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TEST REPORT

Report No.: 15061681HKG-002

Lenbrook Industries Limited

Application
For
Certification
(Original Grant)
(FCC ID: Q2O-VAULT2)
(IC: 152B-VAULT2)

Transceiver

This report contains the data of Bluetooth 3.0 portion only.

Prepared and Checked by:

Approved by:

Signed On File

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Date: Sep 24, 2015

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GENERAL INFORMATION

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Manufacturer:	Dongguan Kwan Hong Electronics Co., Ltd
Manufacturer Address:	KwanHong Building, Xiao Bian 2nd Industrial Zone, Chang An, Dongguan, China.
Brand Name:	Bluesound
FCC Model:	VAULT 2
IC Model:	VAULT 2
Type of EUT:	Transceiver
Description of EUT:	Streaming Music Player, Vault and CD-Ripper
Serial Number:	N/A
FCC ID / IC:	Q2O-VAULT2 / 152B-VAULT2
Date of Sample Submitted:	Jul 10, 2015
Date of Test:	Jul 10, 2015 to Sep 22, 2015
Report No.:	15061681HKG-002
Report Date:	Sep 24, 2015
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 A2.9, RSS-210 2.5	Pass
Radiated Emission in Restricted Bands	15.205 / RSS-210 2.2	Pass

The equipment under test is found to be complying with the following standards:
FCC Part 15, October 1, 2014 Edition
RSS-210 Issue 8, December 2010
RSS-Gen Issue 4, December 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) VAULT 2 is a Streaming Music Player, Vault and CD-Ripper. The EUT contains a Bluetooth module which has Bluetooth 4.0 BLE and Bluetooth 3.0 features. The EUT can accept analog audio signal, digital audio signal, music content from CD, harddisk and wireless audio signal via Bluetooth devices. The EUT is powered by 100-240VAC.

For Bluetooth module:

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.

The antenna(s) used in the EUT is internal, integral.

The circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transceiver (Bluetooth 3.0 portion).

1.3 Test Methodology

Radiated emission measurements was 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 and conducted measurement 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.

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 120VAC

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 rear of unit shall be flushed with the rear of the table.

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.

Different data rates have been tested. Worst case is reported only.

All relevant operation modes have been tested, and the worst case data is included in this report.

All data rates were tested under normal mode of Bluetooth 3.0. Only the worst-case data is shown in the report for GFSK.

2.2 EUT Exercising Software

There was no special software to exercise the device. Once the unit is powered up, it transmits the RF signal continuously.

2.3 Special Accessories

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

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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

- (1) 1 X power cable of 1.8m in length (with termination)
(Supplied by Applicant)
- (2) 4 X audio cable of 1m in length (with termination)
- (3) 1 X digital audio cable of 1m in length (with termination)
- (4) 1 X LAN cable of 1m in length (with termination)
- (5) 2 X IR Trigger Control cable of 1m in length (with termination)
- (6) 1 X 4GB USB flash drive
(Supplied by Intertek)

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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.

$$RA = 52.0 \text{ dB}\mu\text{V/m}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$AV = 5.0 \text{ dB}$$

$$FS = RR + LF$$

$$FS = 18 + 9 = 27 \text{ dB}\mu\text{V/m}$$

$$RR = 18.0 \text{ dB}\mu\text{V}$$

$$LF = 9.0 \text{ dB}$$

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

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 50.326 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 1.4 dB

3.4 Conducted Emission Configuration Photograph

The worst case in line-conducted emission was found at 23.127 MHz

For electronic filing, the worst case line-conducted configuration photographs are saved with filename: conducted photo.pdf.

3.5 Conducted Emission Data

For electronic filing, the graph and data table of conducted emission is saved with filename: conducted.pdf.

Judgment: Pass by 0.8 dB

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Model: VAULT 2

Worst-Case Operating Mode: EUT Transmitting

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dBμV		DELTA LIMIT dB
1 Quasi Peak	154.5 kHz	52.12 N		-13.62
2 CISPR Average	154.5 kHz	47.13 N		-8.61
2 CISPR Average	240 kHz	41.11 N		-10.98
1 Quasi Peak	271.5 kHz	44.20 N		-16.86
1 Quasi Peak	348 kHz	42.00 N		-17.00
2 CISPR Average	402 kHz	36.46 N		-11.34
1 Quasi Peak	429 kHz	48.54 L1		-8.72
2 CISPR Average	442.5 kHz	40.98 N		-6.03
1 Quasi Peak	618 kHz	47.51 N		-8.48
2 CISPR Average	618 kHz	41.20 N		-4.79
1 Quasi Peak	1.032 MHz	41.79 L1		-14.20
2 CISPR Average	1.0545 MHz	35.09 L1		-10.90
1 Quasi Peak	1.0995 MHz	40.68 L1		-15.31
2 CISPR Average	1.0995 MHz	35.12 L1		-10.87
2 CISPR Average	1.644 MHz	33.68 L1		-12.31
1 Quasi Peak	1.6485 MHz	39.92 L1		-16.07
1 Quasi Peak	2.229 MHz	39.88 L1		-16.11
2 CISPR Average	2.229 MHz	32.69 N		-13.30
2 CISPR Average	3.3945 MHz	30.80 L1		-15.19
1 Quasi Peak	3.543 MHz	37.58 L1		-18.42

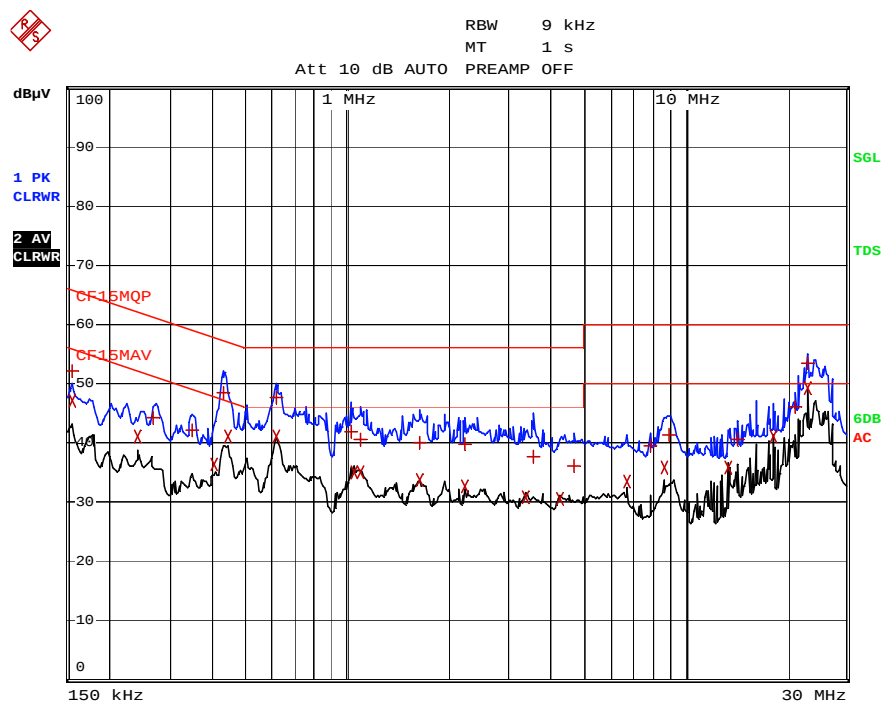
EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dBμV		DELTA LIMIT dB
2 CISPR Average	4.2855 MHz	30.56 L1		-15.43
1 Quasi Peak	4.686 MHz	36.20 L1		-19.79
2 CISPR Average	6.702 MHz	33.40 N		-16.59
1 Quasi Peak	7.9215 MHz	39.53 N		-20.46
2 CISPR Average	8.718 MHz	35.76 N		-14.23
1 Quasi Peak	8.9565 MHz	41.42 N		-18.57
2 CISPR Average	13.3575 MHz	35.94 L1		-14.05
1 Quasi Peak	14.2125 MHz	40.67 L1		-19.32
2 CISPR Average	18.2445 MHz	41.02 L1		-8.97
1 Quasi Peak	21.0525 MHz	46.10 N		-13.89
1 Quasi Peak	23.127 MHz	53.34 L1		-6.65
2 CISPR Average	23.127 MHz	49.19 L1		-0.80

Note: Measurement Uncertainty is ± 4.2 dB at a level of confidence of 95%.

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Model: VAULT 2

Worst-Case Operating Mode: EUT Transmitting



Note: Measurement Uncertainty is ± 4.2 dB at a level of confidence of 95%.

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Applicant: Lenbrook Industries Limited

Date of Test: AUG 10, 2015

Model: VAULT 2

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 1
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 / RSS-210 A2.9 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)
V	2402.000	104.2	33	29.4	100.6	24	76.6	94.0	-17.4
V	4804.000	49.3	33	34.9	51.2	24	27.2	54.0	-26.8
V	7206.000	46.3	33	37.9	51.2	24	27.2	54.0	-26.8
V	9608.000	44.2	33	40.4	51.6	24	27.6	54.0	-26.4
V	12010.000	43.9	33	40.5	51.4	24	27.4	54.0	-26.6
V	14412.000	44.6	33	40.0	51.6	24	27.6	54.0	-26.4

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)
V	2402.000	104.2	33	29.4	100.6	114.0	-13.4
V	4804.000	49.3	33	34.9	51.2	74.0	-22.8
V	7206.000	46.3	33	37.9	51.2	74.0	-22.8
V	9608.000	44.2	33	40.4	51.6	74.0	-22.4
V	12010.000	43.9	33	40.5	51.4	74.0	-22.6
V	14412.000	44.6	33	40.0	51.6	74.0	-22.4

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 Section 2.2.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Lenbrook Industries Limited

Date of Test: AUG 10, 2015

Model: VAULT 2

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 2
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 / RSS-210 A2.9 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)
V	2442.000	105.2	33	29.4	101.6	24	77.6	94.0	-16.4
V	4884.000	49.3	33	34.9	51.2	24	27.2	54.0	-26.8
V	7326.000	46.5	33	37.9	51.4	24	27.4	54.0	-26.6
V	9768.000	44.0	33	40.4	51.4	24	27.4	54.0	-26.6
V	12210.000	43.9	33	40.5	51.4	24	27.4	54.0	-26.6
V	14652.000	46.4	33	38.4	51.8	24	27.8	54.0	-26.2

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)
V	2442.000	105.2	33	29.4	101.6	114.0	-12.4
V	4884.000	49.3	33	34.9	51.2	74.0	-22.8
V	7326.000	46.5	33	37.9	51.4	74.0	-22.6
V	9768.000	44.0	33	40.4	51.4	74.0	-22.6
V	12210.000	43.9	33	40.5	51.4	74.0	-22.6
V	14652.000	46.4	33	38.4	51.8	74.0	-22.2

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 Section 2.2.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Lenbrook Industries Limited

Date of Test: AUG 10, 2015

Model: VAULT 2

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 3
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 / RSS-210 A2.9 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)
V	2480.000	106.4	33	29.4	102.8	24	78.8	94.0	-15.2
V	4960.000	49.5	33	34.9	51.4	24	27.4	54.0	-26.6
V	7440.000	46.5	33	37.9	51.4	24	27.4	54.0	-26.6
V	9920.000	44.0	33	40.4	51.4	24	27.4	54.0	-26.6
V	12400.000	44.3	33	40.5	51.8	24	27.8	54.0	-26.2
V	14880.000	46.4	33	38.4	51.8	24	27.8	54.0	-26.2

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)
V	2480.000	106.4	33	29.4	102.8	114.0	-11.2
V	4960.000	49.5	33	34.9	51.4	74.0	-22.6
V	7440.000	46.5	33	37.9	51.4	74.0	-22.6
V	9920.000	44.0	33	40.4	51.4	74.0	-22.6
V	12400.000	44.3	33	40.5	51.8	74.0	-22.2
V	14880.000	46.4	33	38.4	51.8	74.0	-22.2

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 Section 2.2.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Lenbrook Industries Limited
Model: VAULT 2
Worst-Case Operating Mode: EUT Transmitting

Date of Test: AUG 10, 2015

Table 4

Radiated Emission Data

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	50.326	43.6	16	11.0	38.6	40.0	-1.4
V	125.005	38.7	16	14.0	36.7	43.5	-6.8
V	214.857	34.8	16	17.0	35.8	43.5	-7.7
V	250.006	34.3	16	20.0	38.3	46.0	-7.7
V	375.008	31.5	16	24.0	39.5	46.0	-6.5
V	500.013	30.4	16	26.0	40.4	46.0	-5.6
V	625.018	23.8	16	29.0	36.8	46.0	-9.2
V	750.020	22.3	16	30.0	36.3	46.0	-9.7
V	875.025	19.8	16	32.0	35.8	46.0	-10.2

- NOTES:
1. Peak detector is used for the emission measurement.
 2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance 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 radiated emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative value in the margin column shows emission below limit.
 4. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 Section 2.2.
 5. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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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.

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).

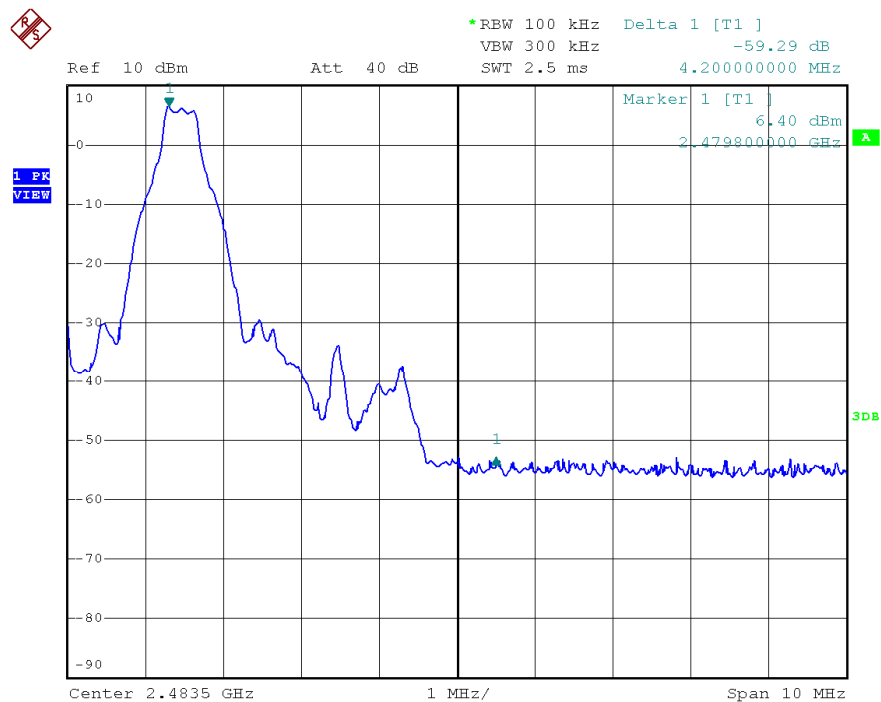
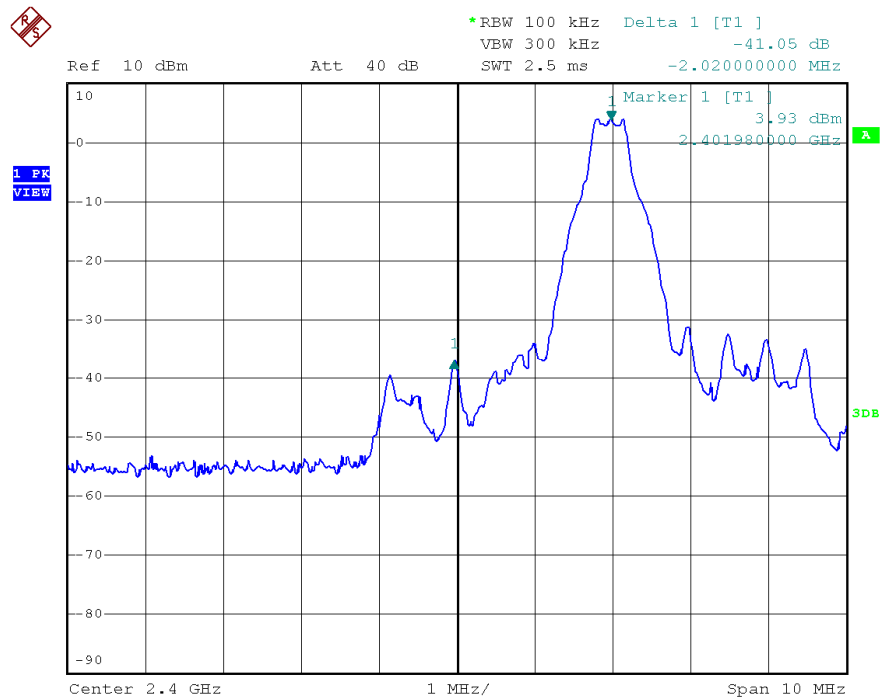
8.1 Radiated Emission on the Bandedge

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 2.5, whichever is the lesser attenuation, which meet the requirement of part 15.249(d) / RSS-210 A2.9.

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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

$$\begin{aligned} &= 100.6 \text{ dB}\mu\text{V/m} - 41.1 \text{ dB} \\ &= 59.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

$$\begin{aligned} &= 76.6 \text{ dB}\mu\text{V/m} - 41.1 \text{ dB} \\ &= 35.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

Upper bandedge

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

$$\begin{aligned} &= 102.8 \text{ dB}\mu\text{V/m} - 59.3 \text{ dB} \\ &= 43.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

$$\begin{aligned} &= 78.8 \text{ dB}\mu\text{V/m} - 59.3 \text{ dB} \\ &= 19.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 0.625ms for a digital "1" bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

8.3 Calculation of Average Factor

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

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

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

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

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

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.

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).

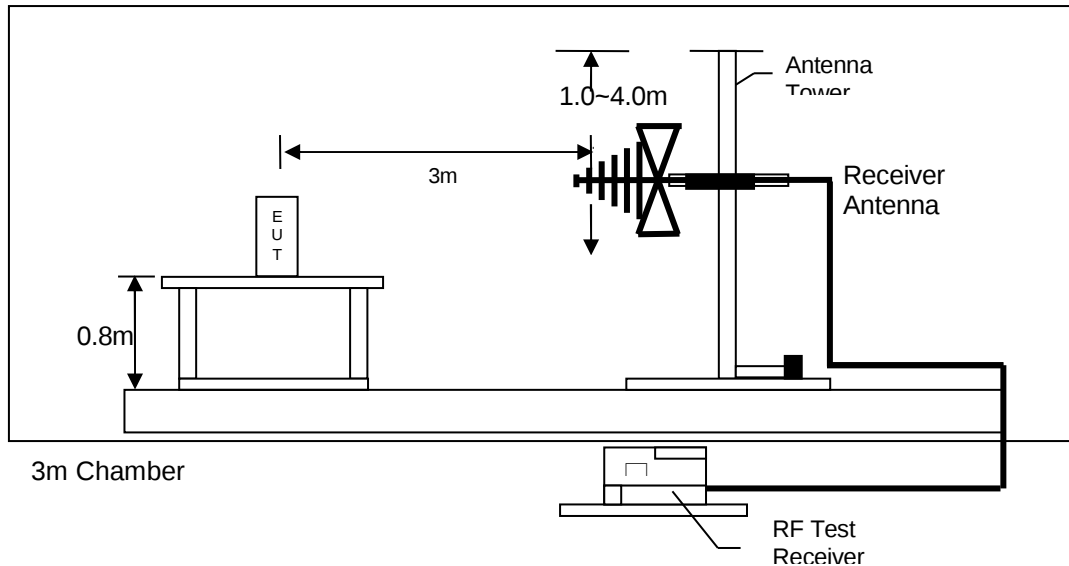
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion 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 1 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.

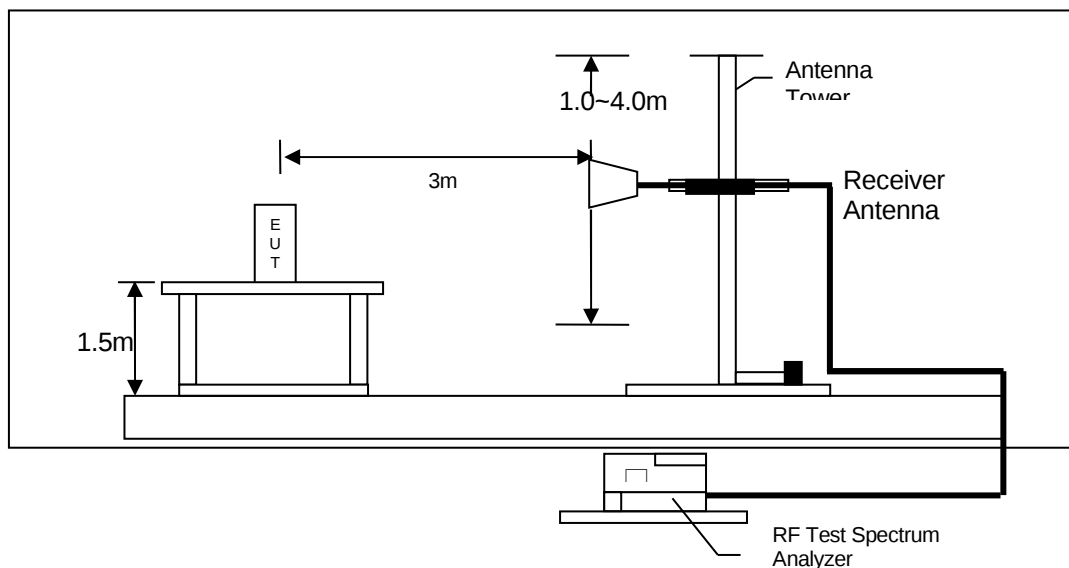
INTERTEK TESTING SERVICES

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 upto 1GHz



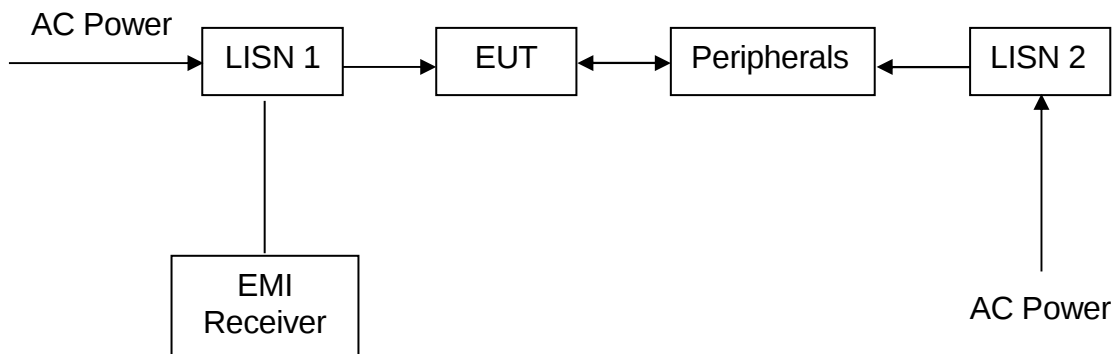
Test setup of radiated emissions above 1GHz

8.4.2 Conducted Emission Test Procedures

For tabletop equipment, the EUT along with its peripherals were placed on a 1.0m(W)×1.5m(L) and 0.8m in height wooden table. For floor-standing equipment, the EUT and all cables were insulated, if required, from the ground plane by up to 12 mm of insulating material. The EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4.3 Conducted Emission Test Setup



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8.5 Occupied Bandwidth

Occupied Bandwidth Results: (Bluetooth 3.0)

Bluetooth	Occupied Bandwidth (kHz)
Low Channel: 2402	850
Middle Channel: 2442	850
High Channel: 2480	840

The worst case is shown as below:



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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	Spectrum Analyzer	Biconical Antenna
Registration No.	EW-3095	EW-2249	EW-2512
Manufacturer	R&S	R&S	EMCO
Model No.	ESCI	FSP30	3104C
Calibration Date	Oct. 16, 2014	Nov. 19, 2014	Jan. 22, 2015
Calibration Due Date	Oct. 16, 2015	Nov. 19, 2015	Jul. 22, 2016

Equipment	Double Ridged Guide Antenna	Log Periodic Antenna
Registration No.	EW-1133	EW-0447
Manufacturer	EMCO	EMCO
Model No.	3115	3146
Calibration Date	Apr. 30, 2014	Mar. 16, 2015
Calibration Due Date	Oct. 30, 2015	Sep. 16, 2016

2) Bandedge Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2249
Manufacturer	R&S
Model No.	FSP30
Calibration Date	Nov. 19, 2014
Calibration Due Date	Nov. 19, 2015

3) Conducted Emissions Test

Equipment	EMI Test Receiver	LISN
Registration No.	EW-2500	EW-2501
Manufacturer	R&S	R&S
Model No.	ESCI	ENV-216
Calibration Date	Nov. 06, 2014	Jan. 15, 2015
Calibration Due Date	Nov. 06, 2015	Jan. 15, 2016

END OF TEST REPORT