since the transmitter transmits the RF signal continuously.

8.3 Calculation of Average Factor

(Bluetooth 3.0)

Based on the Bluetooth Specification Version 3.0 + EDR, the transmitter ON time for each timeslot of Bluetooth is 625µs. DH5 has the maximum duty cycle, which consists of 5 continuous Tx slots and 1 Rx slot. Therefore one hopset take $(5+1) \times 625\mu s = 3.75ms$. For one period for a pseudo-random hopping through at least 20 RF channels in adaptive mode (worse case), it take: $20 \times 3.75ms = 75ms$.

The dwell time for DH5 is $5 \times 625\mu s = 3.125ms$.

For the worst case calculation, there are two transmissions might occur in 100ms. Therefore,

$$\begin{aligned}\text{Duty Cycle (DC)} &= \text{Maximum On time in } 100ms/100ms \\ &= 3.125ms \times 2/100ms \\ &= 0.0625\end{aligned}$$

$$\begin{aligned}\text{Average Factor (AF) of Bluetooth in dB} &= 20 \log_{10} (0.0625) \\ &= -24 \text{ dB}\end{aligned}$$

(Bluetooth 4.0 BLE)

The average factor is not applicable for this device as the transmitted signal is a continuously signal.

INTERTEK TESTING SERVICES

8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services Hong Kong Ltd. in the measurements of transmitter operating under the Part 15, Subpart C rules.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately 0.8m in height above the ground plane for emission measurement at or below 1GHz and 1.5m in height above the ground plane for emission measurement above 1GHz. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axis to obtain maximum emission levels. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

INTERTEK TESTING SERVICES

8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

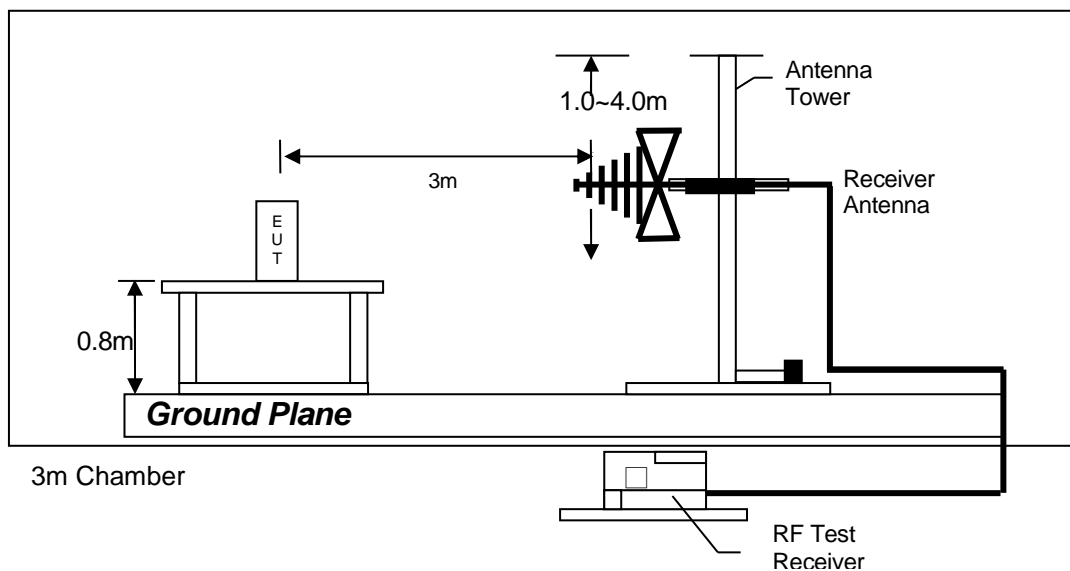
Conducted measurements were made as described in ANSI C63.10 (2013).

The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 3 MHz is used.

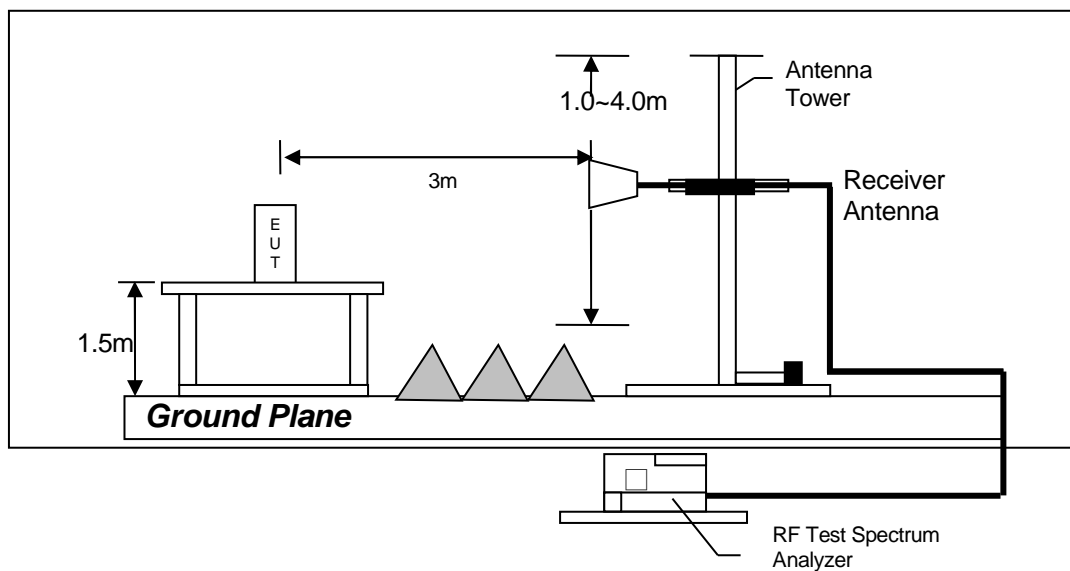
Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, unless otherwise reported. Measurements taken at a closer distance are so marked.

8.4.1 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

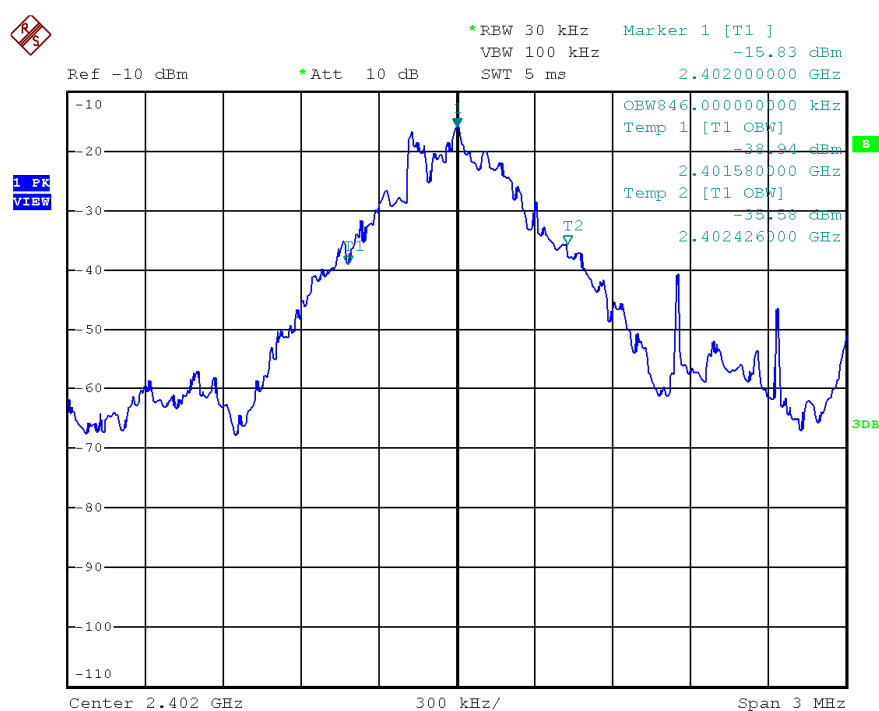
INTERTEK TESTING SERVICES

8.5 Occupied Bandwidth

Occupied Bandwidth Results: (Bluetooth 3.0)

Bluetooth (MHz)	Occupied Bandwidth (kHz)
Low Channel: 2402	846
Middle Channel: 2442	846
High Channel: 2480	834

The worst case is shown as below

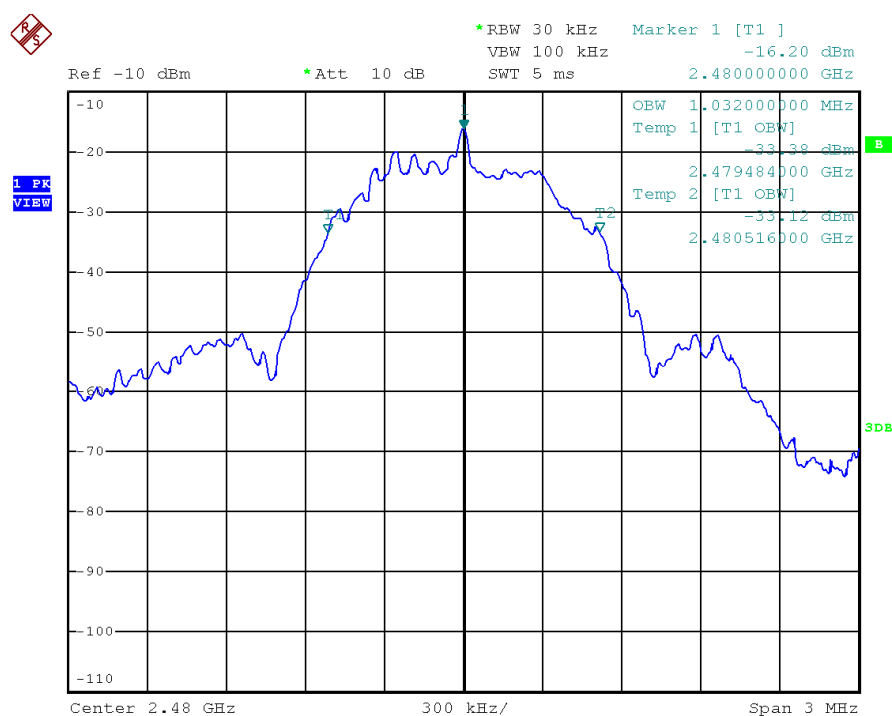


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Occupied Bandwidth Results: (Bluetooth 4.0 BLE)

Bluetooth (MHz)	Occupied Bandwidth (kHz)
Low Channel: 2402	1026
Middle Channel: 2440	1026
High Channel: 2480	1032

The worst case is shown as below



INTERTEK TESTING SERVICES

9.0 Confidentiality Request

For electronic filing, a preliminary copy of the confidentiality request is saved with filename: request.pdf.

10.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Biconical Antenna	Log Periodic Antenna
Registration No.	EW-2666	EW-0571	EW-0953
Manufacturer	R&S	EMCO	EMCO
Model No.	ESCI7	3104C	3148
Calibration Date	Jun. 17, 2016	May 18, 2016	Sep. 11, 2015
Calibration Due Date	Jun. 17, 2017	Nov. 18, 2017	Sep. 05, 2017

Equipment	Spectrum Analyzer	Pyramidal Horn Antenna	Double Ridged Guide Antenna
Registration No.	EW-2188	EW-0905	EW-1133
Manufacturer	AGILENTTECH	EMCO	EMCO
Model No.	E4407B	3160-09	3115
Calibration Date	Apr. 25, 2016	Feb. 12, 2016	Nov. 05, 2015
Calibration Due Date	Apr. 25, 2017	Aug. 12, 2017	May 05, 2017

2) Bandedge/Bandedge Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2253
Manufacturer	R&S
Model No.	FSP40
Calibration Date	Jun. 15, 2016
Calibration Due Date	Jun. 15, 2017

END OF TEST REPORT