

TEST REPORT

Report No.: 15100841HKG-001

Muemma Ug

Application
For
Certification
(Original Grant)
(FCC ID: 2AGFQ4ARI0102)

Transceiver

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Date: April 05, 2016

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GENERAL INFORMATION

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Manufacturer:	N/A
Manufacturer Address:	N/A
Brand Name:	Muemma
Model:	4ARI0102
Type of EUT:	Transceiver
Description of EUT:	ARiNA Bluetooth Speaker
Serial Number:	N/A
FCC ID:	2AGFQ4ARI0102
Date of Sample Submitted:	October 23, 2015
Date of Test:	October 23, 2015 to November 24, 2015
Report No.:	15100841HKG-001
Report Date:	April 05, 2016
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

TEST SPECIFICATION	REFERENCE	RESULTS
Transmitter Power Line Conducted Emissions	15.207	Pass
Radiated Emission Radiated Emission on the Bandedge	15.249, 15.209	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, 2014 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 expected 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 ARiNA Bluetooth Speaker that contains a Bluetooth module with Bluetooth 4.0 BLE and Bluetooth 3.0 features. The EUT can accept analog audio signal and wireless audio signal via external Bluetooth mobile device (such as iphone). The EUT is powered by a 3.7V rechargeable battery and/or USB port (5VDC). Another USB port is also equipped for charging external mobile device (such as iphone).

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.

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

Both AC mains line-conducted and 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 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.

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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 or USB port (5VDC).

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.

Both powering condition of 3.7VDC and USB port (5VDC) has been tested. Only the worse case data using USB port (5VDC) is presented.

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.

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

1. Notebook (for charging the EUT)
2. USB cable in length of 2m long (for discharging)
3. LAN cable in length of 2m long (with termination)
4. 5-ohm resistor (for discharging)
(Provided by Intertek)
5. Audio cable in length of 2m long (with termination)
6. USB cable in length of 69cm long (for charging the EUT)
(Provided by Applicant)

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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 $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

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 $\text{dB}\mu\text{V}/\text{m}$

RR = $RA - AG - AV$ in $\text{dB}\mu\text{V}$

LF = $CF + AF$ in dB

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

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

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

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

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

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

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

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

$$FS = RR + LF$$

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

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

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 54.523 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 5.4 dB

3.4 Conducted Emission Configuration Photograph

The worst case in line-conducted emission was found at 0.209 MHz

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

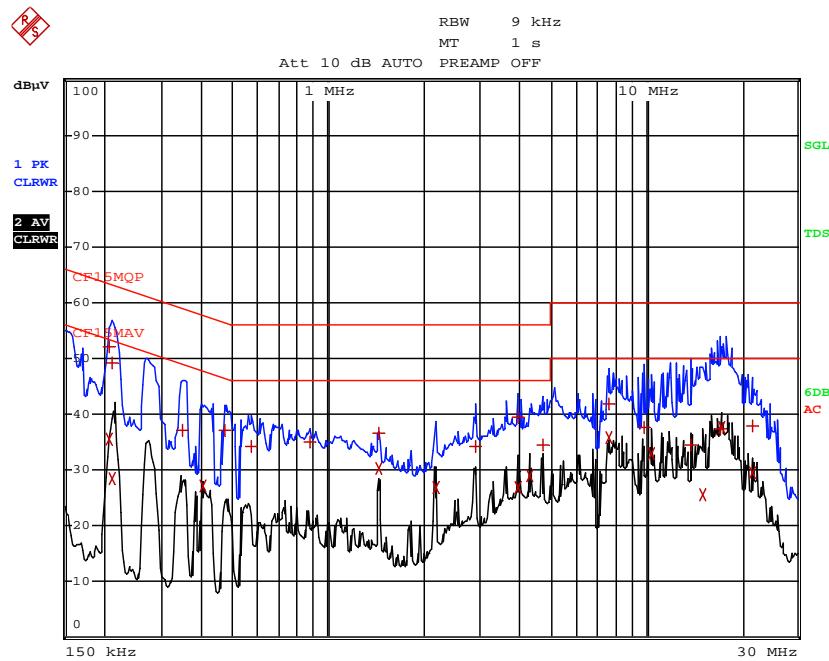
3.5 Conducted Emission Data

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

Judgment: Pass by 11.1 dB

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Worst-Case Operating Mode: Audio Playing with Charging and Discharging



Note: Measurement Uncertainty is $\pm 4.2\text{dB}$ at a level of confidence of 95%.

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Worst-Case Operating Mode: Audio Playing with Charging and Discharging

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dB _μ V	DELTA	LIMIT dB
1	Quasi Peak 208.5 kHz	52.19 N	-11.07	
2	CISPR Average 208.5 kHz	35.49 N	-17.77	
1	Quasi Peak 213 kHz	49.18 N	-13.90	
2	CISPR Average 213 kHz	28.53 N	-24.55	
1	Quasi Peak 352.5 kHz	37.26 N	-21.63	
2	CISPR Average 402 kHz	27.12 N	-20.68	
1	Quasi Peak 474 kHz	37.20 L1	-19.24	
1	Quasi Peak 573 kHz	34.23 L1	-21.76	
1	Quasi Peak 879 kHz	35.06 N	-20.93	
1	Quasi Peak 1.437 MHz	36.64 N	-19.35	
2	CISPR Average 1.437 MHz	30.25 N	-15.74	
2	CISPR Average 2.193 MHz	26.89 N	-19.10	
1	Quasi Peak 2.9085 MHz	34.23 N	-21.76	
1	Quasi Peak 3.9525 MHz	39.59 N	-16.40	
2	CISPR Average 3.957 MHz	26.81 L1	-19.18	
2	CISPR Average 4.3125 MHz	29.04 L1	-16.95	
1	Quasi Peak 4.7535 MHz	34.38 L1	-21.61	
1	Quasi Peak 7.674 MHz	41.88 N	-18.11	
2	CISPR Average 7.6785 MHz	35.85 N	-14.14	
1	Quasi Peak 9.8655 MHz	37.57 N	-22.42	

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dB _μ V	DELTA	LIMIT dB
2	CISPR Average 10.4235 MHz	32.81 N	-17.18	
1	Quasi Peak 13.8795 MHz	34.47 L1	-25.52	
2	CISPR Average 15.0945 MHz	25.56 L1	-24.43	
1	Quasi Peak 17.0475 MHz	37.27 L1	-22.72	
2	CISPR Average 17.25 MHz	37.64 L1	-12.35	
1	Quasi Peak 21.5475 MHz	37.86 N	-22.13	
2	CISPR Average 21.552 MHz	29.50 N	-20.49	

Note: Measurement Uncertainty is $\pm 4.2\text{dB}$ at a level of confidence of 95%.

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Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 1
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 Requirement

Lowest Channel

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2402.000	102.1	33	29.4	98.5	24	74.5	94.0	-19.5
H	4804.000	59.2	33	34.9	61.1	24	37.1	54.0	-16.9
H	7206.000	46.3	33	37.9	51.2	24	27.2	54.0	-26.8
H	9608.000	46.0	33	40.4	53.4	24	29.4	54.0	-24.6
H	12010.000	47.9	33	40.5	55.4	24	31.4	54.0	-22.6
H	14412.000	49.6	33	40.0	56.6	24	32.6	54.0	-21.4

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2402.000	102.1	33	29.4	98.5	114.0	-15.5
H	4804.000	59.2	33	34.9	61.1	74.0	-12.9
H	7206.000	46.3	33	37.9	51.2	74.0	-22.8
H	9608.000	46.0	33	40.4	53.4	74.0	-20.6
H	12010.000	47.9	33	40.5	55.4	74.0	-18.6
H	14412.000	49.6	33	40.0	56.6	74.0	-17.4

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.

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

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Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 2
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 Requirement

Middle Channel

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2442.000	101.8	33	29.4	98.2	24	74.2	94.0	-19.8
H	4884.000	59.0	33	34.9	60.9	24	36.9	54.0	-17.1
H	7326.000	46.5	33	37.9	51.4	24	27.4	54.0	-26.6
H	9768.000	45.8	33	40.4	53.2	24	29.2	54.0	-24.8
H	12210.000	47.8	33	40.5	55.3	24	31.3	54.0	-22.7
H	14652.000	51.3	33	38.4	56.7	24	32.7	54.0	-21.3

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2442.000	101.8	33	29.4	98.2	114.0	-15.8
H	4884.000	59.0	33	34.9	60.9	74.0	-13.1
H	7326.000	46.5	33	37.9	51.4	74.0	-22.6
H	9768.000	45.8	33	40.4	53.2	74.0	-20.8
H	12210.000	47.8	33	40.5	55.3	74.0	-18.7
H	14652.000	51.3	33	38.4	56.7	74.0	-17.3

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.

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

INTERTEK TESTING SERVICES

Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 3
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 Requirement

Highest Channel

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2480.000	101.6	33	29.4	98.0	24	74.0	94.0	-20.0
H	4960.000	59.3	33	34.9	61.2	24	37.2	54.0	-16.8
H	7440.000	46.6	33	37.9	51.5	24	27.5	54.0	-26.5
H	9920.000	45.6	33	40.4	53.0	24	29.0	54.0	-25.0
H	12400.000	48.1	33	40.5	55.6	24	31.6	54.0	-22.4
H	14880.000	51.5	33	38.4	56.9	24	32.9	54.0	-21.1

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2480.000	101.6	33	29.4	98.0	114.0	-16.0
H	4960.000	59.3	33	34.9	61.2	74.0	-12.8
H	7440.000	46.6	33	37.9	51.5	74.0	-22.5
H	9920.000	45.6	33	40.4	53.0	74.0	-21.0
H	12400.000	48.1	33	40.5	55.6	74.0	-18.4
H	14880.000	51.5	33	38.4	56.9	74.0	-17.1

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.

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

INTERTEK TESTING SERVICES

Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

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

Table 4
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2402.000	101.7	33	29.4	98.1	37.9	60.2	94.0	-33.8
H	4804.000	48.2	33	34.9	50.1	37.9	12.2	54.0	-41.8
H	7206.000	46.4	33	37.9	51.3	37.9	13.4	54.0	-40.6
H	9608.000	45.8	33	40.4	53.2	37.9	15.3	54.0	-38.7
H	12010.000	48.1	33	40.5	55.6	37.9	17.7	54.0	-36.3
H	14412.000	49.7	33	40.0	56.7	37.9	18.8	54.0	-35.2

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2402.000	101.7	33	29.4	98.1	114.0	-15.9
H	4804.000	48.2	33	34.9	50.1	74.0	-23.9
H	7206.000	46.4	33	37.9	51.3	74.0	-22.7
H	9608.000	45.8	33	40.4	53.2	74.0	-20.8
H	12010.000	48.1	33	40.5	55.6	74.0	-18.4
H	14412.000	49.7	33	40.0	56.7	74.0	-17.3

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.

6. For the measurement of radiated emission, summation method was used which numerical integrating (in terms of linear power) over the transmitter occupied bandwidth.

7. For the linear power measurement, data in 1MHz spacing was collected by spectrum analyzer with 1MHz resolution bandwidth

8. Measurement Uncertainty is $\pm 5.3\text{dB}$ at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

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

Table 5
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 Requirement

Middle Channel

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2442.000	102.5	33	29.4	98.9	37.9	61.0	94.0	-33.0
H	4884.000	49.5	33	34.9	51.4	37.9	13.5	54.0	-40.5
H	7326.000	46.3	33	37.9	51.2	37.9	13.3	54.0	-40.7
H	9768.000	45.6	33	40.4	53.0	37.9	15.1	54.0	-38.9
H	12210.000	48.0	33	40.5	55.5	37.9	17.6	54.0	-36.4
H	14652.000	51.5	33	38.4	56.9	37.9	19.0	54.0	-35.0

Polari-zation	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2442.000	102.5	33	29.4	98.9	114.0	-15.1
H	4884.000	49.5	33	34.9	51.4	74.0	-22.6
H	7326.000	46.3	33	37.9	51.2	74.0	-22.8
H	9768.000	45.6	33	40.4	53.0	74.0	-21.0
H	12210.000	48.0	33	40.5	55.5	74.0	-18.5
H	14652.000	51.5	33	38.4	56.9	74.0	-17.1

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.

6. For the measurement of radiated emission, summation method was used which numerical integrating (in terms of linear power) over the transmitter occupied bandwidth.

7. For the linear power measurement, data in 1MHz spacing was collected by spectrum analyzer with 1MHz resolution bandwidth

8. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

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

Table 6
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2480.000	104.3	33	29.4	100.7	37.9	62.8	94.0	-31.2
H	4960.000	55.4	33	34.9	57.3	37.9	19.4	54.0	-34.6
H	7440.000	46.5	33	37.9	51.4	37.9	13.5	54.0	-40.5
H	9920.000	46.1	33	40.4	53.5	37.9	15.6	54.0	-38.4
H	12400.000	48.3	33	40.5	55.8	37.9	17.9	54.0	-36.1
H	14880.000	51.1	33	38.4	56.5	37.9	18.6	54.0	-35.4

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2480.000	104.3	33	29.4	100.7	114.0	-13.3
H	4960.000	55.4	33	34.9	57.3	74.0	-16.7
H	7440.000	46.5	33	37.9	51.4	74.0	-22.6
H	9920.000	46.1	33	40.4	53.5	74.0	-20.5
H	12400.000	48.3	33	40.5	55.8	74.0	-18.2
H	14880.000	51.1	33	38.4	56.5	74.0	-17.5

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.

6. For the measurement of radiated emission, summation method was used which numerical integrating (in terms of linear power) over the transmitter occupied bandwidth.

7. For the linear power measurement, data in 1MHz spacing was collected by spectrum analyzer with 1MHz resolution bandwidth

8. Measurement Uncertainty is $\pm 5.3\text{dB}$ at a level of confidence of 95%.

INTERTEK TESTING SERVICES

Applicant: Muemma Ug

Date of Test: November 24, 2015

Model: 4ARI0102

Worst-Case Operating Mode: Audio Playing with Charging and Discharging

Table 7
Radiated Emissions
Pursuant to FCC Part 15 Section 15.209 Requirement

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Limit at 3m (dB μ V/m)	Margin (dB)
H	54.523	39.6	16	11.0	34.6	40.0	-5.4
H	96.489	37.8	16	12.0	33.8	43.5	-9.7
H	144.245	36.8	16	14.0	34.8	43.5	-8.7
H	189.872	34.6	16	16.0	34.6	43.5	-8.9
H	225.563	32.2	16	18.0	34.2	46.0	-11.8
H	278.324	28.6	16	22.0	34.6	46.0	-11.4

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.
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.

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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).

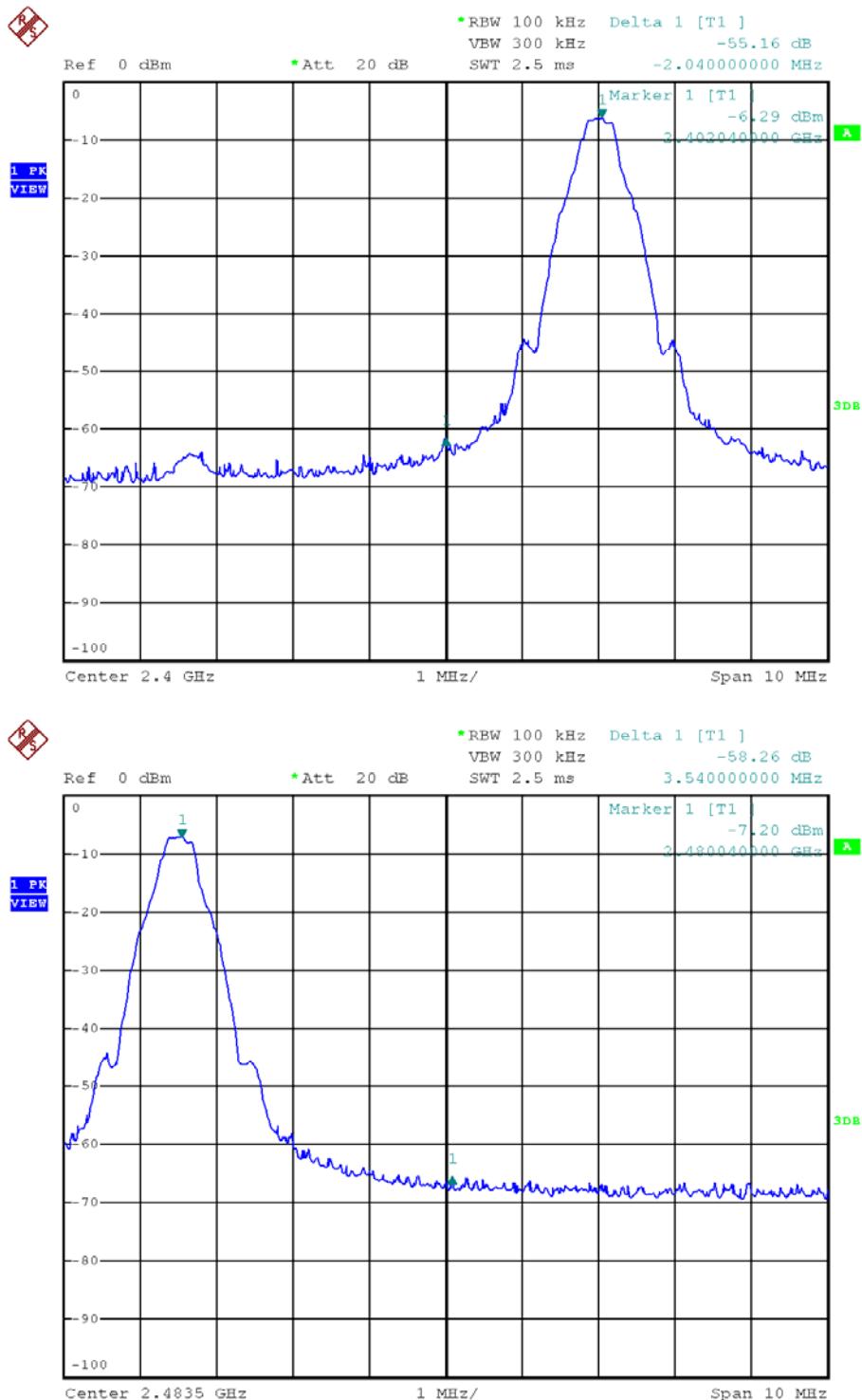
8.1 Radiated Emission on the Bandedge

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, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

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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

$$=98.5 \text{ dB}\mu\text{V/m} - 55.2 \text{ dB}$$

$$=43.3 \text{ dB}\mu\text{V/m}$$

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

$$=74.5 \text{ dB}\mu\text{V/m} - 55.2 \text{ dB}$$

$$=19.3 \text{ dB}\mu\text{V/m}$$

Upper bandedge

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

$$=98.0 \text{ dB}\mu\text{V/m} - 58.3 \text{ dB}$$

$$=39.7 \text{ dB}\mu\text{V/m}$$

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

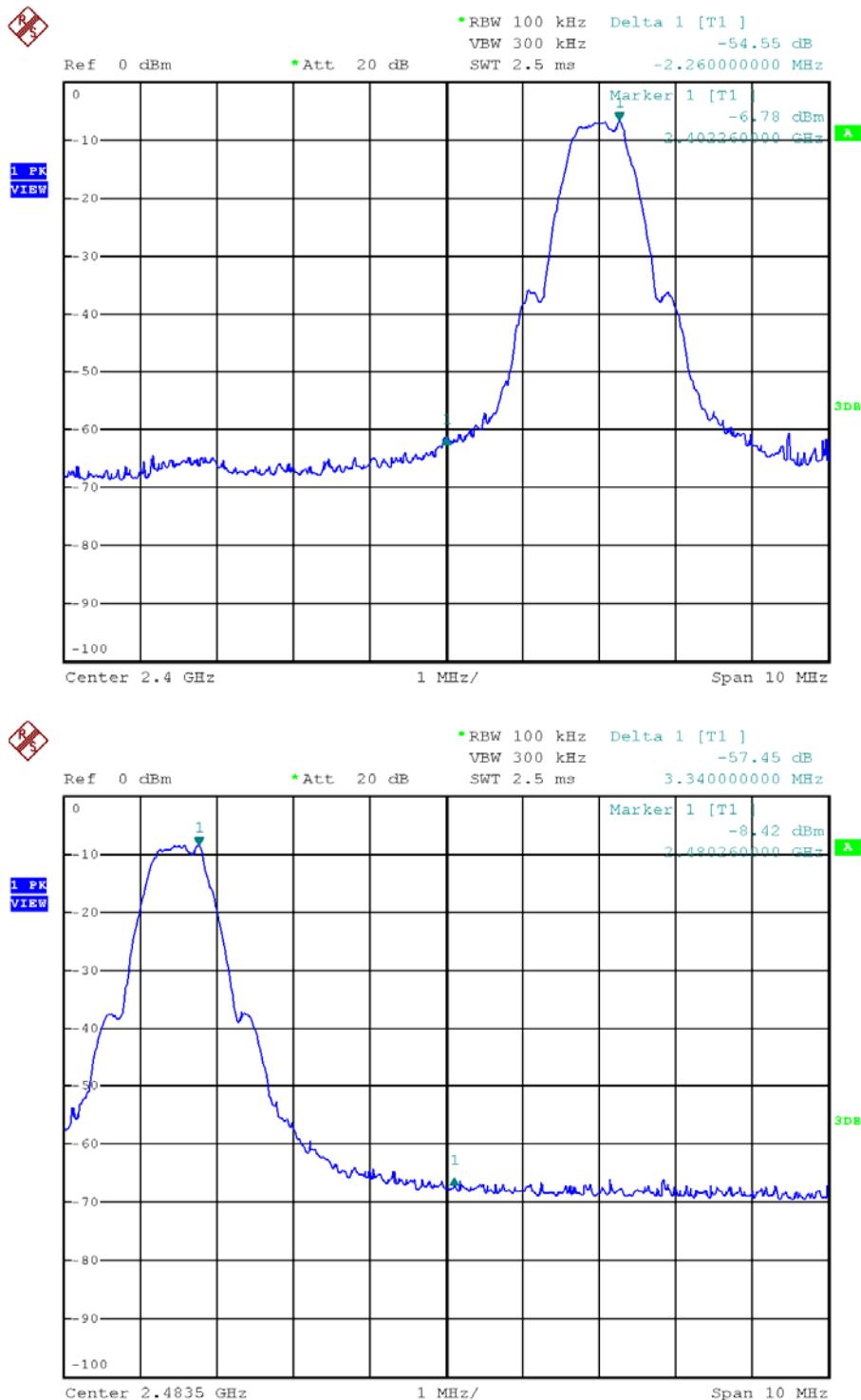
$$=74.0 \text{ dB}\mu\text{V/m} - 58.3 \text{ dB}$$

$$=15.7 \text{ dB}\mu\text{V/m}$$

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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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

$$\begin{aligned} &= 98.1 \text{ dB}\mu\text{V/m} - 54.6 \text{ dB} \\ &= 43.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

$$\begin{aligned} &= 60.2 \text{ dB}\mu\text{V/m} - 54.6 \text{ dB} \\ &= 5.6 \text{ dB}\mu\text{V/m} \end{aligned}$$

Upper bandedge

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

$$\begin{aligned} &= 100.7 \text{ dB}\mu\text{V/m} - 57.5 \text{ dB} \\ &= 43.2 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

$$\begin{aligned} &= 62.8 \text{ dB}\mu\text{V/m} - 57.5 \text{ dB} \\ &= 5.3 \text{ dB}\mu\text{V/m} \end{aligned}$$

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).

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 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.

(Bluetooth 4.0 BLE)

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 0.32ms 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

(Bluetooth 3.0)

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,

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

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

(Bluetooth 4.0 BLE)

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

The duration of one cycle = 100ms

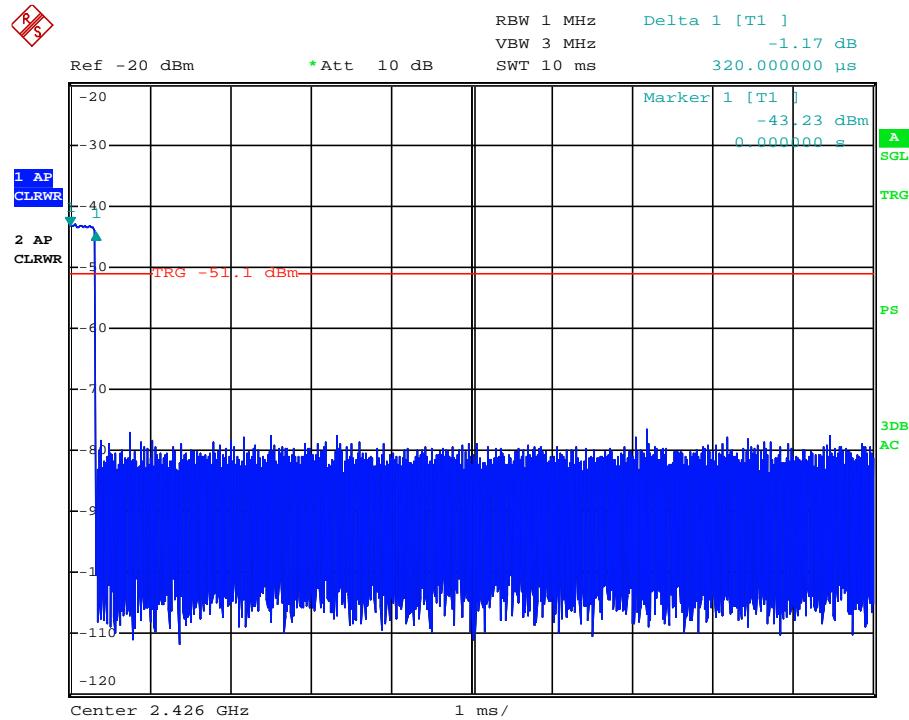
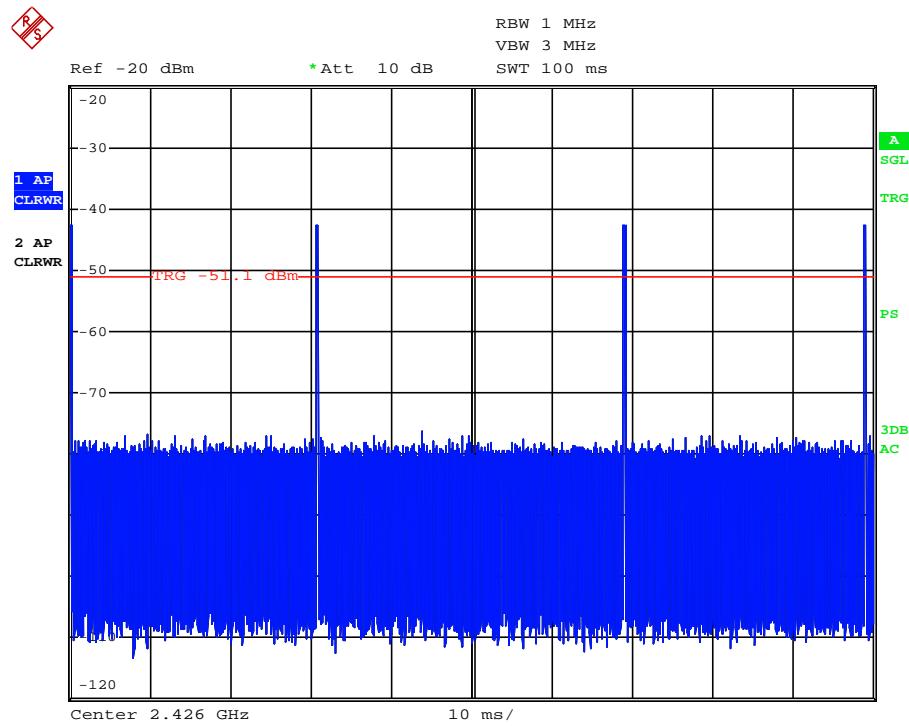
Effective period of the cycle = $(0.32) \times 4 = 1.28\text{ms}$

$$\text{DC} = 1.28/100 = 0.0128$$

Therefore, the averaging factor is found by $20\log 0.0128 = -37.9\text{dB}$.

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Average Factor (Bluetooth 4.0 BLE)



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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 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. For line conducted emissions, the range scanned is 150 kHz to 30 MHz.

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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 C63.10 (2013).

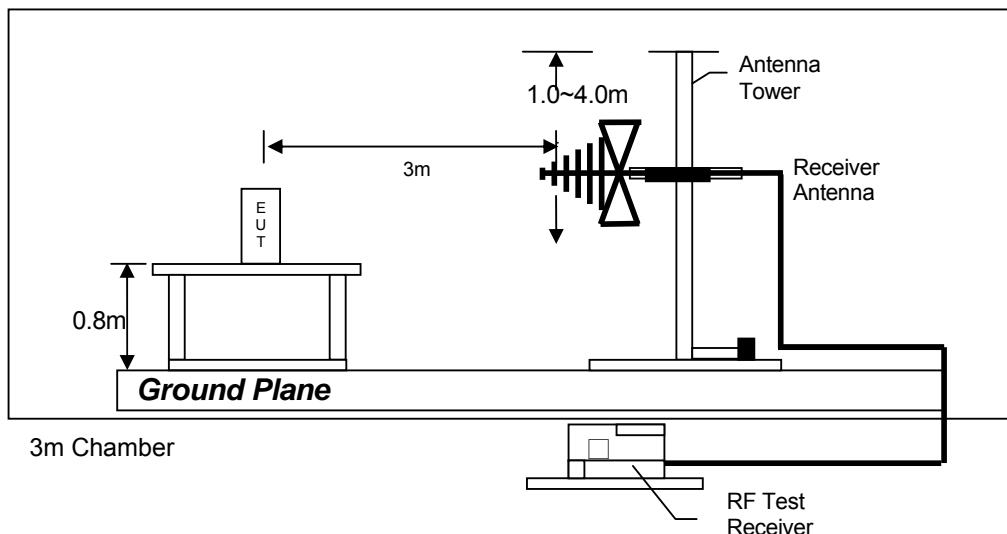
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion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

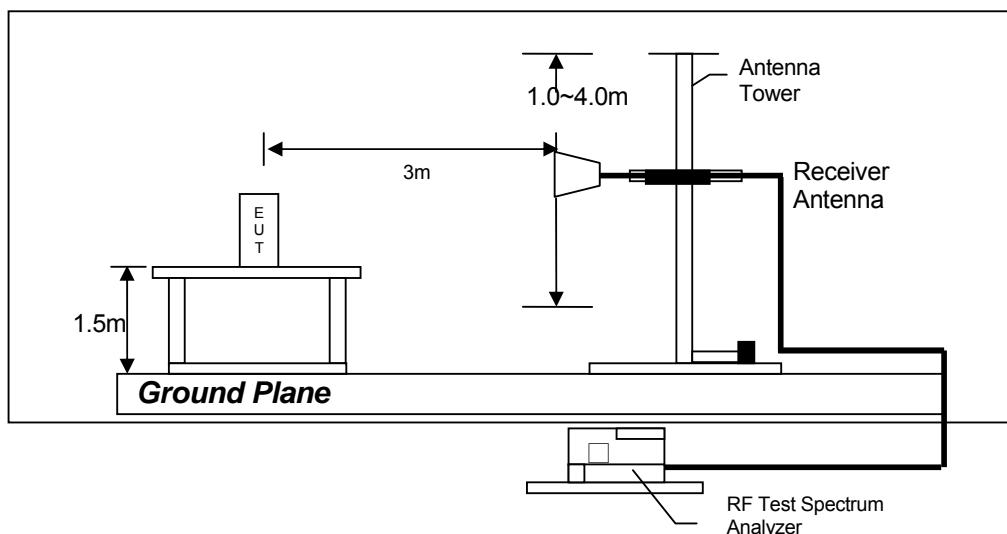
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8.4.1 Radiated Emission Test Setup

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

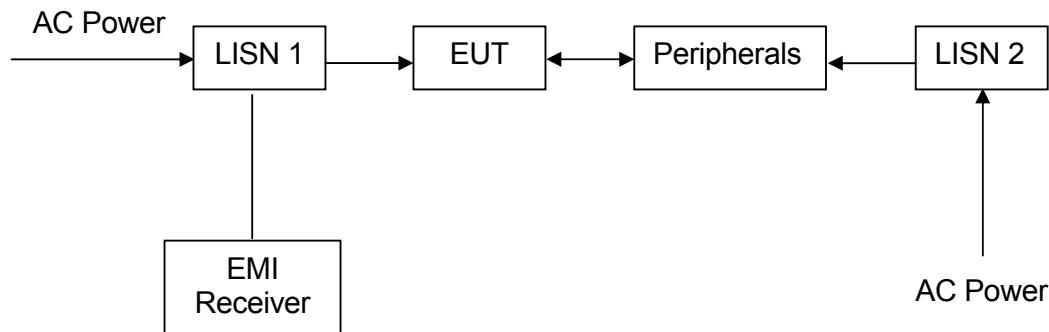
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8.4.2 Conducted Emission Test Procedures

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



9.0 Confidentiality Request

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

INTERTEK TESTING SERVICES

10.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer
Registration No.	EW-3095	EW-2253
Manufacturer	R&S	R&S
Model No.	ESCI	FSP40
Calibration Date	Nov. 05, 2015	May 27, 2015
Calibration Due Date	Nov. 05, 2016	May 27, 2016

Equipment	BiConiLog Antenna	Pyramidal Horn Antenna	Double Ridged Guide Antenna
Registration No.	EW-3061	EW-0905	EW-0194
Manufacturer	EMCO	EMCO	EMCO
Model No.	3412E	3160-09	3115
Calibration Date	Jul. 22, 2015	Jun. 05, 2014	Jan. 29, 2015
Calibration Due Date	Jul. 22, 2016	Dec. 05, 2015	Jul. 29, 2016

2) Conducted Emissions Test

Equipment	EMI Test Receiver	LISN
Registration No.	EW-2666	EW-2874
Manufacturer	R&S	R&S
Model No.	ESCI7	ENV-216
Calibration Date	May 13, 2015	Dec. 08, 2014
Calibration Due Date	May 13, 2016	Dec. 08, 2015

3) Bandedge & Average Factor Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2329
Manufacturer	R&S
Model No.	FSP3
Calibration Date	Jun. 17, 2015
Calibration Due Date	Jun. 17, 2016

END OF TEST REPORT