# Zhong Shan City Richsound Electronic Industrial Ltd.

# TEST REPORT

**SCOPE OF WORK**
FCC Testing – HS312, HS312E, HS312F, AX3100A, AX3100B, AX3100C, AX3102F, TS312

**REPORT NUMBER**
210427027SZN-002

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101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community GuanHu Subdistrict, LongHua District, Shenzhen, People's Republic of China
Tel: (86 755) 8601 6288
Fax: (86 755) 8601 6751
www.intertek.com

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**Test Report**

Intertek Report No.: 210427027SZN-002

# Zhong Shan City Richsound Electronic Industrial Ltd.

Application For Certification

**FCC ID: Z8M-HS312**

**3.1CH Soundbar with Wireless Subwoofer, Wireless Subwoofer**

**Model: HS312, HS312E, HS312F, AX3100A, AX3100B, AX3100C, AX3102F, TS312**

**Brand name: Hisense, TOSHIBA**

2.4GHz Transmitter

Report No.: 210427027SZN-002

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 [10-1-19]

**Prepared and Checked by:**

**Draven Li**
**Project Engineer**

**Approved by:**

**Peter Kang**
**Senior Technical Supervisor**
**Date: 06 July 2021**

## MEASUREMENT/TECHNICAL REPORT

This report concerns (check one:) Original Grant _X_ Class II Change _____

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

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 [10-1-19 Edition] provision.

Report prepared by:

Draven Li
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing
Community, GuanHu Subdistrict, LongHua District, Shenzhen.
Tel: (86 755) 8601 0682 Fax: (86 755) 8601 6661

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## 1.0 Summary of Test Result

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.

Address: No.16, East Shagang Road, Gangkou, Zhongshan, Guangdong, China.

Manufacturer: Zhong Shan City Richsound Electronic Industrial Ltd.

Address: No.16, East Shagang Road, Gangkou, Zhongshan, Guangdong, China.

**Model: HS312**

**FCC ID: Z8M-HS312**

| Test Specification | Reference | Results |
|---|---|---|
| Transmitter Radiated Emission Bandedge | 15.249 &15.209 &15.205 | Pass |
| Conducted Emission | 15.207 | 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 3.1CH Soundbar with Wireless Subwoofer, Wireless Subwoofer with 2.4GHz transmitter function operating at 2.4G Band. 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
Antenna Gain: 1.22dBi

The model: HS312E, HS312F, AX3100A, AX3100B, AX3100C, AX3102F, TS312 is the same as the Model: HS312 in hardware aspect, The differences in model number and brand name serve as marketing strategy.

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 transceiver for the 3.1CH Soundbar with Wireless Subwoofer, Wireless Subwoofer which has Bluetooth function and 2.4GHz Transmitter Function. Bluetooth functions were reported in the certification report: 210427027SZN-001. Other digital functions were reported in the verification report: 210427027SZN-003.

### 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 was powered by AC120V, 60Hz during the test, only the worst data was reported in this report.

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, 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 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 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 V1.5

### 3.3 Special Accessories

No special accessory attached.

### 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.

3.6 Support Equipment List and Description

| Description | Manufacturer | Model No. |
|---|---|---|
| iPod | Apple | A1421 |
| USB Memory | SanDisk | SDCZ36-002G-P36 |
| Test TV | SONY | KDL-24EX520 |
| Mobile phone | SAMSUNG | S7 |
| Remote controller | Hisense | N/A |
| Dummy Load | N/A<br>(provided by Intertek) | Audio Port: 1000Ω<br>Video Port: 75 Ω<br>HDMI Port: 100 Ω |
| Subwoofer | Hisense | HS312 |
| HDMI Cable*1 | N/A | Shielded with ferrite cores,<br>Length 150cm |
| HDMI Cable*2 | N/A<br>(Provided by Intertek) | Shielded with ferrite cores,<br>Length 150cm |
| AC power cord | N/A | Unshielded, Length 150cm |
| Optical Cable | N/A | Unshielded, Length 150cm |
| Coaxial Cable | N/A<br>(Provided by Intertek) | Unshielded, Length 150cm |
| AUX Cable | N/A<br>(Provided by Intertek) | Unshielded, Length 100cm |

## 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
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 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
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. Simultaneous transmission was considered during the test.

Worst Case Radiated Emission

at 39.894 MHz

Judgement: Passed by 5.0 dB

***TEST PERSONNEL:***

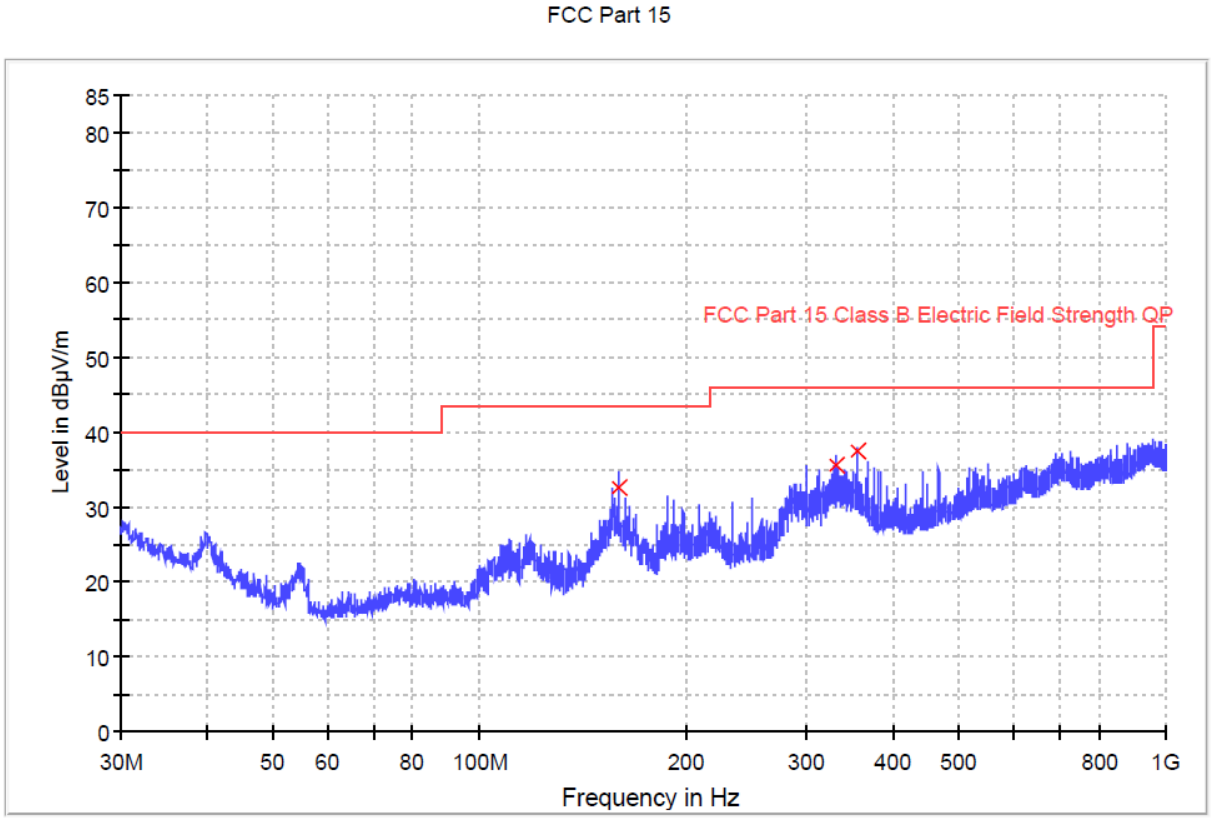
*Sign on file*

Draven Li, Project Engineer
*Typed/Printed Name*

17 May 2021
*Date*

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 17 May 2021
Model: HS312
Worst Case Operating Mode: Simultaneous Transmission
Modulation type: GFSK

ANT Polarity: Horizontal

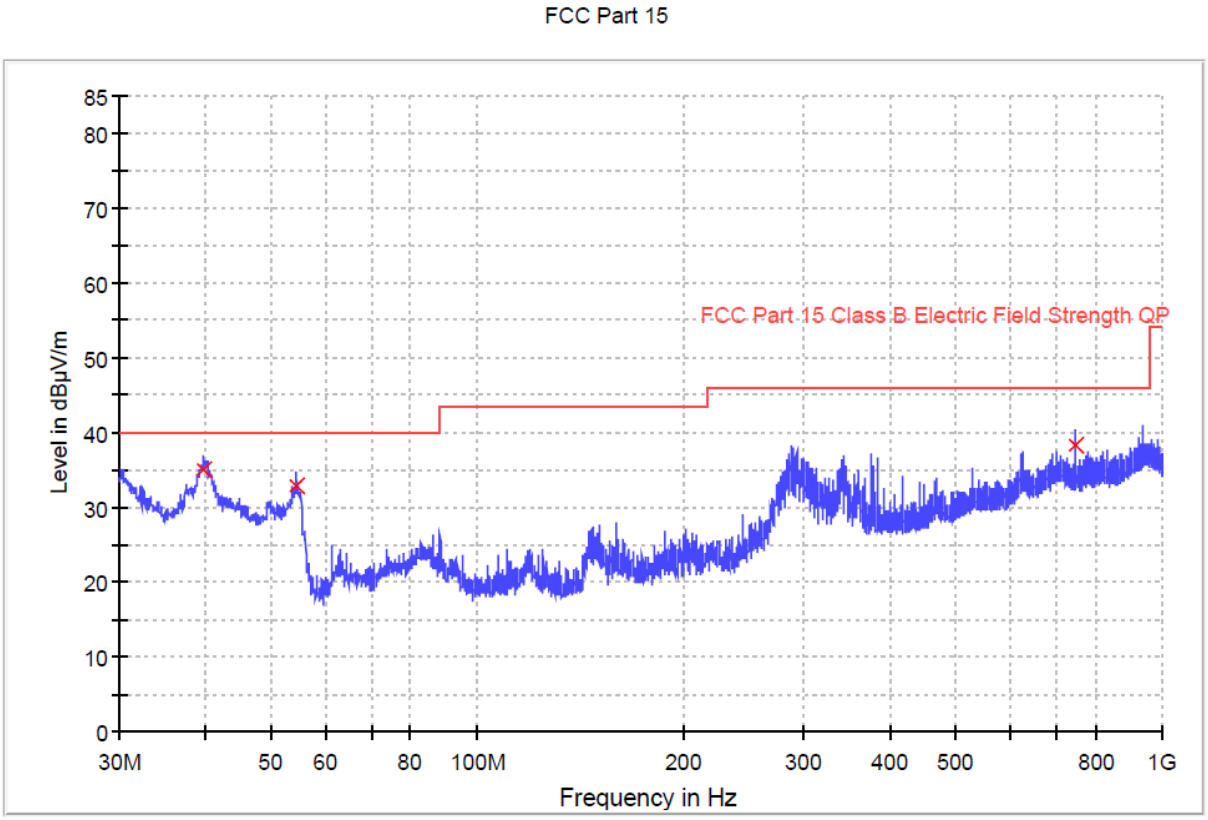



| Frequency (MHz) | QuasiPeak (dBuV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBuV/m) |
|---|---|---|---|---|---|---|---|---|
| 159.721333 | 32.7 | 1000.0 | 120.000 | 100.0 | H | 11.3 | 10.8 | 43.5 |
| 331.734667 | 35.5 | 1000.0 | 120.000 | 100.0 | H | 16.5 | 10.5 | 46.0 |
| 356.340333 | 37.4 | 1000.0 | 120.000 | 100.0 | H | 17.4 | 8.6 | 46.0 |

Remark:
1. Corr. (dB) = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (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: 17 May 2021
Model: HS312
Worst Case Operating Mode: Simultaneous Transmission
Modulation type: GFSK

ANT Polarity: Vertical




| Frequency (MHz) | QuasiPeak (dBuV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBuV/m) |
|---|---|---|---|---|---|---|---|---|
| 39.894000 | 35.0 | 1000.0 | 120.000 | 100.0 | V | 13.0 | 5.0 | 40.0 |
| 54.541000 | 32.8 | 1000.0 | 120.000 | 100.0 | V | 8.6 | 7.2 | 40.0 |
| 749.998667 | 38.2 | 1000.0 | 120.000 | 100.0 | V | 25.1 | 7.8 | 46.0 |

Remark:
1. Corr. (dB) = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (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
2483.503 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 5.1 dB

***TEST PERSONNEL:***

*Sign on file*

Draven Li, Project Engineer
*Typed/Printed Name*

17 May 2021
*Date*

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 17 May 2021 Model: HS312
Worst Case Operating Mode: Transmitting

Table 1

**Radiated Emissions**
(2404.500 MHz)

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2404.500 | 102.4 | 36.7 | 28.1 | 93.8 | 114.0 | -20.2 |
| Vertical | 4809.000 | 41.4 | 36.7 | 35.5 | 40.2 | 74.0 | -33.8 |
| Vertical | 7213.500 | 47.1 | 36.8 | 35.6 | 45.9 | 74.0 | -28.1 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| Vertical | 2404.500 | 102.4 | 36.7 | 28.1 | 9.7 | 84.1 | 94.0 | -9.9 |
| Vertical | 4809.000 | 41.4 | 36.7 | 35.5 | 9.7 | 30.5 | 54.0 | -23.5 |
| Vertical | 7213.500 | 47.1 | 36.8 | 35.6 | 9.7 | 36.2 | 54.0 | -17.8 |

Notes:
1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter 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.

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 17 May 2021 Model: HS312
Worst Case Operating Mode: Transmitting

Table 2

**Radiated Emissions**
(2439.500 MHz)

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2439.500 | 100.6 | 36.7 | 28.1 | 92.0 | 114.0 | -22.0 |
| Vertical | 4879.000 | 39.4 | 36.7 | 35.5 | 38.2 | 74.0 | -35.8 |
| Vertical | 7318.500 | 45.0 | 36.8 | 35.6 | 43.8 | 74.0 | -30.2 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| Vertical | 2439.500 | 100.6 | 36.7 | 28.1 | 9.7 | 82.3 | 94.0 | -11.7 |
| Vertical | 4879.000 | 39.4 | 36.7 | 35.5 | 9.7 | 28.5 | 54.0 | -25.5 |
| Vertical | 7318.500 | 45.0 | 36.8 | 35.6 | 9.7 | 34.1 | 54.0 | -19.9 |

Notes:
1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. 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.

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 17 May 2021 Model: HS312
Worst Case Operating Mode: Transmitting

Table 3

**Radiated Emissions**
(2479.500 MHz)

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2479.500 | 99.7 | 36.7 | 28.1 | 91.1 | 114.0 | -22.9 |
| Vertical | 4959.000 | 38.8 | 36.7 | 35.5 | 37.6 | 74.0 | -36.4 |
| Vertical | 7438.500 | 44.5 | 36.8 | 35.6 | 43.3 | 74.0 | -30.7 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| Vertical | 2479.500 | 99.7 | 36.7 | 28.1 | 9.7 | 81.4 | 94.0 | -12.6 |
| Vertical | 4959.000 | 38.8 | 36.7 | 35.5 | 9.7 | 27.9 | 54.0 | -26.1 |
| Vertical | 7438.500 | 44.5 | 36.8 | 35.6 | 9.7 | 33.6 | 54.0 | -20.4 |

Notes:

1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter 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.

4.2 Conducted Emission Configuration Photograph

For electronic filing, the worst-case radiated emission configuration photographs are saved with filename: conducted photos.pdf. Simultaneous transmission was considered during the test.

4.2.1 Conducted Emission

Worst Case Conducted Configuration
at
0.522MHz

Judgement: Passed by 11.7dB margin

***TEST PERSONNEL:***

*Sign on file*

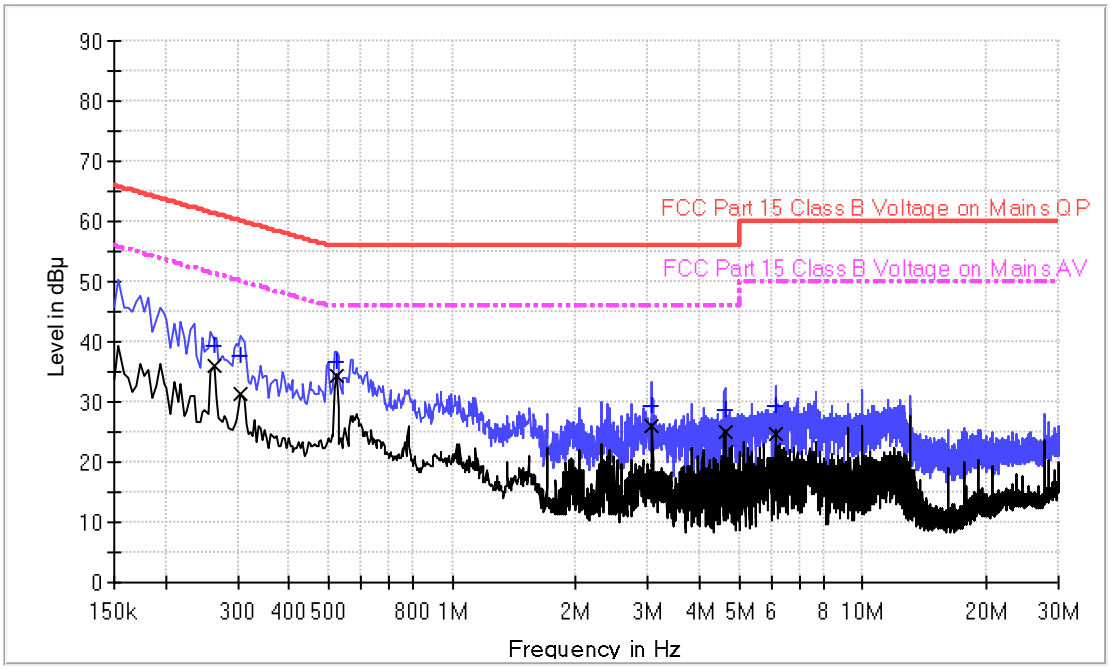
Draven Li, Project Engineer
*Typed/Printed Name*

17 May 2021
*Date*

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 17 May 2021
Model: HS312
Worst Case Operating Mode: Simultaneous Transmission
Modulation type: GFSK
Phase: Live

## Graphic / Data Table

## Conducted Emissions
## Pursuant to FCC 15.207: Emissions Requirement




### Limit and Margin QP

| Frequency (MHz) | QuasiPeak (dBuV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|
| 0.262000 | 39.2 | 9.000 | L1 | 9.6 | 22.2 | 61.4 |
| 0.306000 | 37.8 | 9.000 | L1 | 9.6 | 22.3 | 60.1 |
| 0.522000 | 36.6 | 9.000 | L1 | 9.6 | 19.4 | 56.0 |
| 3.070000 | 29.2 | 9.000 | L1 | 9.7 | 26.8 | 56.0 |
| 4.610000 | 28.8 | 9.000 | L1 | 9.7 | 27.2 | 56.0 |
| 6.146000 | 29.4 | 9.000 | L1 | 9.7 | 30.6 | 60.0 |

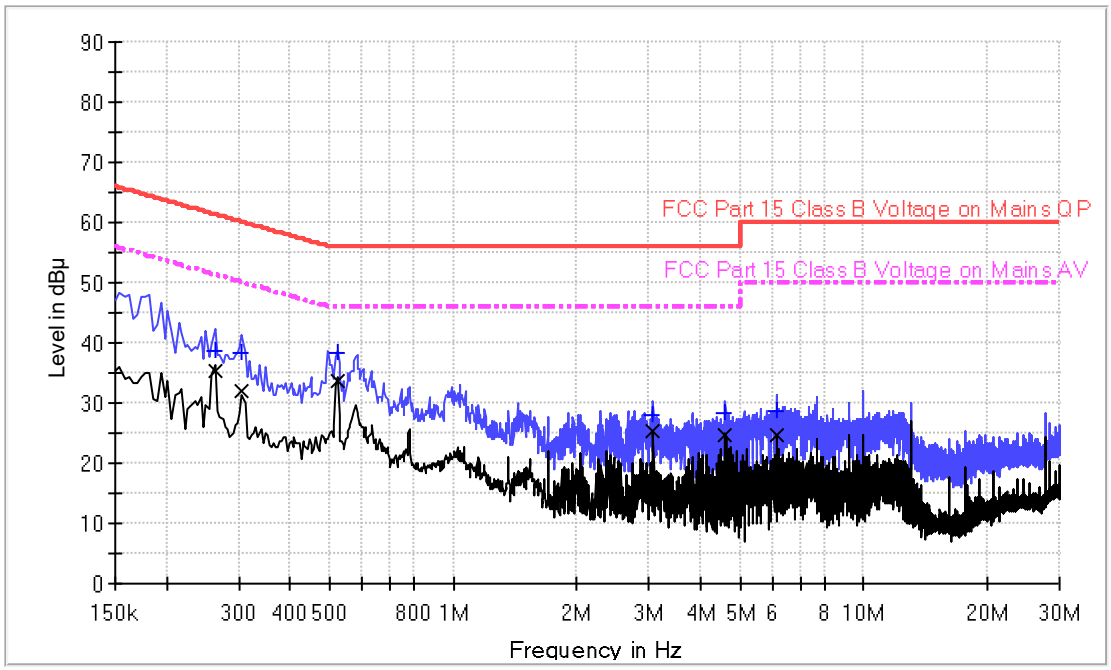
### Limit and Margin AV

| Frequency (MHz) | Average (dBuV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|
| 0.262000 | 36.0 | 9.000 | L1 | 9.6 | 15.4 | 51.4 |
| 0.306000 | 31.5 | 9.000 | L1 | 9.6 | 18.6 | 50.1 |
| 0.522000 | 34.3 | 9.000 | L1 | 9.6 | 11.7 | 46.0 |
| 3.070000 | 26.1 | 9.000 | L1 | 9.7 | 19.9 | 46.0 |
| 4.610000 | 25.0 | 9.000 | L1 | 9.7 | 21.0 | 46.0 |
| 6.146000 | 24.8 | 9.000 | L1 | 9.7 | 25.2 | 50.0 |

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: 17 May 2021
Model: HS312
Worst Case Operating Mode: Simultaneous Transmission
Modulation type: GFSK
Phase: Neutral

## Graphic / Data Table

## Conducted Emissions
## Pursuant to FCC 15.207: Emissions Requirement




### Limit and Margin QP

| Frequency (MHz) | QuasiPeak (dBuV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|
| 0.262000 | 38.5 | 9.000 | N | 9.5 | 22.9 | 61.4 |
| 0.306000 | 38.5 | 9.000 | N | 9.5 | 21.6 | 60.1 |
| 0.522000 | 38.5 | 9.000 | N | 9.5 | 17.5 | 56.0 |
| 3.074000 | 28.0 | 9.000 | N | 9.5 | 28.0 | 56.0 |
| 4.606000 | 28.2 | 9.000 | N | 9.5 | 27.8 | 56.0 |
| 6.146000 | 28.6 | 9.000 | N | 9.6 | 31.4 | 60.0 |

### Limit and Margin AV

| Frequency (MHz) | Average (dBuV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|
| 0.262000 | 35.4 | 9.000 | N | 9.5 | 16.0 | 51.4 |
| 0.306000 | 31.9 | 9.000 | N | 9.5 | 18.2 | 50.1 |
| 0.522000 | 33.6 | 9.000 | N | 9.5 | 12.4 | 46.0 |
| 3.074000 | 25.4 | 9.000 | N | 9.5 | 20.6 | 46.0 |
| 4.606000 | 24.6 | 9.000 | N | 9.5 | 21.4 | 46.0 |
| 6.146000 | 24.7 | 9.000 | N | 9.6 | 25.3 | 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 plot, 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

Restricted-band band-edge tests shall be performed as radiated measurements, i.e (Band-edge Plot).

**(i) Lower channel 2404.500 MHz:**

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2400.000 | 69.9 | 36.7 | 27.9 | 61.1 | 74.0 | -12.9 |

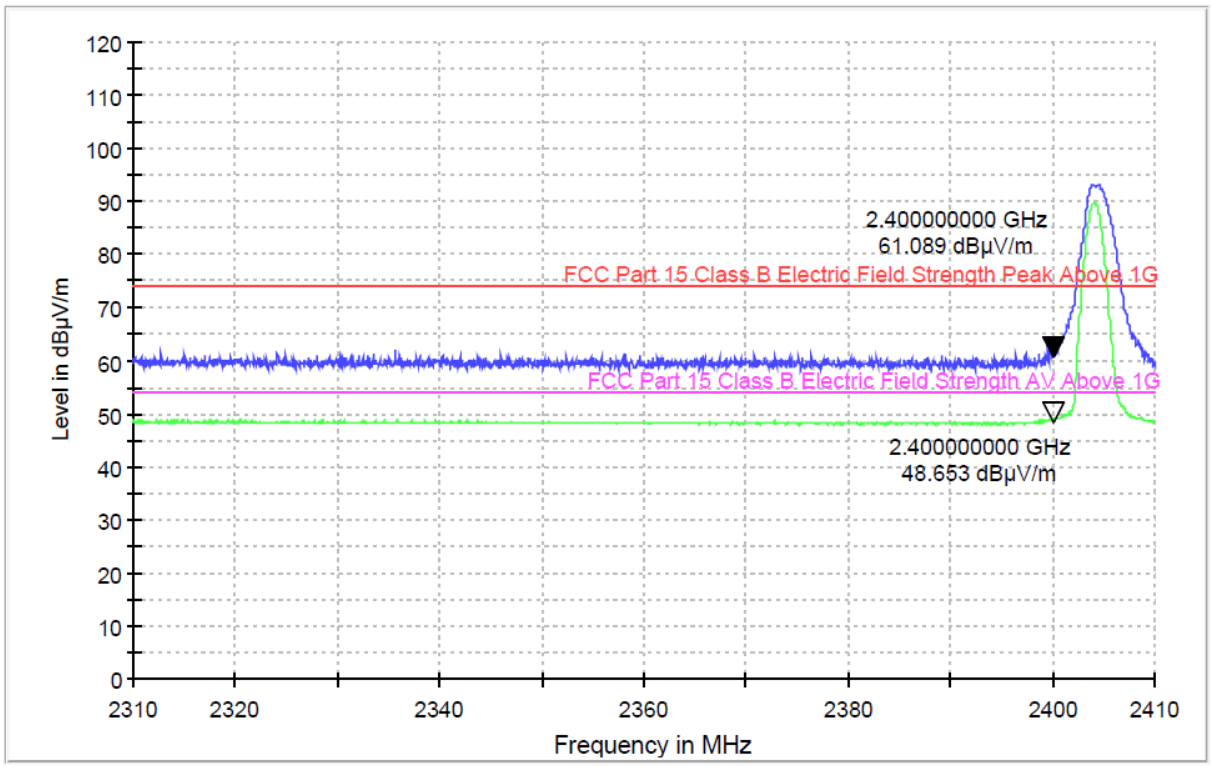
| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2400.000 | 57.5 | 36.7 | 27.9 | 48.7 | 54.0 | -5.3 |

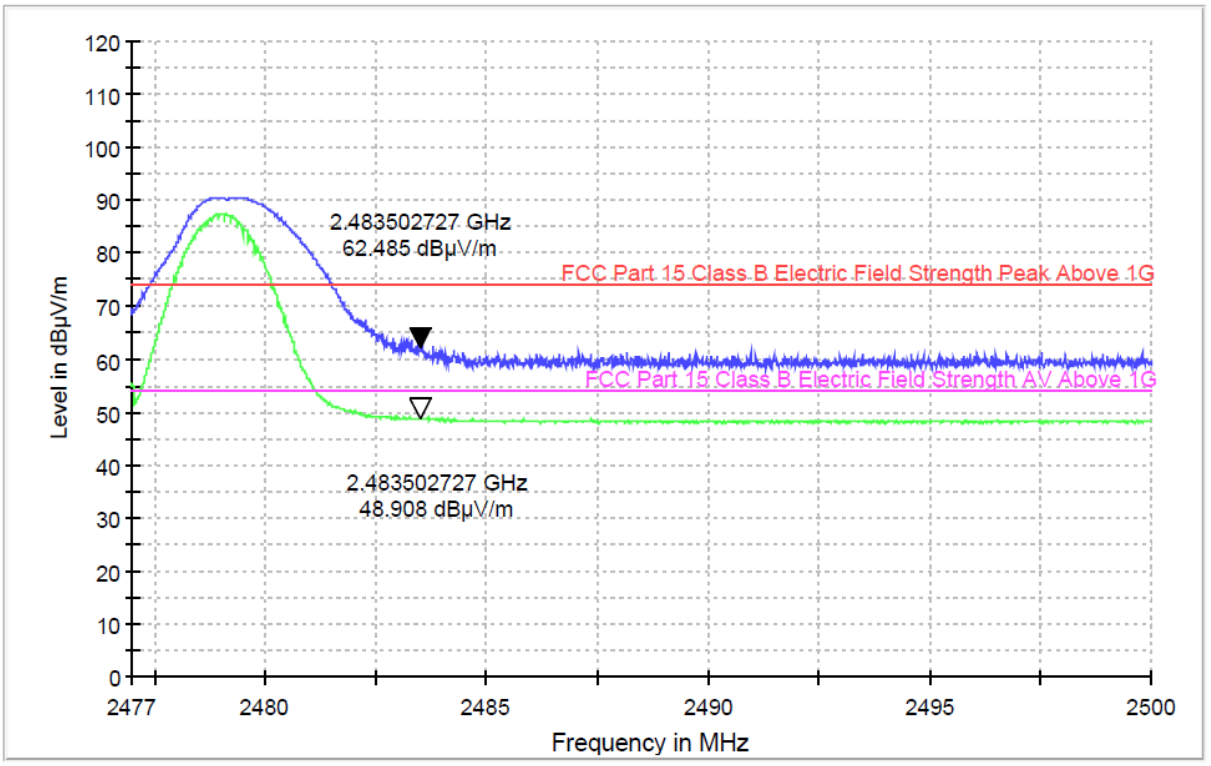
**(ii) Upper channel 2479.500 MHz:**

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2483.503 | 70.2 | 36.8 | 29.1 | 62.5 | 74.0 | -11.5 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 2483.503 | 35.7 | 36.8 | 50.0 | 48.9 | 54.0 | -5.1 |

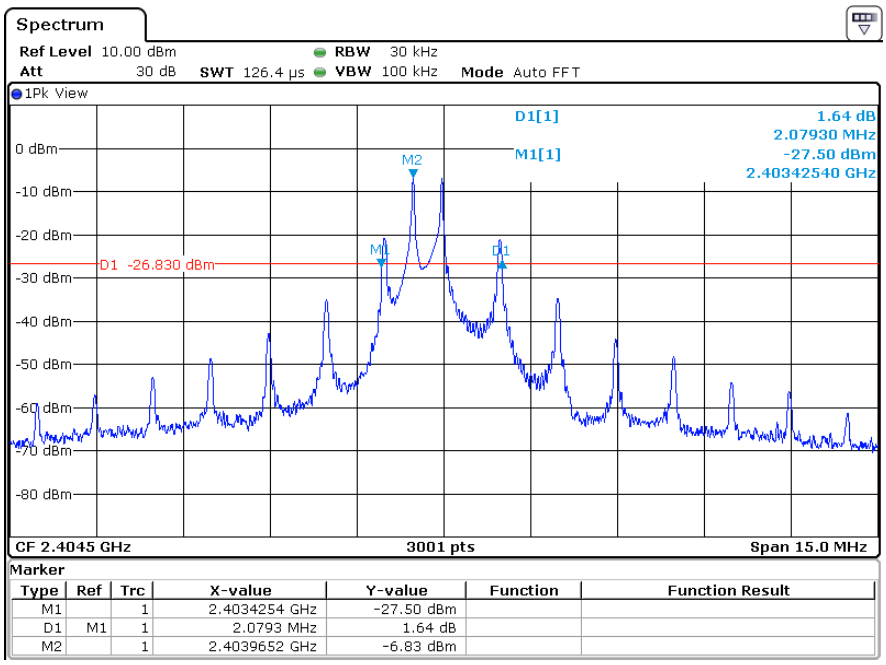
The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74dBµv/m (Peak Limit) and 54dBµv/m (Average Limit).

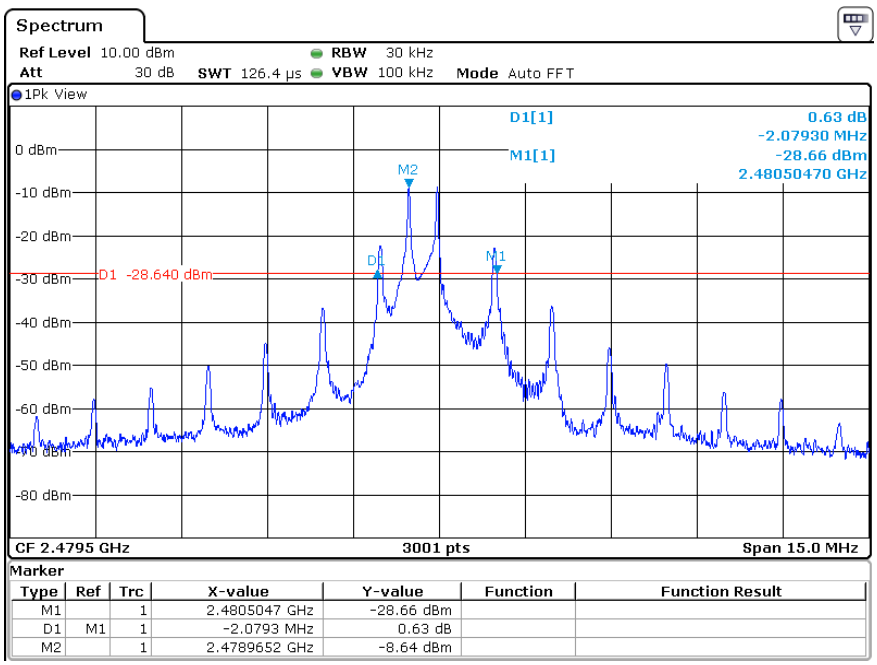

2.400000000 GHz
61.089 dBµV/m
FCC Part 15 Class B Electric Field Strength Peak Above 1G
FCC Part 15 Class B Electric Field Strength AV Above 1G
2.400000000 GHz
48.653 dBµV/m
Level in dBµV/m
Frequency in MHz
120
110
100
90
80
70
60
50
40
30
20
10
0
2310
2320
2340
2360
2380
2400
2410


2.483502727 GHz
62.485 dBµV/m
FCC Part 15 Class B Electric Field Strength Peak Above 1G
FCC Part 15 Class B Electric Field Strength AV Above 1G
2.483502727 GHz
48.908 dBµV/m
Level in dBµV/m
Frequency in MHz
120
110
100
90
80
70
60
50
40
30
20
10
0
2477
2480
2485
2490
2495
2500

## 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 ($T_{eff}$) is approximately 0.339ms for a digital "1" bit, as shown in the plots of Section 9.4. With a resolution bandwidth (3 dB) of 100 kHz, the pulse desensitivity factor was 0 dB

9.4 Calculation of Average Factor

Averaging factor in dB = 20 log (duty cycle)

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

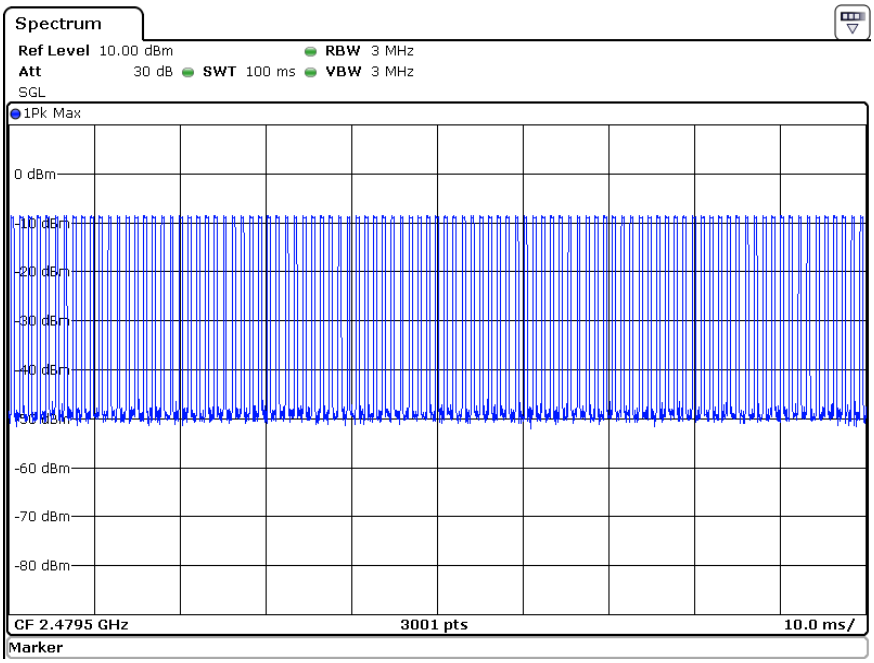
The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

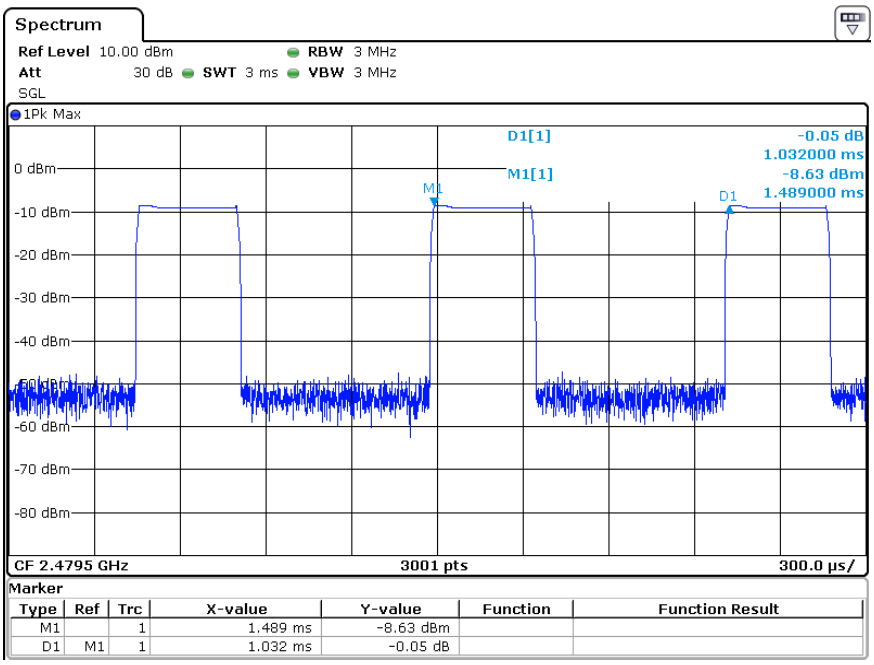
The duty cycle is simply the on-time divided by the period:

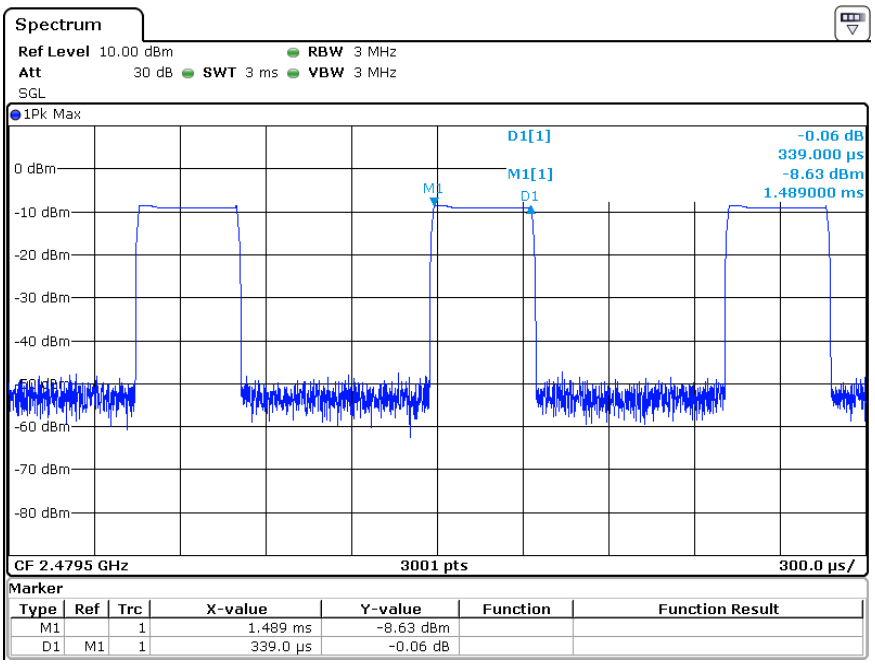
The duration of one cycle = 1.032ms
Effective period of the cycle = 0.339ms
DC =0.339ms / 1.032ms =0.3285 or 32.85%

Therefore, the averaging factor is found by $20 \log_{10} ( 0.3285 ) = -9.7$ dB

The test plots are attached as below.


Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 30 dB SWT 100 ms VBW 3 MHz
SGL
1Pk Max
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.4795 GHz
3001 pts
10.0 ms/
Marker


Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 30 dB SWT 3 ms VBW 3 MHz
SGL
1Pk Max
D1[1]
-0.05 dB
1.032000 ms
M1[1]
-8.63 dBm
1.489000 ms
M1
D1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.4795 GHz
3001 pts
300.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 1.489 ms -8.63 dBm
D1 M1 1 1.032 ms -0.05 dB


Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 30 dB SWT 3 ms VBW 3 MHz
SGL
1Pk Max
D1[1]
-0.06 dB
339.000 µs
M1[1]
-8.63 dBm
1.489000 ms
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.4795 GHz
3001 pts
300.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 1.489 ms -8.63 dBm
D1 M1 1 339.0 µs -0.06 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 adjusted 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.

9.6 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. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Section 9.3). Above 1000 MHz, a resolution bandwidth of 1 MHz is used, RBW 5MHz 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 |
|---|---|---|---|---|---|---|
| SZ061-03 | BiConiLog Antenna | ETS | 3142C | 00166158 | 24-May-2019 | 24-May-2022 |
| SZ185-01 | EMI Receiver | R&S | ESCI | 100547 | 22-Dec-2020 | 22-Dec-2021 |
| SZ061-08 | Horn Antenna | ETS | 3115 | 00092346 | 07-Sep-2019 | 07-Sep-2021 |
| SZ061-06 | Active Loop Antenna | Electro-Metrics | EM-6876 | 217 | 24-May-2019 | 24-May-2021 |
| SZ056-03 | Spectrum Analyzer | R&S | FSP 30 | 101148 | 27-May-2020 | 27-May-2021 |
| SZ056-06 | Signal Analyzer | R&S | FSV 40 | 101101 | 27-May-2020 | 27-May-2021 |
| SZ181-04 | Preamplifier | Agilent | 8449B | 3008A02474 | 27-May-2020 | 27-May-2021 |
| SZ188-01 | Anechoic Chamber | ETS | RFD-F/A-100 | 4102 | 15-Dec-2018 | 15-Dec-2021 |
| SZ062-02 | RF Cable | RADIALL | RG 213U | -- | 01-Dec-2020 | 01-Jun-2021 |
| SZ062-05 | RF Cable | RADIALL | 0.04-26.5GHz | -- | 01-Dec-2020 | 01-Jun-2021 |
| SZ062-12 | RF Cable | RADIALL | 0.04-26.5GHz | -- | 01-Dec-2020 | 01-Jun-2021 |
| SZ067-04 | Notch Filter | Micro-Tronics | BRM50702-02 | -- | 27-May-2020 | 27-May-2021 |
| SZ185-02 | EMI Test Receiver | R&S | ESCI | 100692 | 27-Oct-2020 | 27-Oct-2021 |
| SZ187-01 | Two-Line V-Network | R&S | ENV216 | 100072 | 27-Oct-2020 | 27-Oct-2021 |
| SZ187-02 | Two-Line V-Network | R&S | ENV216 | 100072 | 27-May-2020 | 27-May-2021 |
| SZ062-16 | RF Cable | HUBER+SUHNER | CBL2-BN-1m | 110127-2231000 | 13-Nov-2020 | 13-Nov-2021 |
| SZ188-03 | Shielding Room | ETS | RFD-100 | 4100 | 07-Jan-2020 | 07-Jan-2023 |

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