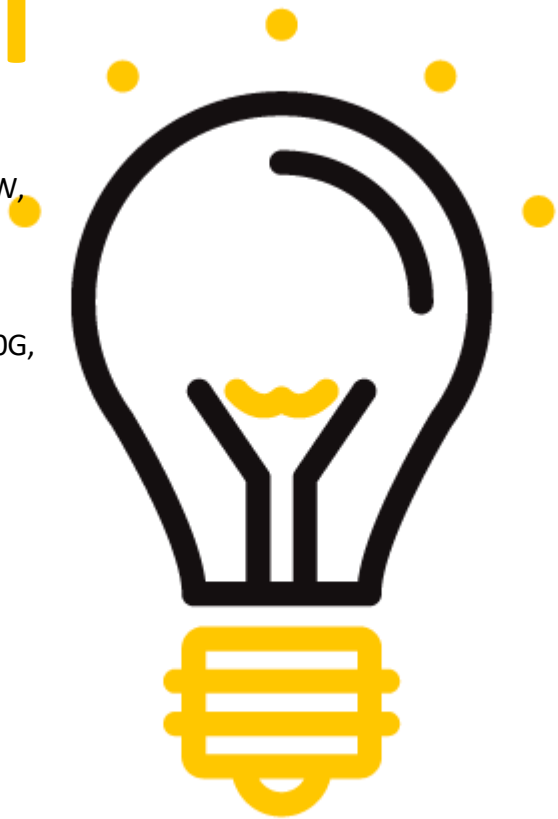
Zhong Shan City Richsound Electronic Industrial Ltd.

TEST REPORT



SCOPE OF WORK
FCC TESTING–HS3100, HS310, HS310L, HS310P, HS310W, HS3100AU, HS3100N, HS3100A, HS3100B, HS3100C, HS3100E, HS3100F, HS3100G, HS3100K, HS3100M, HS3100P, HS3100Q, HS3100R, HS3100T, HS3100W, HS3100Y, W3100B, W3100C, W3100E, W3100F, W3100G, W3100K, W3100M, W3100P, W3100Q, W3100R, W3100T, W3100W, W3100Y, TS3100A, TS3100, R310, R631, A310, A631

REPORT NUMBER
240123061SZN-003

ISSUE DATE **[REVISED DATE]**

29 February 2024 [----------]

PAGES
28

DOCUMENT CONTROL NUMBER
FCC ID 249_C

Zhong Shan City Richsound Electronic Industrial Ltd.

Application
For
Certification

FCC ID: Z8M-HS3100SW

Wireless Subwoofer

Model: HS3100, HS310, HS310L, HS310P, HS310W, HS3100AU, HS3100N, HS3100A, HS3100B, HS3100C, HS3100E, HS3100F, HS3100G, HS3100K, HS3100M, HS3100P, HS3100Q, HS3100R, HS3100T, HS3100W, HS3100Y, W3100B, W3100C, W3100E, W3100F, W3100G, W3100K, W3100M, W3100P, W3100Q, W3100R, W3100T, W3100W, W3100Y, TS3100A, TS3100, R310, R631, A310, A631

Brand Name: Hisense, TOSHIBA

2.4GHz Transceiver

Report No.: 240123061SZN-003

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-22]

Prepared and Checked by:

Mandy

Mandy Chen
Engineer

Approved by:

Ryan

Ryan Chen
Senior Project Engineer
Date: 29 February 2024

Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, ShenZhen, P.R. China
Tel: (86 755) 8601 6288 Fax: (86 755) 8601 6751

MEASUREMENT/TECHNICAL REPORT

This report concerns (check one:) Original Grant X Class I Change _____

Equipment Type: DXX - Part 15 Low Power Communication Device Transmitter

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Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No X

If yes, defer until:
date

Company Name agrees to notify the Commission by:
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes _____ No X

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [10-1-22 Edition] provision.

Report prepared by:

Mandy Chen
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue,
Zhangkengjing Community, GuanHu Subdistrict,
LongHua District, ShenZhen, P.R. China
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Table of Contents

1.0 Summary of Test Result

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Applicant Address: No.16, East Shagang Road, Gangkou, Zhongshan, Guangdong, China.
Manufacturer: Zhong Shan City Richsound Electronic Industrial Ltd.
Manufacturer Address: No.16, East Shagang Road, Gangkou, Zhongshan, Guangdong, China.

MODEL: HS3100, HS310, HS310L, HS310P, HS310W, HS3100AU, HS3100N, HS3100A, HS3100B, HS3100C, HS3100E, HS3100F, HS3100G, HS3100K, HS3100M, HS3100P, HS3100Q, HS3100R, HS3100T, HS3100W, HS3100Y, W3100B, W3100C, W3100E, W3100F, W3100G, W3100K, W3100M, W3100P, W3100Q, W3100R, W3100T, W3100W, W3100Y, TS3100A, TS3100, R310, R631, A310, A631

FCC ID: Z8M-HS3100SW

Test Specification	Reference	Results
Transmitter Radiated Emission	15.249 &15.209 &15.205	Pass
Conducted Emission	15.207	Pass
Band edge	15.249 &15.209 &15.205	Pass
20dB Bandwidth	15.215(c)	Pass

Notes: The EUT uses an Integral Antenna which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

2.0 General Description

2.1 Product Description

The equipment under test (EUT) is a Wireless Subwoofer with Bluetooth 5.3 EDR(Single Mode) function operating in 2402-2480MHz. The EUT is powered by AC 100-240V~ 50/60Hz. For more detail information pls. refer to the user manual.

Antenna Type: Integral antenna
Modulation Type: GFSK, π/4-DQPSK and 8-DPSK
Antenna Gain: 3.1dBi Max(This information is provided by applicant, and the applicant is responsible for the authenticity of the provided information.)
Bluetooth Version: 5.3 EDR (Single Mode)

The Model: HS310, HS310L, HS310P, HS310W, HS3100AU, HS3100N, HS3100A, HS3100B, HS3100C, HS3100E, HS3100F, HS3100G, HS3100K, HS3100M, HS3100P, HS3100Q, HS3100R, HS3100T, HS3100W, HS3100Y, W3100B, W3100C, W3100E, W3100F, W3100G, W3100K, W3100M, W3100P, W3100Q, W3100R, W3100T, W3100W, W3100Y, TS3100A, TS3100, R310, R631, A310, A631 are the same as the Model: HS3100 in hardware and electrical aspect. The difference in model number and trade name servers as marketing strategy. Please refer to the below table.

Brand name	Model No.
Hisense	HS3100, HS310, HS310L, HS310P, HS310W, HS3100AU, HS3100N
Hisense	HS3100A, HS3100B, HS3100C, HS3100E, HS3100F, HS3100G, HS3100K, HS3100M, HS3100P, HS3100Q, HS3100R, HS3100T, HS3100W, HS3100Y
Hisense	W3100B, W3100C, W3100E, W3100F, W3100G, W3100K, W3100M, W3100P, W3100Q, W3100R, W3100T, W3100W, W3100Y
Hisense	R310, R631, A310, A631
TOSHIBA	TS3100A, TS3100

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

2.2 Related Submittal(s) Grants

This is an application for certification of a transceiver for the Wireless Subwoofer which has Bluetooth function. Other digital functions were reported in the SDOC report: 240123061SZN-004.

2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in Semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the 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. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The Semi-Anechoic chamber and shield room used to collect the radiated data and conducted data are **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, ShenZhen, P.R. China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: CN1188).

3.0 System Test Configuration

3.1 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 EUT is powered by AC 100-240V~ 50/60Hz during the test, only the worst data was reported in this report.

All packets DH1, DH3 & DH5 mode in modulation type GFSK, π/4-DQPSK and 8-DPSK were tested and only the worst data was reported in this report.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the bottom of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. 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 Section 4.

The EUT and transmitting antenna was centered on the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

3.2 EUT Exercising Software

The EUT exercise program (provided by client) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The worst case configuration is used in all specified testing.

The parameters of test software setting:
During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the application and is going to be fixed on the firmware of the end product.

Test Software: FCC_assist_1.0.2.2

3.3 Special Accessories

No special accessories used.

3.4 Equipment Modification

Any modifications installed previous to testing by Zhong Shan City Richsound Electronic Industrial Ltd. will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

3.5 Measurement Uncertainty

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

Measurement Uncertainty	Uncertainty
Channel Bandwidth	±3.46%
RF Output Power	±0.31dB
Conducted Unwanted Emission	±0.55dB
Spurious emission (Above 18GHz)	±5.3dB
Spurious emission (6GHz to 18GHz)	±5.1dB
Radiated emission (1GHz to 6GHz)	±4.8dB
Radiated emission (Up to 1GHz)	±4.8dB
AC Conducted emission	±3.2 dB
Dwell time	±5%
Temperature	±1°C
Humidity	±5%

3.6 Support Equipment List and Description

Description	Manufacturer	Remark
AC Power cord*1	N/A (provided by Client)	Detachable, Length 150cm

4.0 Emission Results

Data is included worst-case configuration (the configuration which resulted in the highest emission levels).

4.1 Radiated Test Results

A sample calculation, configuration photographs and data tables of the emissions are included.

4.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV
Where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB/m
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

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

Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB/m and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 62.0 dBµV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB
AV = -10 dB
FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 dBµV/m

Level in µV/m = Common Antilogarithm [(42 dBµV/m)/20] = 125.9 µV/m

4.1.2 Radiated Emission Configuration Photograph

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

4.1.3 Radiated Emissions

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.

Worst Case Radiated Emission
at
126.482667 MHz

Judgement: Passed by 16.2 dB

TEST PERSONNEL:

Sign on file

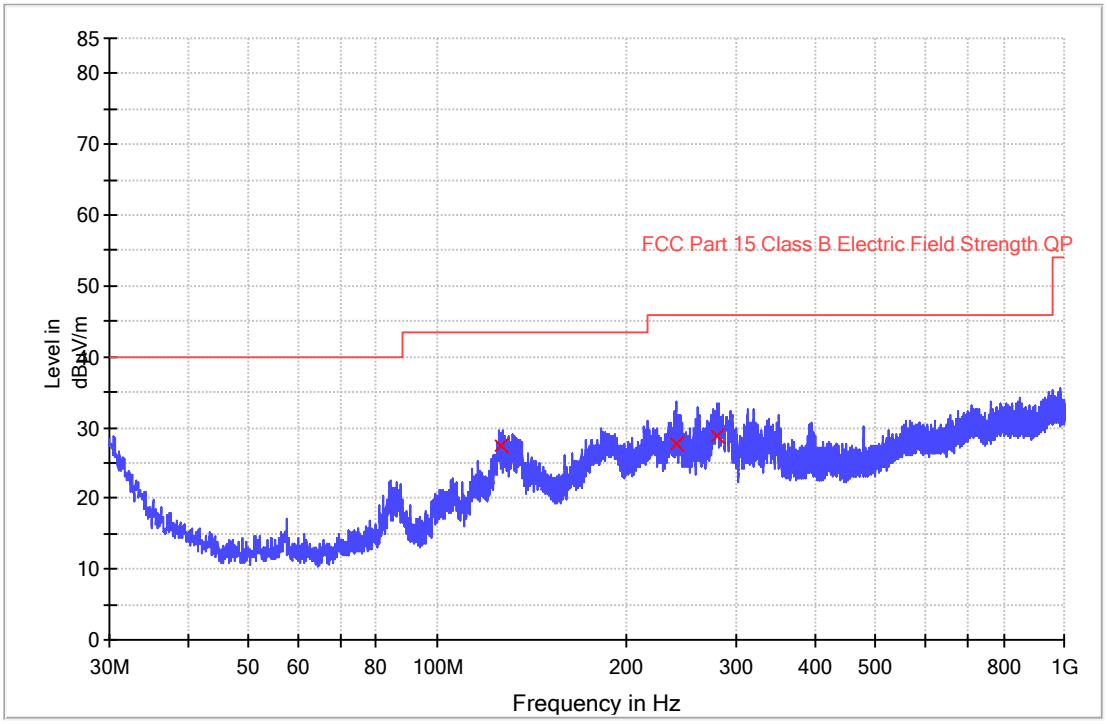
Mandy Chen, Engineer
Typed/Printed Name

04 February 2024
Date

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 04 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2402MHz)
Modulation type: GFSK

ANT Polarity: Horizontal

FCC Part 15



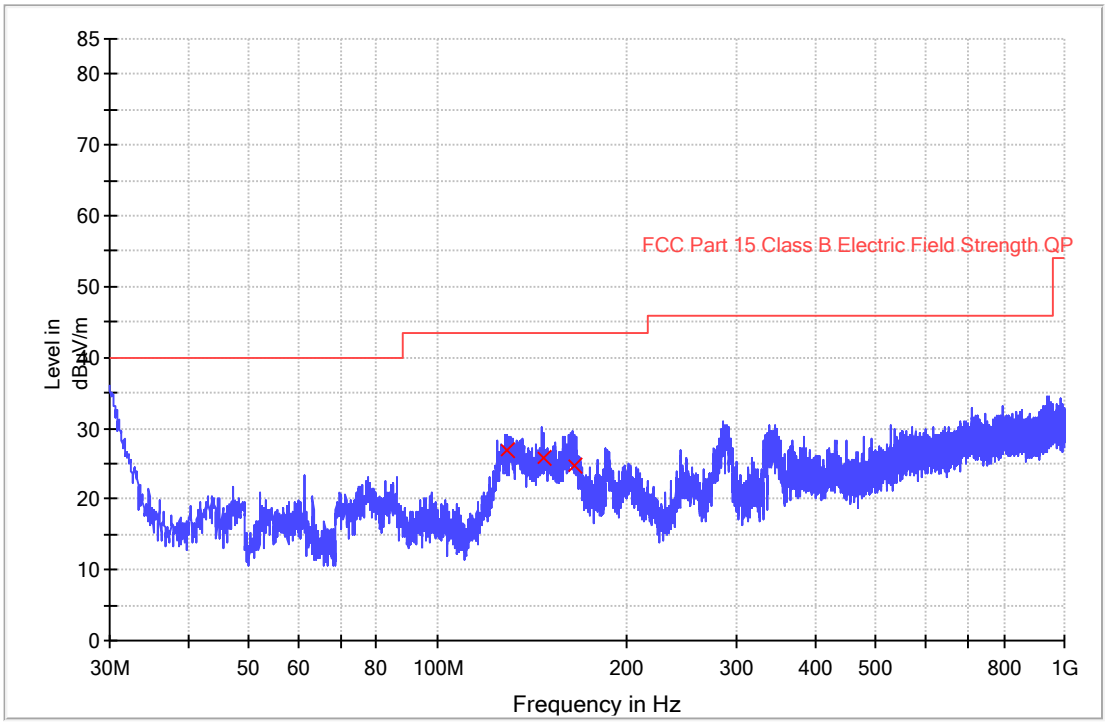
Frequency (MHz)	Quasi Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Corr. (dB/m)	Margin - QPK (dB)	Limit – QPK (dBµV/m)
126.482667	27.3	1000.0	120.000	100.0	H	14.5	16.2	43.5
240.037333	27.8	1000.0	120.000	100.0	H	18.6	18.2	46.0
278.760000	28.9	1000.0	120.000	100.0	H	19.8	17.1	46.0

Remark:
1. Corr. (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
2. Quasi Peak (dBµV/m) = Corr. (dB/m) + Read Level (dBµV)
3. Margin (dB) = Limit Line (dBµV/m) – Level (dBµV/m)

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 04 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2402MHz)
Modulation type: GFSK

ANT Polarity: Vertical

FCC Part 15



Frequency (MHz)	Quasi Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Corr. (dB/m)	Margin - QPK (dB)	Limit – QPK (dBµV/m)
128.972333	26.8	1000.0	120.000	100.0	V	14.6	16.7	43.5
147.720000	25.7	1000.0	120.000	100.0	V	16.1	17.8	43.5
165.185667	24.7	1000.0	120.000	100.0	V	16.8	18.8	43.5

Remark:
1. Corr. (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
2. Quasi Peak (dBµV/m) = Corr. (dB/m) + Read Level (dBµV)
3. Margin (dB) = Limit Line (dBµV/m) – Level (dBµV/m)

4.1.4 Transmitter Spurious Emissions (Radiated)

Worst Case Radiated Emission
at
2402.000 MHz

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

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.

Judgement: Passed by 19.7 dB

TEST PERSONNEL:

Sign on file

Mandy Chen, Engineer
Typed/Printed Name

04 February 2024
Date

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 04 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2402MHz)
Modulation type: GFSK

Table 1

Radiated Emissions

(2402MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2402.000	102.9	36.7	28.1	94.3	114.0	-19.7
Horizontal	4804.000	44.1	36.7	35.5	42.9	74.0	-31.1
Horizontal	7206.000	47.4	36.1	36.5	47.8	74.0	-26.2
Horizontal	9608.000	49.0	36.3	38.0	50.7	74.0	-23.3

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2402.000	102.9	36.7	28.1	22.5	71.8	94.0	-22.2
Horizontal	4804.000	44.1	36.7	35.5	22.5	20.4	54.0	-33.6
Horizontal	7206.000	47.4	36.1	36.5	22.5	25.3	54.0	-28.7
Horizontal	9608.000	49.0	36.3	38.0	22.5	28.2	54.0	-25.8

Notes:
1. Peak detector is used for the emission measurement.
2. All measurements were made at 3 meter. Harmonic 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 harmonic 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. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Mandy Chen

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 04 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2441MHz)
Modulation type: GFSK

Table 2

Radiated Emissions

(2441MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2441.000	101.8	36.7	28.1	93.2	114.0	-20.8
Horizontal	4882.000	45.0	36.7	35.5	43.8	74.0	-30.2
Horizontal	7323.000	46.8	36.1	37.2	47.9	74.0	-26.1
Horizontal	9764.000	50.6	36.2	37.0	51.4	74.0	-22.6

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2441.000	101.8	36.7	28.1	22.5	70.7	94.0	-23.3
Horizontal	4882.000	45.0	36.7	35.5	22.5	21.3	54.0	-32.7
Horizontal	7323.000	46.8	36.1	37.2	22.5	25.4	54.0	-28.6
Horizontal	9764.000	50.6	36.2	37.0	22.5	28.9	54.0	-25.1

Notes:
1. Peak detector is used for the emission measurement.
2. All measurements were made at 3 meter. Harmonic 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 harmonic 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. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Mandy Chen

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 04 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2480MHz)
Modulation type: GFSK

Table 3

Radiated Emissions

(2480MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2480.000	99.2	36.7	28.1	90.6	114.0	-23.4
Horizontal	4960.000	45.4	36.7	35.5	44.2	74.0	-29.8
Horizontal	7440.000	47.4	36.1	37.2	48.5	74.0	-25.5
Horizontal	9920.000	50.1	36.3	38.9	52.7	74.0	-21.3

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2480.000	99.2	36.7	28.1	22.5	68.1	94.0	-25.9
Horizontal	4960.000	45.4	36.7	35.5	22.5	21.7	54.0	-32.3
Horizontal	7440.000	47.4	36.1	37.2	22.5	26.0	54.0	-28.0
Horizontal	9920.000	50.1	36.3	38.9	22.5	30.2	54.0	-23.8

Notes:
1. Peak detector is used for the emission measurement.
2. All measurements were made at 3 meter. Harmonic 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 harmonic 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. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Mandy Chen

4.2 Conducted Emission Configuration Photograph

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

4.2.1 Conducted Emission

Worst Case Conducted Configuration
at
0.306000MHz

Judgement: Passed by 15.5dB margin

TEST PERSONNEL:

Sign on file

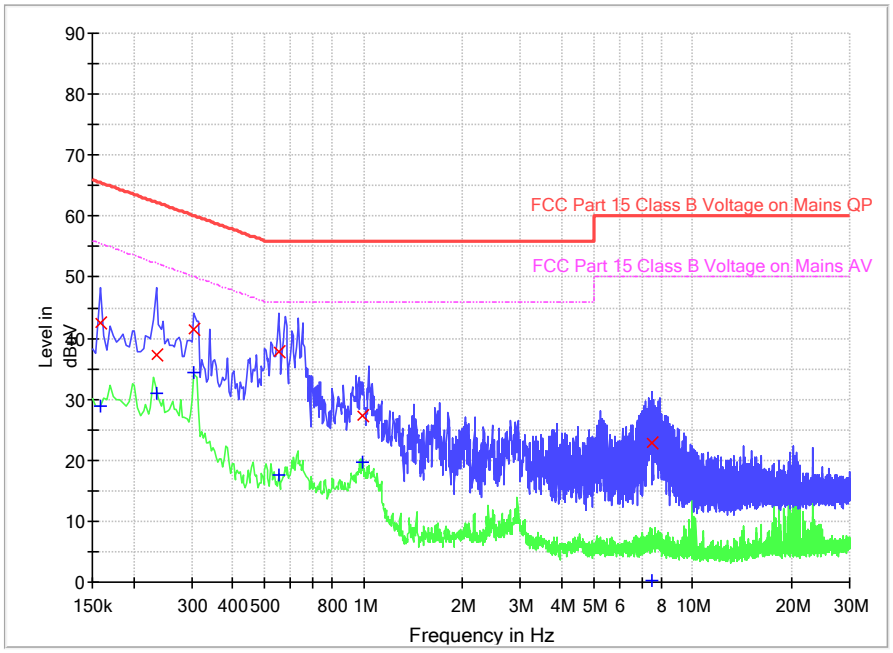
Mandy Chen, Engineer
Typed/Printed Name

06 February 2024
Date

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 06 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2402MHz)
Modulation type: GFSK
Test Voltage: AC 120V/60Hz
Phase: Live

Graphic / Data Table

Conducted Emissions
Pursuant to FCC 15.207: Emissions Requirement



Limit and Margin QP

Frequency (MHz)	Quasi Peak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.158000	42.5	9.000	L1	9.6	23.1	65.6
0.234000	37.3	9.000	L1	9.6	25.0	62.3
0.306000	41.5	9.000	L1	9.7	18.6	60.1
0.550000	37.9	9.000	L1	9.7	18.1	56.0
0.998000	27.2	9.000	L1	9.7	28.8	56.0
7.486000	22.7	9.000	L1	9.9	37.3	60.0

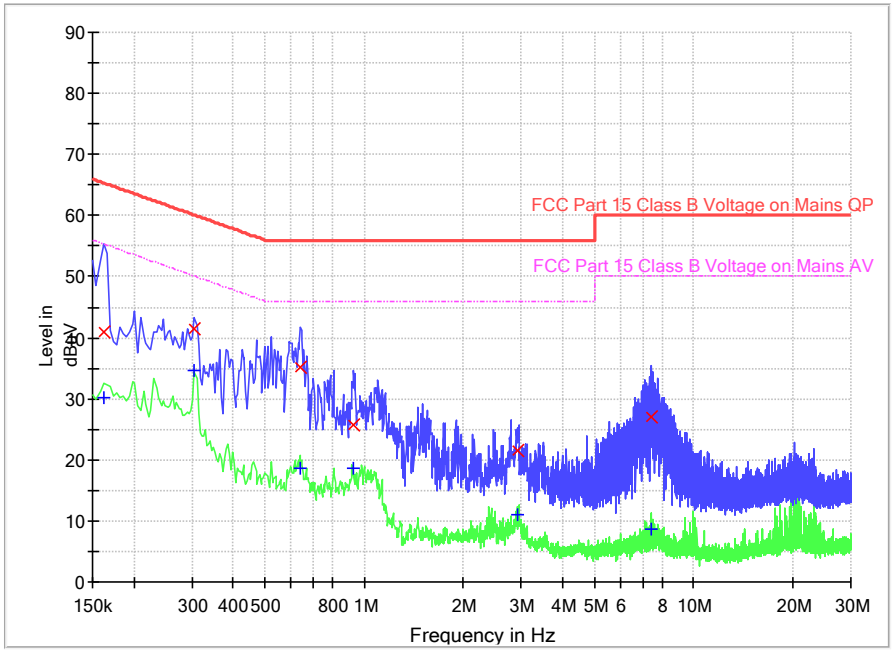
Limit and Margin AV

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.158000	28.8	9.000	L1	9.6	26.7	55.6
0.234000	31.0	9.000	L1	9.6	21.3	52.3
0.306000	34.4	9.000	L1	9.7	15.7	50.1
0.550000	17.5	9.000	L1	9.7	28.5	46.0
0.998000	19.7	9.000	L1	9.7	26.3	46.0
7.486000	0.2	9.000	L1	9.9	49.8	50.0

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 06 February 2024 Model: HS3100
Worst Case Operating Mode: Transmitting(2402MHz)
Modulation type: GFSK
Test Voltage: AC 120V/60Hz
Phase: Neutral

Graphic / Data Table

Conducted Emissions
Pursuant to FCC 15.207: Emissions Requirement



Limit and Margin QP

Frequency (MHz)	Quasi Peak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.162000	41.1	9.000	N	9.6	24.3	65.4
0.306000	41.5	9.000	N	9.6	18.6	60.1
0.638000	35.2	9.000	N	9.6	20.8	56.0
0.930000	25.6	9.000	N	9.7	30.4	56.0
2.938000	21.6	9.000	N	9.7	34.4	56.0
7.458000	26.9	9.000	N	9.9	33.1	60.0

Limit and Margin AV

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.162000	30.2	9.000	N	9.6	25.2	55.4
0.306000	34.6	9.000	N	9.6	15.5	50.1
0.638000	18.7	9.000	N	9.6	27.3	46.0
0.930000	18.7	9.000	N	9.7	27.3	46.0
2.938000	11.1	9.000	N	9.7	34.9	46.0
7.458000	8.6	9.000	N	9.9	41.4	50.0

5.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

6.0 Product Labelling

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

7.0 Technical Specifications

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

8.0 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.

9.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandedge, 20dB Bandwidth, the test procedure and calculation of factor such as pulse desensitization.

9.1 Bandedge Plot

The test plots are attached as below. From the below plots, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfils the requirement of 15.249(d).

Peak Measurement

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

(i) Lowest frequency channel (2402MHz):

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

= 94.3 dBµv/m-41.11 dB
= 53.19 dBµv/m

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

= 71.8 dBµv/m-41.11 dB
= 30.69 dBµv/m

(ii) Highest frequency channel (2480MHz):

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

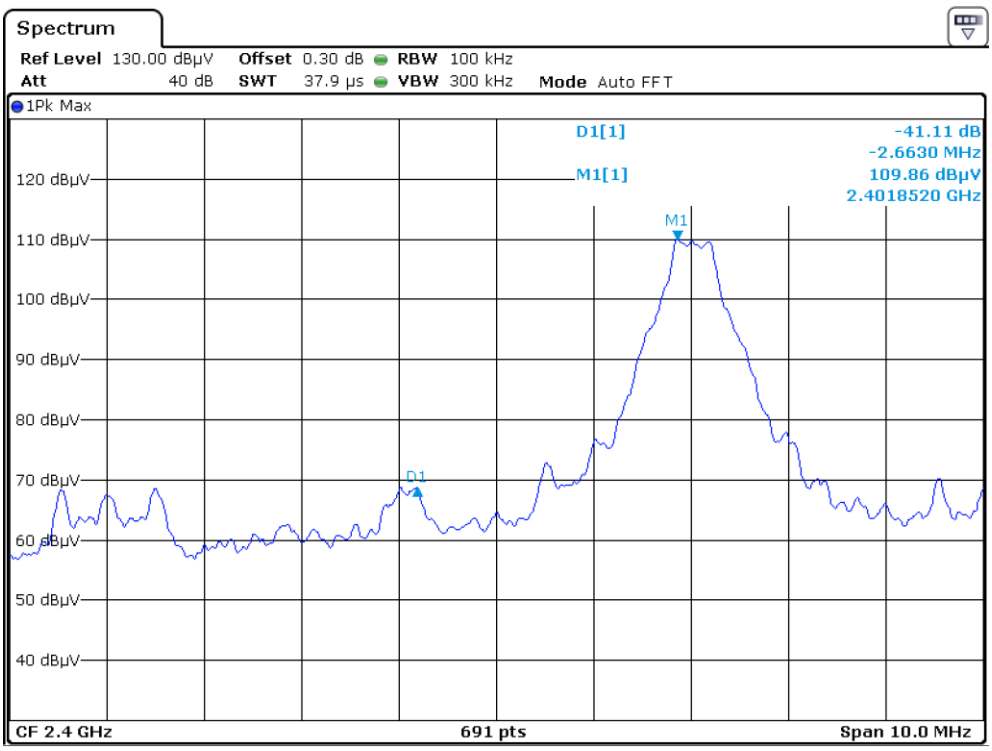
= 90.6 dBµv/m-47.52 dB
= 43.08 dBµv/m

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

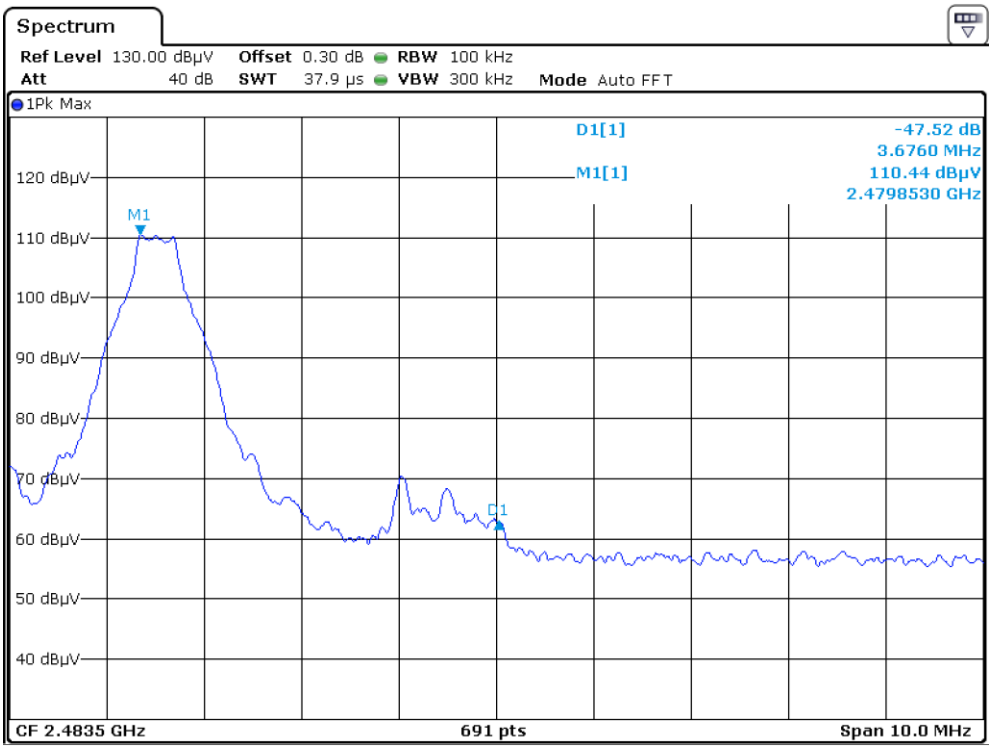
= 68.1 dBµv/m-47.52 dB
= 20.58 dBµv/m

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

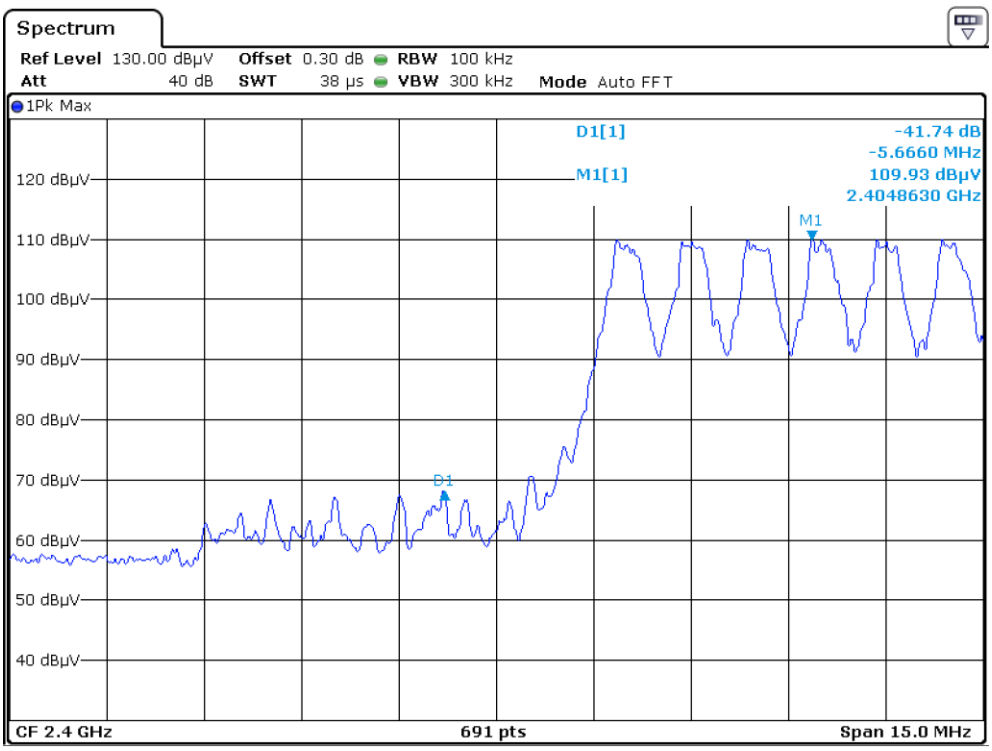
Hopping function off
Lowest frequency Channel



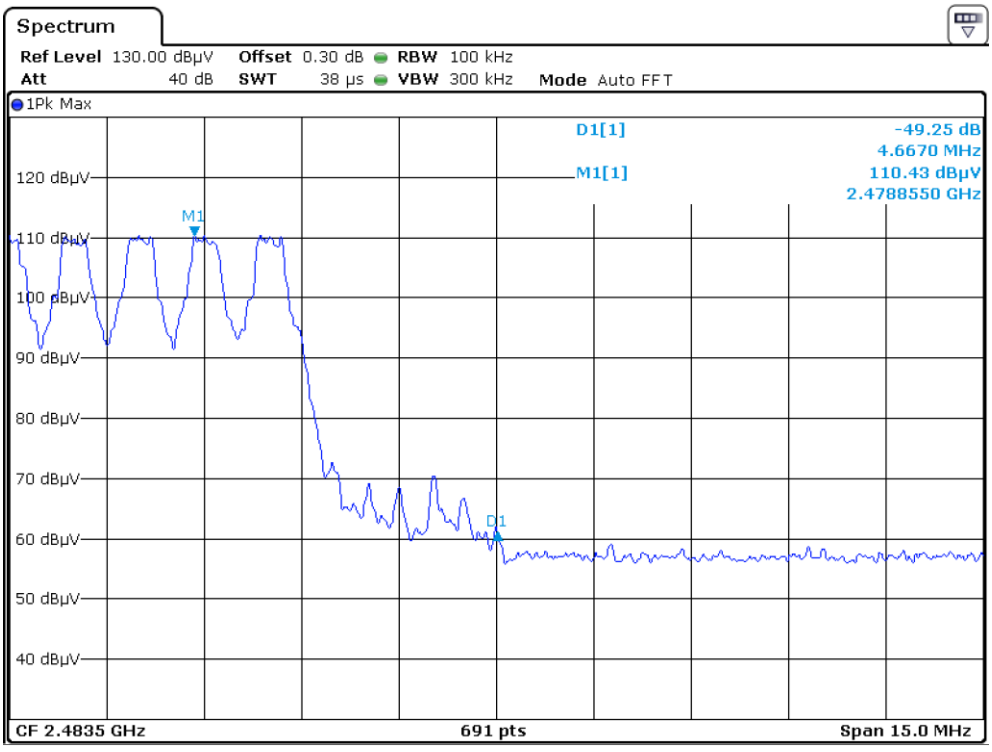
Highest frequency Channel



Hopping function on
Lowest frequency Channel

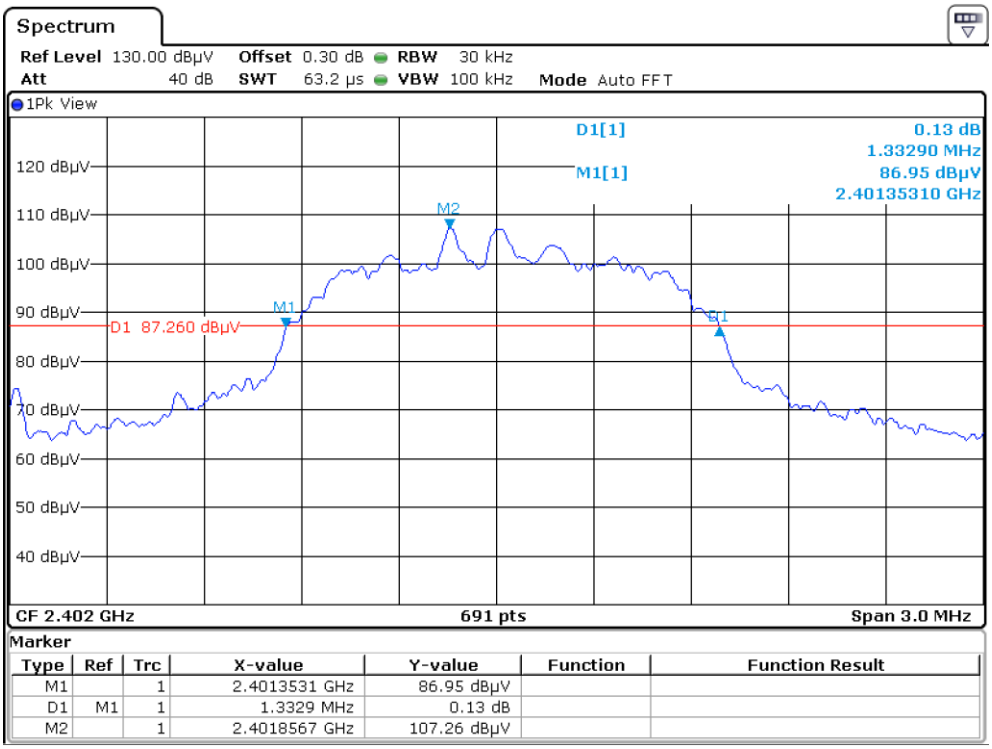


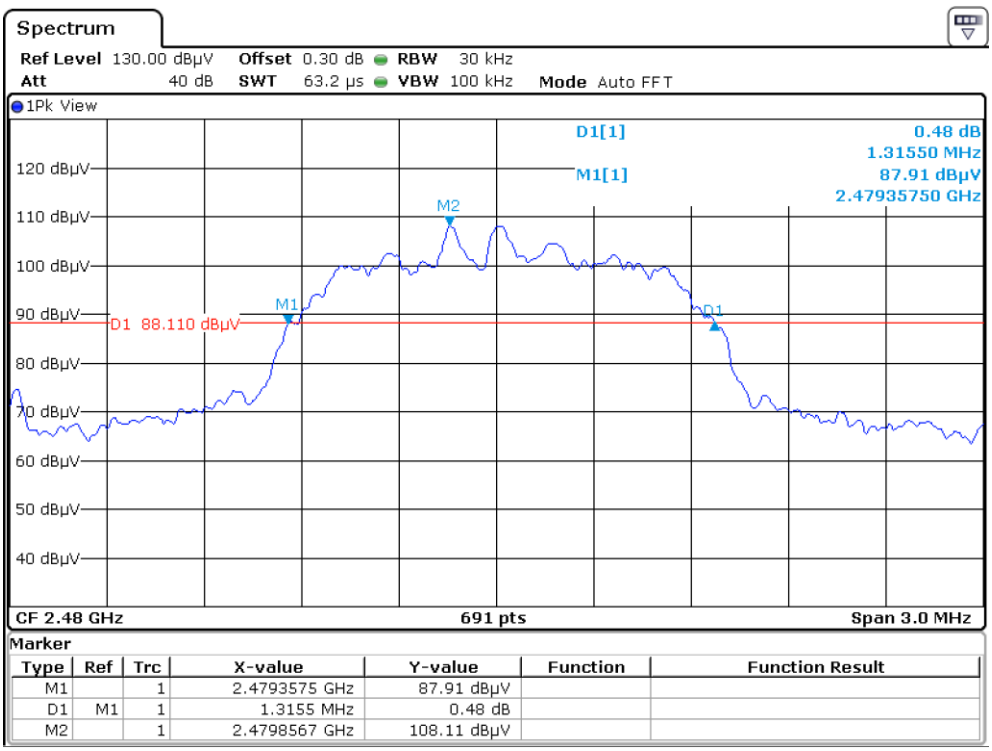
Highest frequency Channel



9.2 20dB bandwidth

Pursuant to FCC part 15 Section 15.215(c), the 20dB 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. The test plots are reported as below.





9.3 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 625μs for Bluetooth. With a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

9.4 Calculation of Average Factor

Based on the Bluetooth Specification Version 5.3 (EDR mode) and worst case AFH mode, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length, the AFH mode Duty cycle connection factor as below:

Channel hop rate = 800 hops/second (AFH Mode)

Adjusted channel hop rate for DH5 mode = 133.33 hops/second

Time per channel hop = 1 / 133.33 hops/second = 7.5 ms

Time to cycle through all channels = 7.5 x 20 channels = 150 ms

Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)

Worst case dwell time = 7.5 ms

Duty cycle connection factor = 20log10 (7.5ms / 100ms) = -22.5 dB

9.5 Emissions Test Procedures

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

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10 - 2013.

The transmitting equipment under test (EUT) is placed on a styrene turntable which is four feet in diameter and approximately 0.8 meter up to 1GHz and 1.5 meter above 1GHz 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 adjust through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

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 section 9.4.

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.

Detector function for conducted emissions is in QP & AV mode and IFBW setting is 9 kHz from the frequency band 150 kHz to 30MHz.

9.5 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 are made as described in ANSI C63.10 - 2013.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 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. Above 1000 MHz, a resolution bandwidth of 1 MHz is used (RBW 3MHz used for fundamental emission).

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted 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, but those measurements taken at a closer distance are so marked.

10.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	04-Aug-2021	04-Aug-2024
SZ185-03	EMI Receiver	R&S	ESR7	101975	27-Apr-2023	27-Apr-2024
SZ061-08	Horn Antenna	ETS	3115	00092346	05-Sep-2021	05-Sep-2024
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	18-May-2021	18-May-2024
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	27-Apr-2023	27-Apr-2024
SZ056-06	Signal Analyzer	R&S	FSV 40	101101	13-Dec-2023	13-Dec-2024
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	27-Apr-2023	27-Apr-2024
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	12-Dec-2021	12-Dec-2024
SZ062-23	RF Cable	RADIALL	SF104PE	--	26-Sep-2023	26-Sep-2024
SZ062-35	RF Cable	RADIALL	A50-3.5M3.5M-8M	--	26-Sep-2023	26-Sep-2024
SZ062-30	RF Cable	RADIALL	A50-3.5M3.5M-4.5M	--	26-Sep-2023	26-Sep-2024
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	27-Apr-2023	27-Apr-2024
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	11-Jul-2023	11-Jul-2024
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	18-Oct-2023	19-Oct-2024
SZ187-02	Two-Line V-Network	R&S	ENV216	100072	27-Apr-2023	27-Apr-2024
SZ062-16	RF Cable	HUBER+SUHNER	CBL2-BN-1m	110127-2231000	11-Jul-2023	11-Jul-2024
SZ188-03	Shielding Room	ETS	RFD-100	4100	20-Dec-2022	20-Dec-2025

********** End of Report**********