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TEST REPORT

Report No.: 14100530HKG-001

Acoustic Arc International Ltd.

Application
For
Certification
(Original Grant)
(FCC ID: VHC-AAI-BH1410-00)

Transceiver

Prepared and Checked by:

Approved by:

A handwritten signature in black ink, appearing to read 'Ray Chak'.

Chak Chun Yin, Ray
Assistant Engineer

A handwritten signature in black ink, appearing to read 'Terry Chan'.

Chan Chi Hung, Terry
Supervisor

Date: November 27, 2014

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GENERAL INFORMATION

Grantee:	Acoustic Arc International Ltd.
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Manufacturer:	ShengHai Electronics (Shenzhen) Ltd.
Manufacturer Address:	Block 17&18, Hui Ming Ying Industry, YanChuan, SongGang, Baoan County, Shenzhen, China 518105.
Brand Name:	ARC
Tested Model:	BH1410US
Additional Model:	Aurem, Aurem2, Aurem3, Aurem4, Parvus, Parvus2, Parvus3, Parvus4, Auris, Auris2, Auris3, Auris4
Type of EUT:	Transceiver
Description of EUT:	ARC AUREM Bluetooth Earbuds
Serial Number:	N/A
FCC ID:	VHC-AAI-BH1410-00
Date of Sample Submitted:	October 15, 2014
Date of Test:	October 15, 2014 to November 25, 2014
Report No.:	14100530HKG-001
Report Date:	November 27, 2014
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	Pass
Radiated Emission in Restricted Bands	15.205	Pass

The equipment under test is found to be complying with the following standards:
FCC Part 15, October 1, 2012 Edition

- 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 a Bluetooth Stereo Earbuds. The EUT is using adaptive frequency hopping for Bluetooth module. The Bluetooth can support Bluetooth 4.0 BLE and Bluetooth 3.0. The Bluetooth portion operates in frequency range from 2402MHz to 2480MHz. The EUT is powered by 3.7 VDC Li-ion rechargeable battery. The Micro-USB port is for charging internal rechargeable battery of EUT only. The left earbud and the right earbud are identical in RF circuit. The only differences between the left earbud and the right earbud are audio signal output due to software setting.

The Model: Aurem, Aurem2, Aurem3, Aurem4, Parvus, Parvus2, Parvus3, Parvus4, Auris, Auris2, Auris3, Auris4 are the same as the Model: BH1410US in hardware aspect. The difference in color, cosmetic details and model number serves as marketing strategy.

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.



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1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.4 (2009). Preliminary scans were performed 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. Average measurements were performed according to ANSI C63.10 (2009).

1.4 Test Facility

The radiated used to collect the 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.



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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 C63.4 (2009).

The device was powered by Li-ion rechargeable battery 3.7V 65mAh.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emissions at and above 30MHz, 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.



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2.2 EUT Exercising Software

The EUT exercise program used during radiated and conducted 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.

2.5 Support Equipment List and Description

iPhone 5, Model: MD297, FCC ID: BCG-E2599A (Provided 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 48.141 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 9.4 dB compared with peak limit

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Applicant: Acoustic Arc International Ltd.

Date of Test: November 25, 2014

Model: BH1410US

Worst-Case Operating Mode: Transmitting (Bluetooth 4.0)

Table 1
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 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	107.5	33	29.4	103.9	34.7	69.2	94.0	-24.8
V	4804.000	57.4	33	34.9	59.3	34.7	24.6	54.0	-29.4
V	7206.000	53.7	33	37.9	58.6	34.7	23.9	54.0	-30.1
V	9608.000	53.9	33	40.4	61.3	34.7	26.6	54.0	-27.4
V	12010.000	51.9	33	40.5	59.4	34.7	24.7	54.0	-29.3
V	14412.000	49.8	33	40.0	56.8	34.7	22.1	54.0	-31.9

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	107.5	33	29.4	103.9	114.0	-10.1
V	4804.000	57.4	33	34.9	59.3	74.0	-14.7
V	7206.000	53.7	33	37.9	58.6	74.0	-15.4
V	9608.000	53.9	33	40.4	61.3	74.0	-12.7
V	12010.000	51.9	33	40.5	59.4	74.0	-14.6
V	14412.000	49.8	33	40.0	56.8	74.0	-17.2

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
- Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

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Model: BH1410US

Worst-Case Operating Mode: Transmitting (Bluetooth 4.0)

Table 2
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 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	107.3	33	29.4	103.7	34.7	69.0	94.0	-25.0
V	4880.000	57.7	33	34.9	59.6	34.7	24.9	54.0	-29.1
V	7320.000	53.7	33	37.9	58.6	34.7	23.9	54.0	-30.1
V	9760.000	53.1	33	40.4	60.5	34.7	25.8	54.0	-28.2
V	12200.000	51.2	33	40.5	58.7	34.7	24.0	54.0	-30.0
V	14640.000	51.4	33	38.4	56.8	34.7	22.1	54.0	-31.9

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	107.3	33	29.4	103.7	114.0	-10.3
V	4880.000	57.7	33	34.9	59.6	74.0	-14.4
V	7320.000	53.7	33	37.9	58.6	74.0	-15.4
V	9760.000	53.1	33	40.4	60.5	74.0	-13.5
V	12200.000	51.2	33	40.5	58.7	74.0	-15.3
V	14640.000	51.4	33	38.4	56.8	74.0	-17.2

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
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Date of Test: November 25, 2014

Model: BH1410US

Worst-Case Operating Mode: Transmitting (Bluetooth 4.0)

Table 3
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 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	106.7	33	29.4	103.1	34.7	68.4	94.0	-25.6
V	4960.000	57.6	33	34.9	59.5	34.7	24.8	54.0	-29.2
V	7440.000	53.7	33	37.9	58.6	34.7	23.9	54.0	-30.1
V	9920.000	53.5	33	40.4	60.9	34.7	26.2	54.0	-27.8
V	12400.000	51.2	33	40.5	58.7	34.7	24.0	54.0	-30.0
V	14880.000	51.4	33	38.4	56.8	34.7	22.1	54.0	-31.9

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	106.7	33	29.4	103.1	114.0	-10.9
V	4960.000	57.6	33	34.9	59.5	74.0	-14.5
V	7440.000	53.7	33	37.9	58.6	74.0	-15.4
V	9920.000	53.5	33	40.4	60.9	74.0	-13.1
V	12400.000	51.2	33	40.5	58.7	74.0	-15.3
V	14880.000	51.4	33	38.4	56.8	74.0	-17.2

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
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Applicant: Acoustic Arc International Ltd.

Date of Test: November 25, 2014

Model: BH1410US

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 4
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 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	107.4	33	29.4	103.8	24	79.8	94.0	-14.2
V	4804.000	56.6	33	34.9	58.5	24	34.5	54.0	-19.5
V	7206.000	52.5	33	37.9	57.4	24	33.4	54.0	-20.6
V	9608.000	53.4	33	40.4	60.8	24	36.8	54.0	-17.2
V	12010.000	51.1	33	40.5	58.6	24	34.6	54.0	-19.4
V	14412.000	49.7	33	40.0	56.7	24	32.7	54.0	-21.3

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	107.4	33	29.4	103.8	114.0	-10.2
V	4804.000	56.6	33	34.9	58.5	74.0	-15.5
V	7206.000	52.5	33	37.9	57.4	74.0	-16.6
V	9608.000	53.4	33	40.4	60.8	74.0	-13.2
V	12010.000	51.1	33	40.5	58.6	74.0	-15.4
V	14412.000	49.7	33	40.0	56.7	74.0	-17.3

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
- Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

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Date of Test: November 25, 2014

Model: BH1410US

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 5
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 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	107.5	33	29.4	103.9	24	79.9	94.0	-14.1
V	4880.000	56.9	33	34.9	58.8	24	34.8	54.0	-19.2
V	7320.000	53.0	33	37.9	57.9	24	33.9	54.0	-20.1
V	9760.000	53.4	33	40.4	60.8	24	36.8	54.0	-17.2
V	12200.000	51.2	33	40.5	58.7	24	34.7	54.0	-19.3
V	14640.000	51.5	33	38.4	56.9	24	32.9	54.0	-21.1

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	107.5	33	29.4	103.9	114.0	-10.1
V	4880.000	56.9	33	34.9	58.8	74.0	-15.2
V	7320.000	53.0	33	37.9	57.9	74.0	-16.1
V	9760.000	53.4	33	40.4	60.8	74.0	-13.2
V	12200.000	51.2	33	40.5	58.7	74.0	-15.3
V	14640.000	51.5	33	38.4	56.9	74.0	-17.1

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
- Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

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Applicant: Acoustic Arc International Ltd.

Date of Test: November 25, 2014

Model: BH1410US

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 6
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 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	106.5	33	29.4	102.9	24	78.9	94.0	-15.1
V	4960.000	56.3	33	34.9	58.2	24	34.2	54.0	-19.8
V	7440.000	52.1	33	37.9	57.0	24	33.0	54.0	-21.0
V	9920.000	52.9	33	40.4	60.3	24	36.3	54.0	-17.7
V	12400.000	50.9	33	40.5	58.4	24	34.4	54.0	-19.6
V	14880.000	50.8	33	38.4	56.2	24	32.2	54.0	-21.8

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	106.5	33	29.4	102.9	114.0	-11.1
V	4960.000	56.3	33	34.9	58.2	74.0	-15.8
V	7440.000	52.1	33	37.9	57.0	74.0	-17.0
V	9920.000	52.9	33	40.4	60.3	74.0	-13.7
V	12400.000	50.9	33	40.5	58.4	74.0	-15.6
V	14880.000	50.8	33	38.4	56.2	74.0	-17.8

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
- Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

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Applicant: Acoustic Arc International Ltd.

Date of Test: November 25, 2014

Model: BH1410US

Worst-Case Operating Mode: Music Playing via Bluetooth

Table 7

Radiated Emissions
Pursuant to FCC Part 15 Section 15.209 Requirement

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	48.141	35.6	16	11.0	30.6	40.0	-9.4
V	144.237	34.6	16	14.0	32.6	43.5	-10.9
V	240.235	31.8	16	19.0	34.8	46.0	-11.2
V	480.126	25.6	16	26.0	35.6	46.0	-10.4
H	720.367	21.2	16	30.0	35.2	46.0	-10.8
H	960.266	17.8	16	33.0	34.8	54.0	-19.2

NOTES: 1. Quasi-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. 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.



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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.



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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

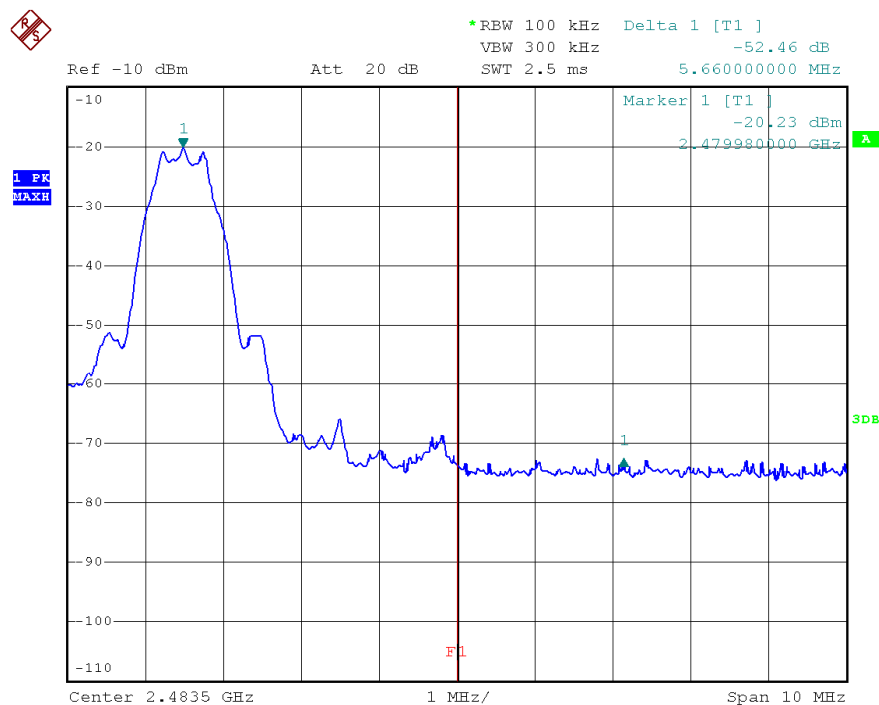
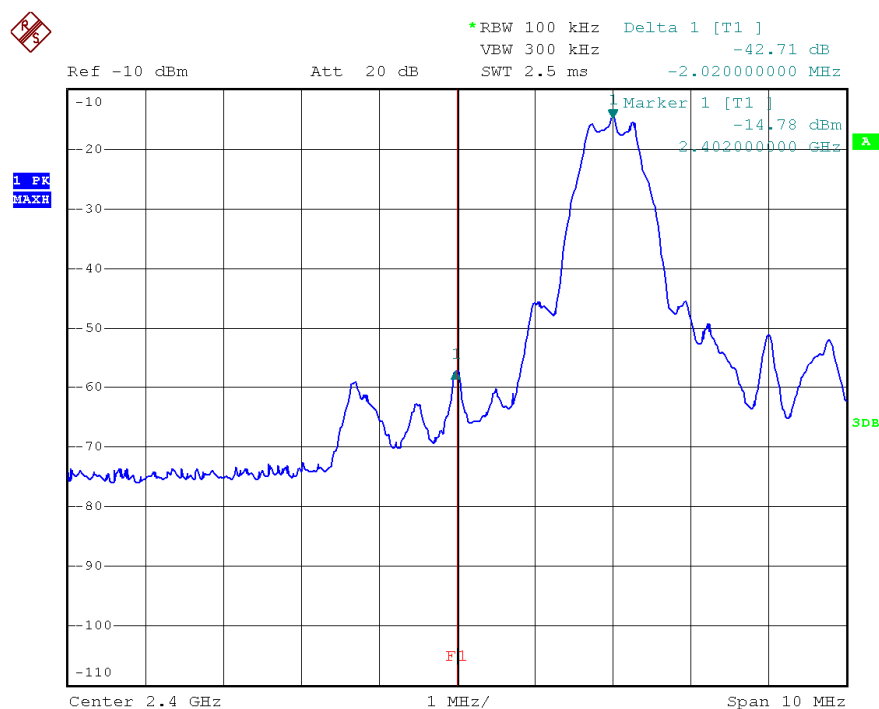
From the following plots, they show that the fundamental emissions are confined in the specified band (2400MHz to 2483.5MHz). In case of the fundamental emissions are within two standard bandwidths from the bandedge, the delta measurement technique as according to C63.10 (2009) is used for determining bandedge compliance. Standard bandwidth is the bandwidth specified by ANSI C63.4 (2009) 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, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

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Peak Measurement (Bluetooth 4.0)



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Peak Measurement (Bluetooth 4.0)

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

=103.9 dBμV/m - 42.71 dB

=61.19 dBμV/m

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

=69.2 dBμV/m - 42.71 dB

=26.49 dBμV/m

Upper bandedge

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

=103.1 dBμV/m - 52.46 dB

=50.64 dBμV/m

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

=68.4 dBμV/m - 52.46 dB

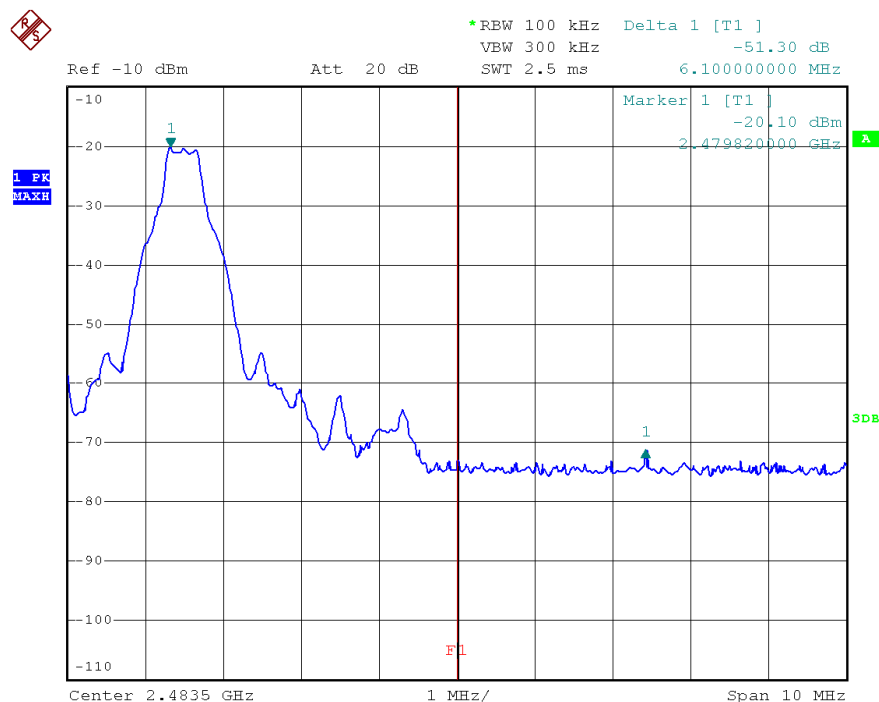
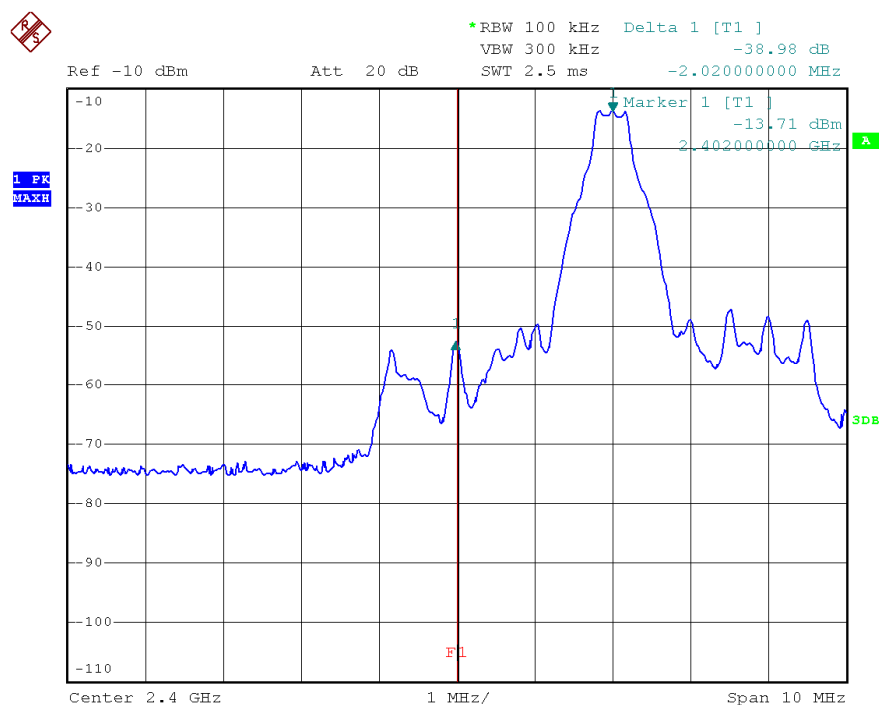
=15.94 dBμV/m

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

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Peak Measurement (Bluetooth 3.0)



Issuing Laboratory:
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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

$$\begin{aligned} &= 103.8 \text{ dB}\mu\text{V/m} - 38.98 \text{ dB} \\ &= 64.82 \text{ B}\mu\text{V/m} \end{aligned}$$

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

$$\begin{aligned} &= 79.8 \text{ dB}\mu\text{V/m} - 38.98 \text{ dB} \\ &= 40.82 \text{ dB}\mu\text{V/m} \end{aligned}$$

Upper bandedge

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

$$\begin{aligned} &= 102.9 \text{ dB}\mu\text{V/m} - 51.3 \text{ dB} \\ &= 51.6 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

$$\begin{aligned} &= 78.9 \text{ dB}\mu\text{V/m} - 51.3 \text{ dB} \\ &= 27.6 \text{ dB}\mu\text{V/m} \end{aligned}$$

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).

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Intertek Testing Services Hong Kong Limited

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8.2 Discussion of Pulse Desensitization

For Bluetooth 4.0: Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 1.84ms for a digital “1” bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 3MHz, so the pulse desensitivity factor is 0dB.

For Bluetooth 3.0: Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 1.84ms for a digital “1” bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 3MHz, so the pulse desensitivity factor is 0dB.

8.3 Calculation of Average Factor

(For Bluetooth 4.0)

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 96ms+88ms = 184ms

Effective period of the cycle = $0.184 \times 10 = 1.84$

DC = $1.84 / 100 = 0.0184$

Therefore, the averaging factor is found by $20 \log 0.0184 = -34.7\text{dB}$.

(For 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 $(5+1) \times 625\mu\text{s} = 3.75\text{ms}$. 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,

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

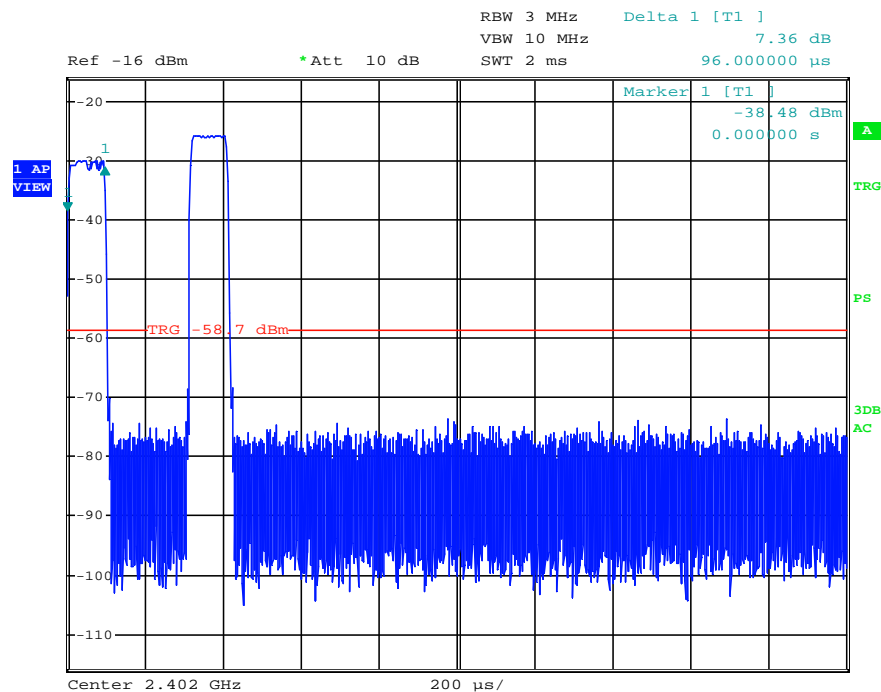
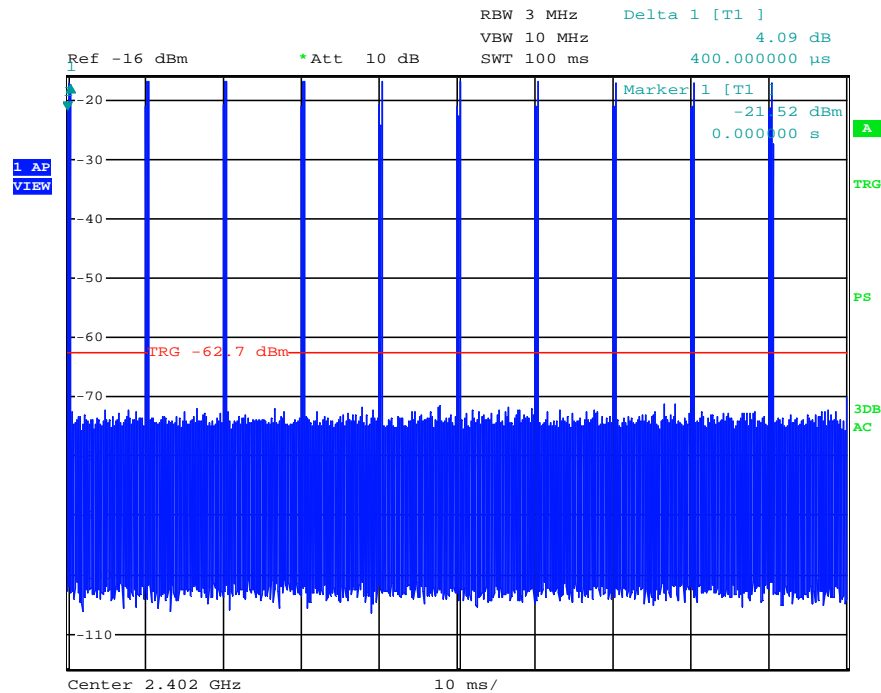
Average Factor (AF) of Bluetooth in dB = $20 \log_{10} (0.0625)$
= -24 dB

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Average Factor (Bluetooth 4.0)





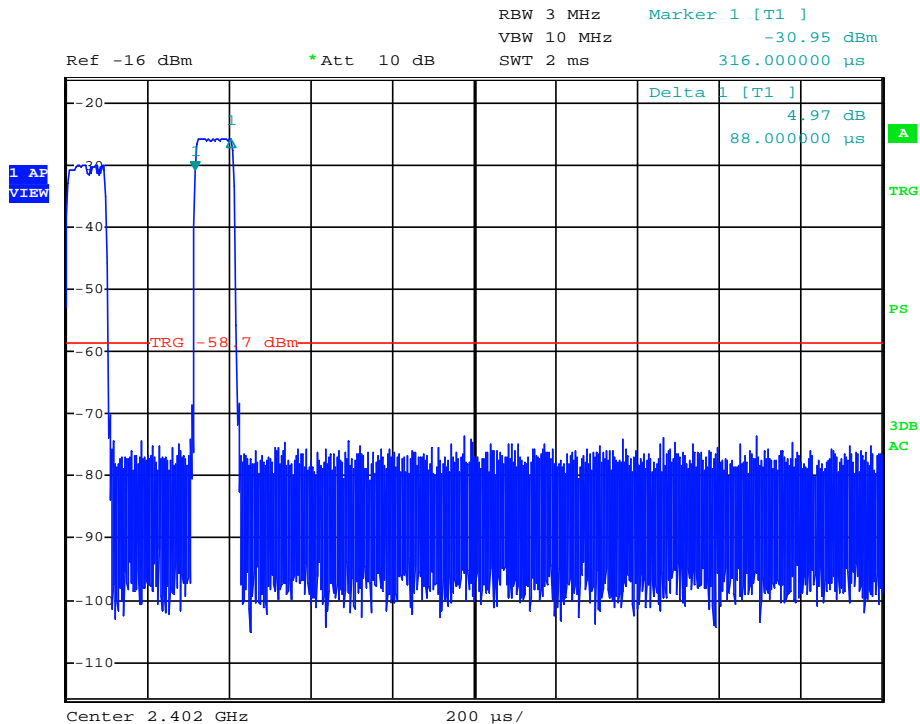
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Average Factor (Bluetooth 4.0)





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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 one meter in height above the ground plane. 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.

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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 C63.4 (2009).

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.

9.0 **Confidentiality Request**

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

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10.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Biconical Antenna	Log Periodic Antenna
Registration No.	EW-2666	EW-0571	EW-0572
Manufacturer	R&S	EMCO	EMCO
Model No.	ESCI7	3104C	3146
Calibration Date	Jun. 20, 2013	Nov. 01, 2013	Jun. 26, 2013
Calibration Due Date	Dec. 20, 2014	May 01, 2015	Dec. 26, 2014

Equipment	Spectrum Analyzer	Pyramidal Horn Antenna	Double Ridged Guide Antenna
Registration No.	EW-2253	EW-0905	EW-1133
Manufacturer	R&S	EMCO	EMCO
Model No.	FSP40	3160-09	3115
Calibration Date	May. 08, 2014	Jan. 28, 2014	Apr. 30, 2014
Calibration Due Date	May. 08, 2015	Jul. 28, 2015	Oct. 30, 2015

2) Bandedge Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2329
Manufacturer	R&S
Model No.	FSP3
Calibration Date	Jun. 19, 2014
Calibration Due Date	Jun. 19, 2015

END OF TEST REPORT