Total Quality. Assured.

Zhongshan City Richsound Electronic Industrial Ltd.

Application
For
Certification

FCC ID: Z8M-TB236DWW

2.1 CH Soundbar with Wireless Subwoofer

Model: TB236DWW

Additional Models: TB230WW, TB230DWW, TB231WW, TB231DWW, TB232WW, TB232DWW, TB234WW, TB234DWW, TB235WW, TB235DWW, TB236WW, TB238DWW, TB280WW, TB280DWW, TB281WW, TB281DWW, TB282WW, TB282DWW, TB341WW, TB341DWW, TB343WW, TB343DWW, TH-M337B

Brand Name: RSR, JVC

2.4GHz Transceiver

Report No.: 170908004SZN-001

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 [10-1-16]

Prepared and Checked by:	Approved by:
Sign on file	Digitally signed by Kidd Yang Location: Intertek Testing Services
Powell Bao Engineer	Kidd Yang Senior Project Engineer Date: September 15, 2017

TRF No.: FCC 15C_TX_c

Intertek Testing Services Shenzhen Ltd. Longhua Branch

1F/2F, Building B, QiaoAn Scientific Technology Park, Shangkeng Community, Guanhu Subdistrict, Longhua District, Shenzhen, P.R. China China

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LIST OF EXHIBITS

MEASUREMENT/TECHNICAL REPORT

Zhongshan City Richsound Electronic Industrial Ltd.

Model: TB236DWW
Additional Models: TB230WW, TB230DWW, TB231WW, TB231DWW, TB232WW, TB232DWW, TB234WW, TB234DWW, TB235WW, TB235DWW, TB236WW, TB238DWW, TB280WW, TB280DWW, TB281WW, TB281DWW,TB282WW, TB282DWW, TB341WW, TB341DWW, TB343WW, TB343DWW, TH-M337B

FCC ID: Z8M-TB236DWW

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

Equipment Type: DSS - Part 15 Spread Spectrum 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 [10-1-16 Edition] provision.

Report prepared by:

Powell Bao
Intertek Testing Services Shenzhen Ltd.
Longhua Branch

1F/2F, Building B, QiaoAn Scientific Technology Park, Shangkeng Community, Guanhu Subdistrict, Longhua District, Shenzhen, P.R. China China

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Exhibit type	File Description	filename
Test Report	Test Report	report.pdf
Operational Description	Technical Description	descri.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
Test Setup Photo	Conducted Emission	conducted photos.pdf
External Photos	External Photo	external photos.pdf
Internal Photos	Internal Photo	internal photos.pdf
ID Label/Location Info	Label Artwork and Location	label.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Users Manual	User Manual	manual.pdf
Cover Letter	Letter of Agency	agency.pdf
Cover Letter	Confidentiality Letter	request.pdf

EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

The equipment under test (EUT) is a 2.1 CH Soundbar with Wireless Subwoofer, with Bluetooth FHSS technology operating in 2402-2480MHz. The EUT is powered by AC 120V, 60Hz. The NFC tag is passive. For more detail information pls. refer to the user manual.

Bluetooth Version: 4.2 (without BLE)
Antenna Type: Integral antenna
Antenna Gain: 1 dBi
Modulation Type: GFSK, π/4-DQPSK and 8-DPSK

The Model: TB230WW, TB230DWW, TB231WW, TB231DWW, TB232WW, TB232DWW, TB234WW, TB234DWW, TB235WW, TB235DWW, TB236WW, TB238DWW, TB280WW, TB280DWW, TB281WW, TB281DWW, TB282WW, TB282DWW, TB341WW, TB341DWW,TB343WW, TB343DWW, TH-M337B are the same as the Model: TB236DWW in hardware aspect except partial functions are difference, pls. refer list as below. The models are difference in packaging and marketing purpose.

Model / Function	TB230WW	TB230DWW	TB231WW	TB231DWW	TB232WW	TB232DWW	TB234WW	TB234DWW
AUX	☐	☐	☐	☐	☐	☐	☐	☐
AUX 1	☑	☑	☑	☑	☑	☑	☑	☑
AUX 2	☑	☑	☑	☑	☑	☑	☑	☑
Optical	☑	☑	☑	☑	☑	☑	☑	☑
Coaxial	☑	☑	☑	☑	☑	☑	☑	☑
Bluetooth function	☑	☑	☑	☑	☑	☑	☑	☑
NFC	☑	☑	☑	☑	☑	☑	☑	☑
HDMI	☑	☑	☑	☑	☑	☑	☑	☑
HDMI ARC	☑	☑	☑	☑	☑	☑	☑	☑
USB PLAY	☑	☑	☑	☑	☑	☑	☑	☑
Wireless Subwoofer	☑	☑	☑	☑	☑	☑	☑	☑
Support Dolby	☐	☑	☐	☑	☐	☑	☐	☑
.Flat plastic side panel	☑	☑	☐	☐	☐	☐	☐	☐
Oval plastic side panel.	☐	☐	☑	☑	☑	☑	☑	☑
Small size speak grill and house	☑	☑	☑	☑	☐	☐	☐	☐
Bigger size speak grill and house	☐	☐	☐	☐	☑	☑	☑	☑

Model / Function	TB235WW	TB235DWW	TB236WW	TB236DWW	TB280WW	TB280DWW	TB281WW	TB281DWW
AUX	☐	☐	☐	☐	☐	☐	☐	☐
AUX 1	☑	☑	☑	☑	☑	☑	☑	☑
AUX 2	☑	☑	☑	☑	☑	☑	☑	☑
Optical	☑	☑	☑	☑	☑	☑	☑	☑
Coaxial	☑	☑	☑	☑	☑	☑	☑	☑
Bluetooth function	☑	☑	☑	☑	☑	☑	☑	☑
NFC	☑	☑	☑	☑	☑	☑	☑	☑
HDMI	☑	☑	☑	☑	☑	☑	☑	☑
HDMI ARC	☑	☑	☑	☑	☑	☑	☑	☑
USB PLAY	☑	☑	☑	☑	☑	☑	☑	☑
Wireless Subwoofer	☑	☑	☑	☑	☑	☑	☑	☑
Support Dolby	☐	☑	☐	☑	☐	☑	☐	☑
.Flat plastic side panel	☐	☐	☐	☐	☑	☑	☐	☐
Oval plastic side panel.	☑	☑	☑	☑	☐	☐	☑	☑
Small size speak grill and house	☐	☐	☐	☐	☐	☐	☐	☐
Bigger size speak grill and house	☑	☑	☑	☑	☑	☑	☑	☑

Model / Function	TB282WW	TB282DWW	TB341WW	TB341DWW	TB343WW	TB343DWW	TB238DWW	TH-M337B
AUX	☐	☐	☐	☐	☐	☐	☐	☑
AUX 1	☑	☑	☑	☑	☑	☑	☑	☐
AUX 2	☑	☑	☑	☑	☑	☑	☑	☐
Optical	☑	☑	☑	☑	☑	☑	☑	☑
Coaxial	☑	☑	☑	☑	☑	☑	☑	☑
Bluetooth function	☑	☑	☑	☑	☑	☑	☑	☑
NFC	☑	☑	☑	☑	☑	☑	☑	☐
HDMI	☑	☑	☑	☑	☑	☑	☐	☐
HDMI ARC	☑	☑	☑	☑	☑	☑	☑	☐
USB PLAY	☑	☑	☑	☑	☑	☑	☑	☑
Wireless Subwoofer	☑	☑	☑	☑	☑	☑	☑	☑
Support Dolby	☐	☑	☐	☑	☐	☑	☑	☑
.Flat plastic side panel	☐	☐	☐	☐	☐	☐	☐	☐
Oval plastic side panel.	☑	☑	☑	☑	☑	☑	☑	☑
Small size speak grill and house	☐	☐	☐	☐	☐	☐	☐	☐
Bigger size speak grill and house	☑	☑	☑	☑	☑	☑	☑	☑

Note: Symbol ☑ indicates with this function;
Symbol ☐ indicates without this function.

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

1.2 Related Submittal(s) Grants

This is an application for certification of transceiver for the 2.1 CH Soundbar with Wireless Subwoofer which has Bluetooth function (BT4.2 single mode), and the 2.4GHz transmitter function is subject to the report 170908004SZN-002. For the other functions were tested and demonstrated in report 170908004SZN-003.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10: 2013 and DA 00-705. Radiated emission measurement was performed in semi-anechoic chamber. 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.

1.4 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 1F/2F, Building B, QiaoAn Scientific Technology Park, Shangkeng Community, Guanhu Subdistrict, Longhua District, Shenzhen, P.R. China. This test facility and site measurement data have been fully placed on file with File Number: CN1188.

EXHIBIT 2

SYSTEM TEST CONFIGURATION

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 EUT was powered by AC 120V, 60Hz during the test.

All packets DH1, DH3 & DH5 mode in modulation type GFSK, π/4-DQPSK and 8-DPSK were tested and simultaneously transmitting with 2.4G module was considered, only the worst data was reported in this report.

All kinds of models were tested respectively, only the worst data was reported in this report.

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 was 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.

2.2 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.

2.3 Special Accessories

No special accessory attached.

2.4 Equipment Modification

Any modifications installed previous to testing by Zhongshan 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.

2.5 Measurement Uncertainty

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

2.6 Support Equipment List and Description

Description	Manufacturer	Model No.
iPod	Apple	A1446
Audio In Cable	N/A	Unshielded, Length 120cm
HDMI In Cable *3	N/A	Unshielded, Length 150cm
USB Disk	TOSHIBA	UHYBS-004G-BL
Detached AC power cord	Richsound	Unshielded, Length 150cm
Optical Cable with Load	N/A	Unshielded, Length 120cm
Coaxial Cable	N/A	Unshielded, Length 120cm
Dummy Load	N/A	N/A
Remote Controller	Richsound	N/A

EXHIBIT 3

TEST RESULTS

3.0 Test Results

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

3.1 Radiated Test Results

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

3.1.1 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 + (-10) = 32 dBµV/m

Level in µV/m = Common Antilogarithm [(32 dBµV/m)/20] = 39.8 µV/m

3.1.2 Radiated Emission Configuration Photograph

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

3.1.3 Radiated Emissions- FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Simultaneous transmission spurious was considered. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 39.700 MHz

Judgement: Passed by 7.3 dB

TEST PERSONNEL:

Sign on file

Powell Bao, Engineer
Typed/Printed Name

September 11, 2017
Date

Applicant: Zhongshan City Richsound Electronic Industrial Ltd. Date of Test: September 11, 2017
Model: TB236DWW
Sample: 1/1
Worst-case operating Mode: Transmit (CH00)
Modulation type: GFSK

Table 1

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	173.560	38.6	20.0	10.9	29.5	43.5	-14.0
Horizontal	281.715	40.1	20.0	14.6	34.7	46.0	-11.3
Horizontal	492.205	34.2	20.0	19.9	34.1	46.0	-11.9
Vertical	39.700	45.4	20.0	7.3	32.7	40.0	-7.3
Vertical	231.275	27.6	20.0	19.2	26.8	46.0	-19.2
Vertical	895.240	40.0	20.0	13.0	33.0	46.0	-13.0

NOTES:
1. Quasi-Peak detector is used except for others 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 value in the margin column shows emission below limit.
4. All emissions are below the QP limit.

3.1.4 Transmitter Spurious Emissions (Radiated) - FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Simultaneous transmission spurious was considered. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 7440.000 MHz

Judgement: Passed by 17.6 dB

TEST PERSONNEL:

Sign on file

Powell Bao, Engineer
Typed/Printed Name

September 11, 2017
Date

Applicant: Zhongshan City Richsound Electronic Industrial Ltd. Date of Test: September 11, 2017
Model: TB236DWW
Sample: 1/1
Worst-case operating Mode: Transmit (2402 MHz)
Modulation type: GFSK

Table 2

Radiated Emissions

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)
Horizontal	**2402.000	103.2	36.7	28.1	94.6	--	--
Horizontal	*4804.000	53.7	36.1	35.5	53.1	74.0	-20.9

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)
Horizontal	**2402.000	103.2	36.7	28.1	22.5	72.1	--	--
Horizontal	*4804.000	53.7	36.1	35.5	22.5	30.6	54.0	-23.4

NOTES: 1. Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

** Fundamental emission was measured for determining band-edge compliance of using delta measurement technique.

Applicant: Zhongshan City Richsound Electronic Industrial Ltd. Date of Test: September 11, 2017
Model: TB236DWW
Sample: 1/1
Worst-case operating Mode: Transmit (2441 MHz)
Modulation type: GFSK

Table 3

Radiated Emissions

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)
Horizontal	*4882.000	54.2	36.1	35.5	53.6	74.0	-20.4
Horizontal	*7323.000	55.4	36.2	37.9	57.1	74.0	-16.9

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)
Horizontal	*4882.000	54.2	36.1	35.5	22.5	31.1	54.0	-22.9
Horizontal	*7323.000	55.4	36.2	37.9	22.5	34.6	54.0	-19.4

NOTES: 1. Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Applicant: Zhongshan City Richsound Electronic Industrial Ltd. Date of Test: September 11, 2017
Model: TB236DWW
Sample: 1/1
Worst-case operating Mode: Transmit (2480 MHz)
Modulation type: GFSK

Table 4

Radiated Emissions

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)
Horizontal	**2480.000	103.4	36.7	28.1	94.8	--	--
Horizontal	*4960.000	53.5	36.1	35.5	52.9	74.0	-21.1
Horizontal	*7440.000	54.8	36.2	38.2	56.8	74.0	-17.2

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	*4960.000	53.5	36.1	35.5	22.5	30.4	54.0	-23.6
Vertical	*7440.000	54.8	36.2	38.2	22.5	34.3	54.0	-19.7

NOTES: 1. Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

** Fundamental emission was measured for determining band-edge compliance of using delta measurement technique.

3.2 Conducted Emission at Mains Terminal

3.2.1 Conducted Emissions Configuration Photograph

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

3.2.2 Conducted Emissions

Worst Case Conducted Configuration

at 0.402 MHz

Judgement: Passed by 10.7 dB margin

TEST PERSONNEL:

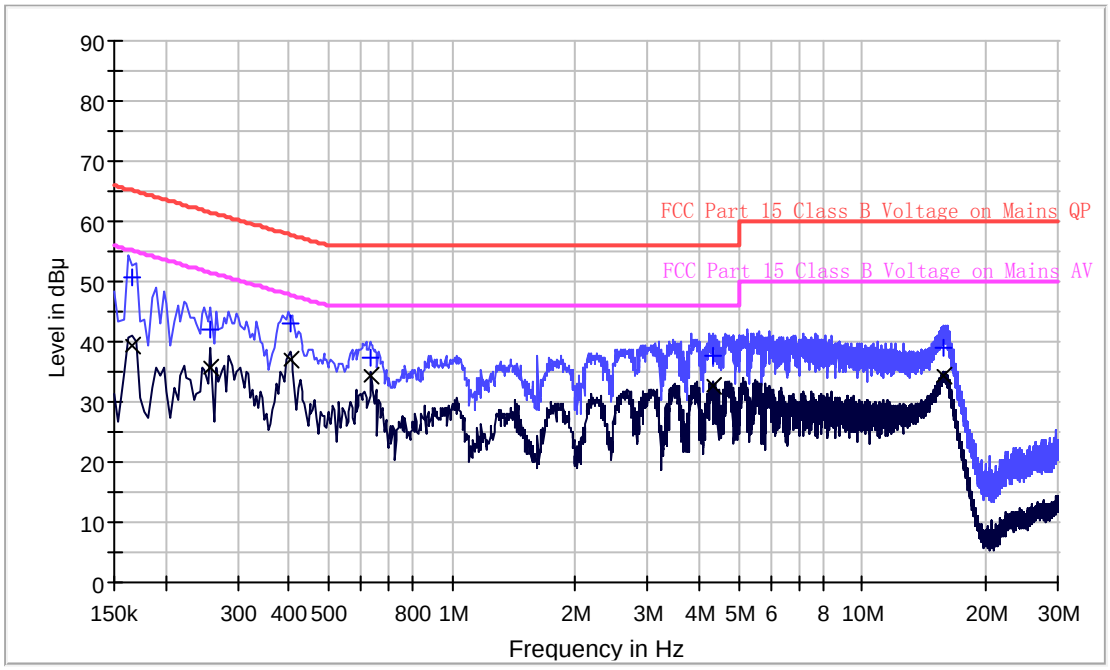
Sign on file

Powell Bao, Engineer
Typed/Printed Name

September 11, 2017
Date

Applicant: Zhongshan City Richsound Electronic Industrial Ltd. Date of Test: September 11, 2017
Model: TB236DWW
Sample: 1/1
Worst-case operating Mode: Transmit (CH00)
Modulation type: GFSK

Conducted Emission Test - FCC



Result Table QP

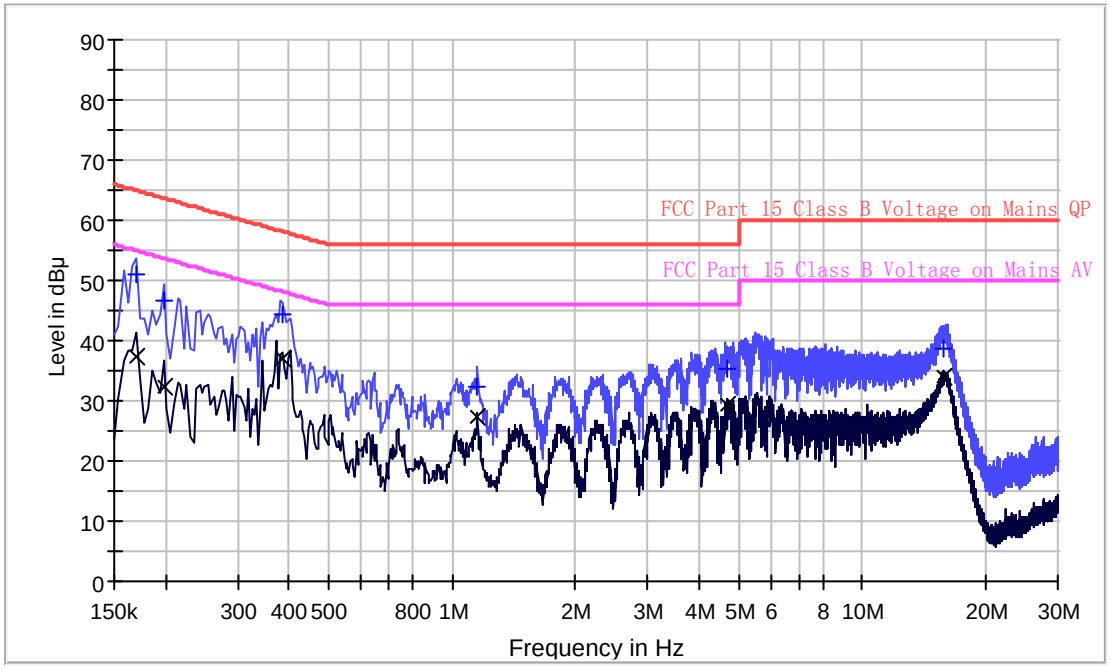
Frequency (MHz)	QuasiPeak (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.166	50.5	L1	9.6	14.7	65.2
0.258	42.1	L1	9.7	19.4	61.5
0.402	43.0	L1	9.7	14.8	57.8
0.634	37.3	L1	9.7	18.7	56.0
4.330	37.8	L1	9.8	18.2	56.0
15.810	38.9	L1	10.1	21.1	60.0

Result Table AV

Frequency (MHz)	Average (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.166	39.2	L1	9.6	16.0	55.2
0.258	35.6	L1	9.7	15.9	51.5
0.402	37.1	L1	9.7	10.7	47.8
0.634	34.4	L1	9.7	11.6	46.0
4.330	32.8	L1	9.8	13.2	46.0
15.810	34.3	L1	10.1	15.7	50.0

Applicant: Zhongshan City Richsound Electronic Industrial Ltd. Date of Test: September 11, 2017
Model: TB236DWW
Sample: 1/1
Worst-case operating Mode: Transmit (CH00)
Modulation type: GFSK

Conducted Emission Test - FCC



Result Table QP

Frequency (MHz)	QuasiPeak (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.170	51.0	N	9.6	14.0	65.0
0.198	46.6	N	9.7	17.1	63.7
0.386	44.3	N	9.7	13.8	58.1
1.154	32.5	N	9.7	23.5	56.0
4.706	35.4	N	9.8	20.6	56.0
15.818	38.6	N	10.1	21.4	60.0

Result Table AV

Frequency (MHz)	Average (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.170	37.4	N	9.6	17.6	55.0
0.198	32.4	N	9.7	21.3	53.7
0.386	37.0	N	9.7	11.1	48.1
1.154	27.4	N	9.7	18.6	46.0
4.706	29.2	N	9.8	16.8	46.0
15.818	34.0	N	10.1	16.0	50.0

3.3 Peak Power

Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(1). The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for RBW > 20dB bandwidth and power was read directly in dBm.

For antenna with gains of 6dBi or less, and frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, the systems operate with an output power no greater than 125 mW.

Antenna Gain = 1dBi			
Modulation Type	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
GFSK	2402	-4.53	0.352
	2441	-5.00	0.316
	2480	-4.73	0.337

Cable loss: 2.0 dB External Attenuation: 0 dB

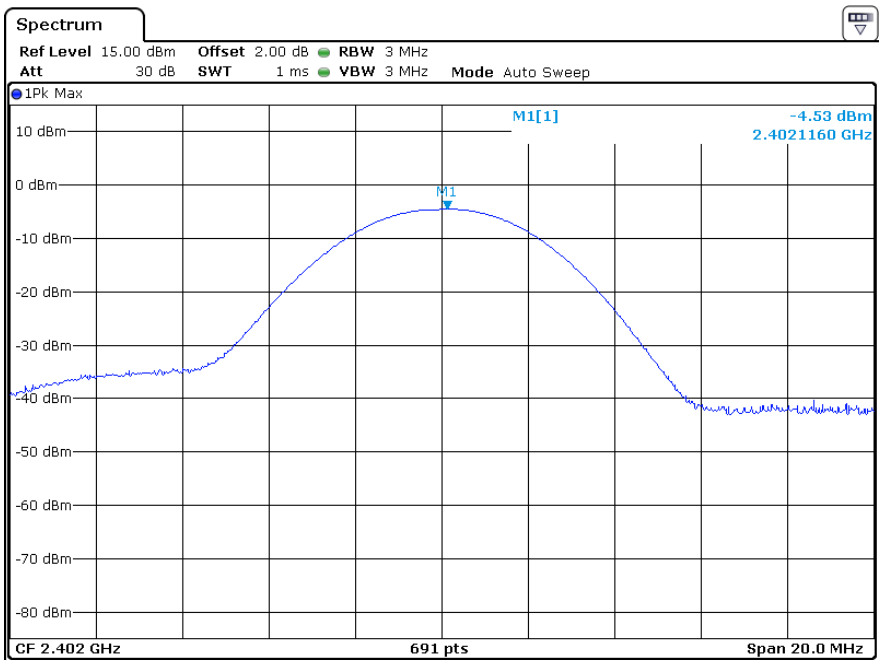
Cable Loss, External attenuation has been included in OFF SET function.

EUT max. output level = -4.53dBm
EuT max. radiated power = -4.53dBm +1dBi= -3.53dBm

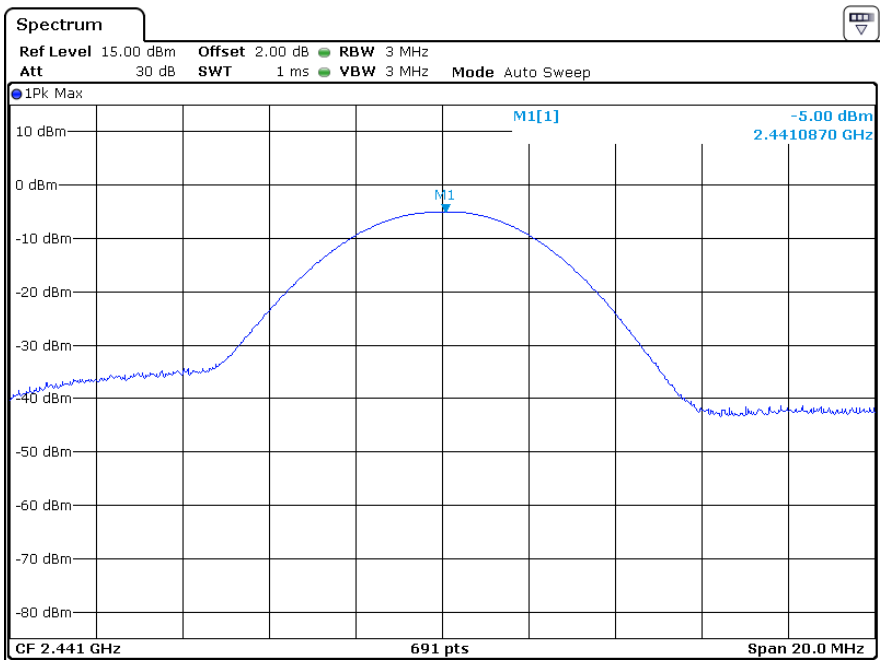
For RF exposure, the information is saved with filename: RF exposure.pdf.

Modulation Type: GFSK

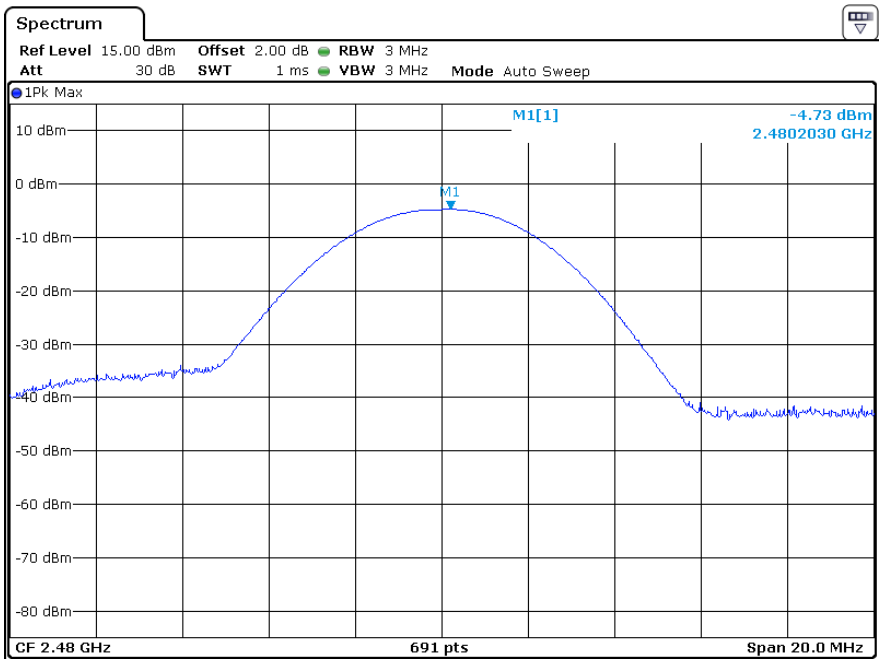
CH00



CH39



CH78


Spectrum
Ref Level 15.00 dBm
Offset 2.00 dB
RBW 3 MHz
Att 30 dB
SWT 1 ms
VBW 3 MHz
Mode Auto Sweep
1Pk Max
M1[1]
-4.73 dBm
2.4802030 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
CF 2.48 GHz
691 pts
Span 20.0 MHz

3.4 20dB Bandwidth

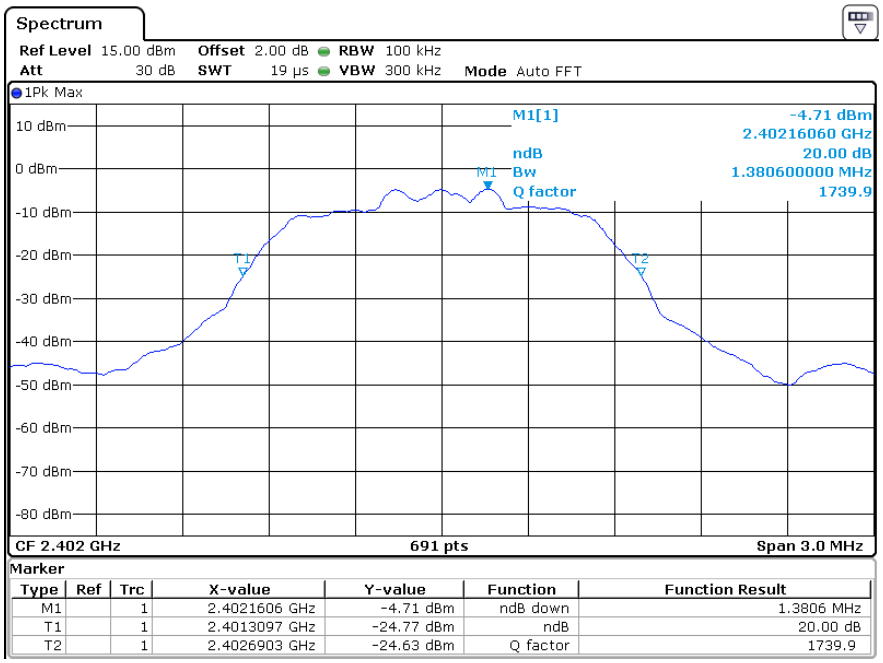
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

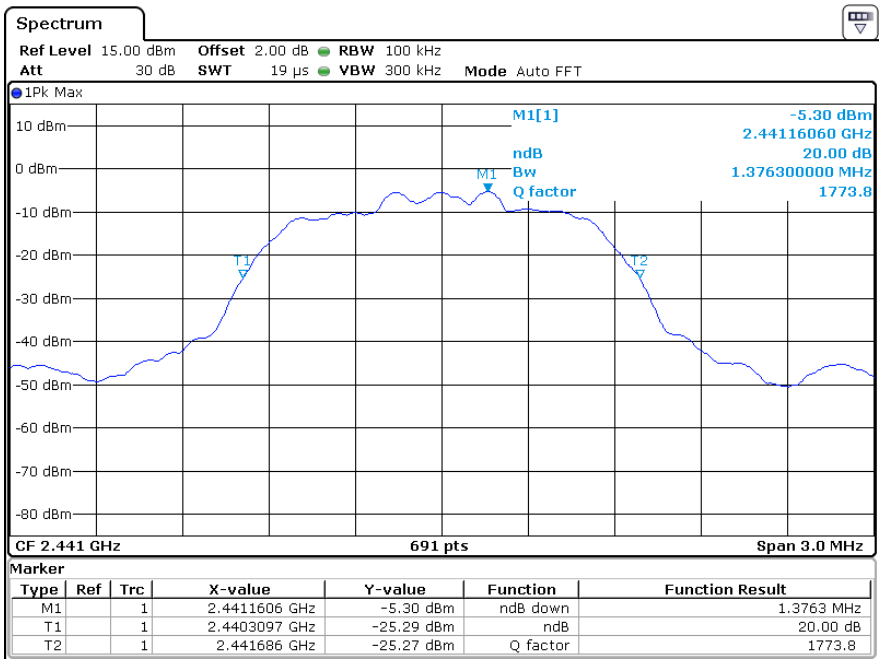
Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.381
2441	1.376
2480	1.376

Modulation Type: π/4-DQPSK

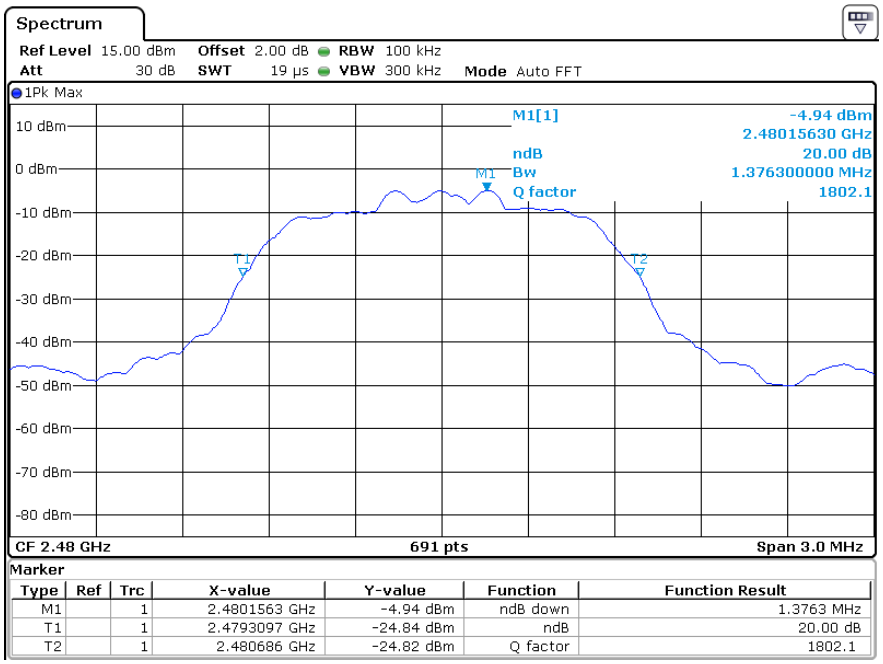
CH00



CH39


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -5.30 dBm
2.44116060 GHz
ndB 20.00 dB
Bw 1.376300000 MHz
Q factor 1773.8
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
T1
T2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4411606 GHz -5.30 dBm ndB down 1.3763 MHz
T1 1 2.4403097 GHz -25.29 dBm ndB 20.00 dB
T2 1 2.441686 GHz -25.27 dBm Q factor 1773.8

CH78


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -4.94 dBm
2.48015630 GHz
ndB 20.00 dB
Bw 1.376300000 MHz
Q factor 1802.1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
T1
T2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4801563 GHz -4.94 dBm ndB down 1.3763 MHz
T1 1 2.4793097 GHz -24.84 dBm ndB 20.00 dB
T2 1 2.480686 GHz -24.82 dBm Q factor 1802.1

3.5 Channel Number (Number of Hopping Frequencies)

Minimum Number of Hopping Frequencies, FCC Rule 15.247(a) (1) (iii):

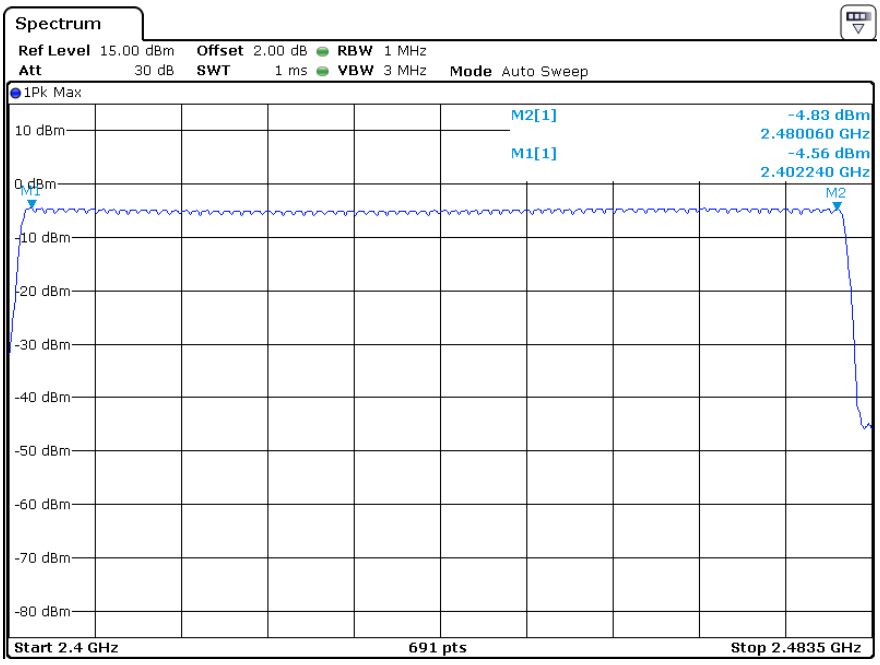
The RF passband of the EUT was divided into 3 approximately equal bands. With the analyzer set to MAX HOLD readings were taken for 2-3 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

Number of hopping channels =	79

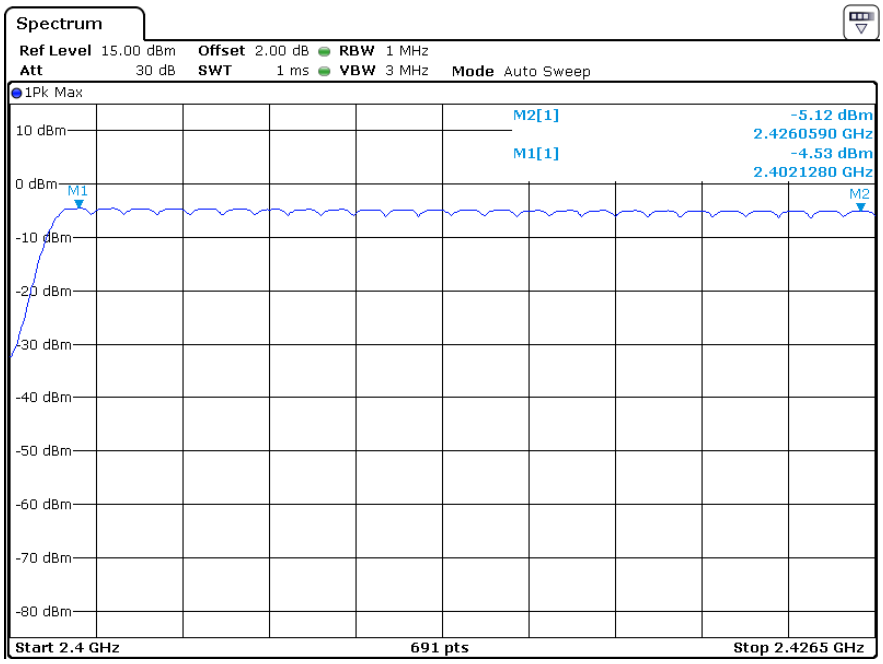
Note: In AFH mode, this device operates using 20 channels and it's satisfied the requirement of limit of minimum of 15 hopping channels.

Modulation Type: GFSK

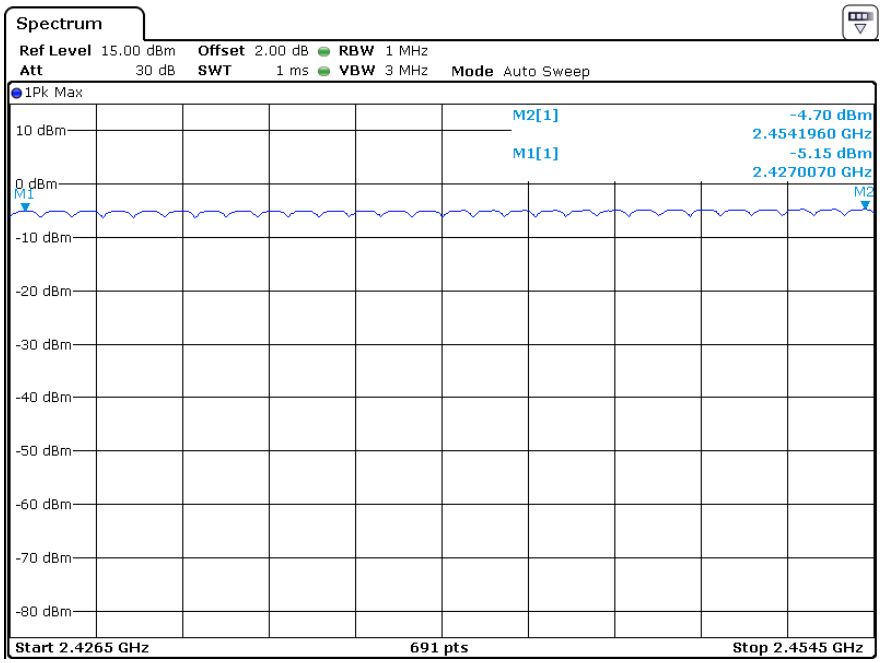
CH00-CH78



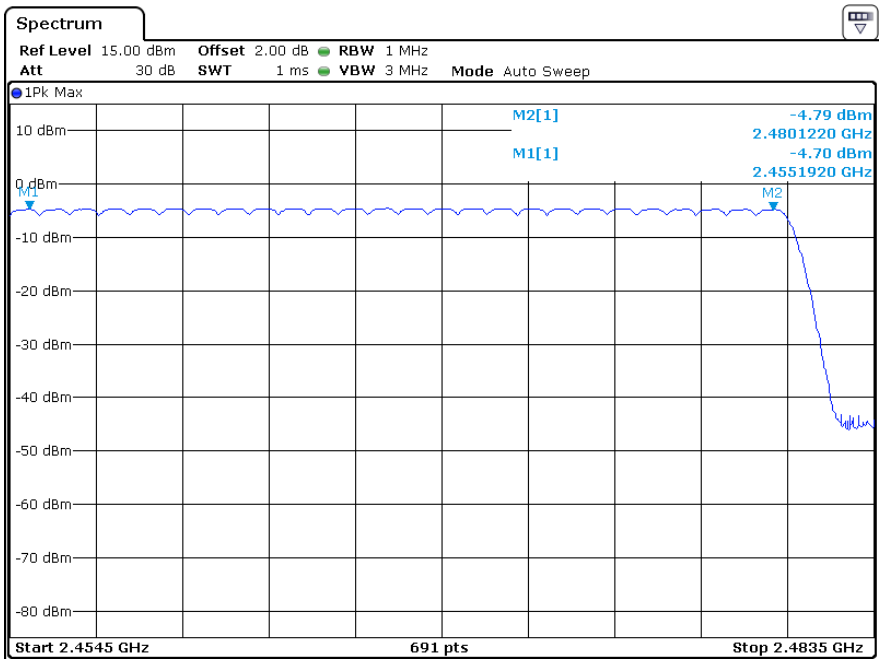
CH00-CH24



CH25-CH52



CH53-CH78


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 1 MHz
Att 30 dB SWT 1 ms VBW 3 MHz Mode Auto Sweep
1Pk Max
M2[1] -4.79 dBm
2.4801220 GHz
M1[1] -4.70 dBm
2.4551920 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
M2
Start 2.4545 GHz
691 pts
Stop 2.4835 GHz

3.6 Channel Separation (Carrier Frequency Separation)

Minimum Hopping Channel Carrier Frequency Separation, FCC Ref: 15.247(a)(1):

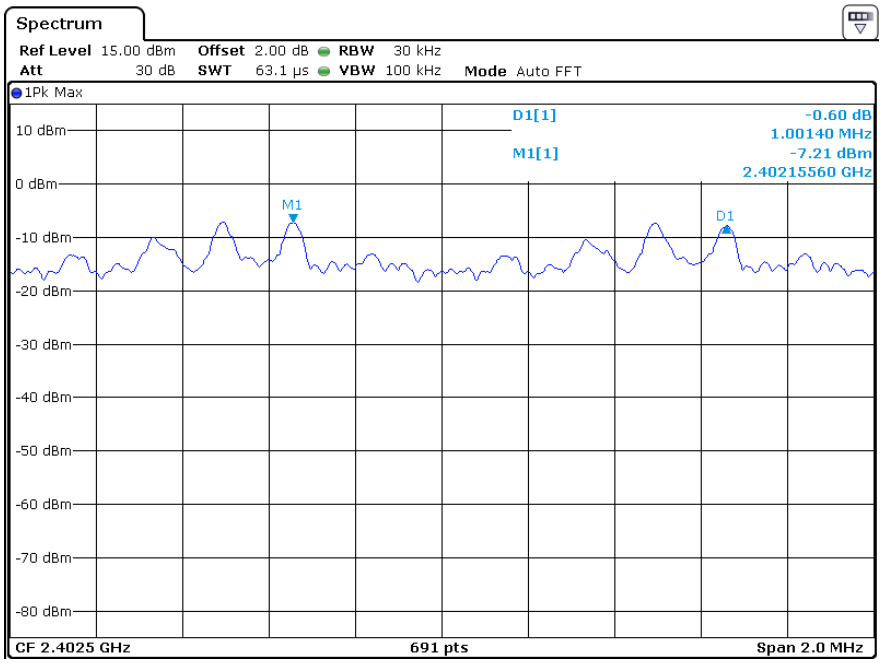
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: 1.381 x 2/3 = 0.921MHz

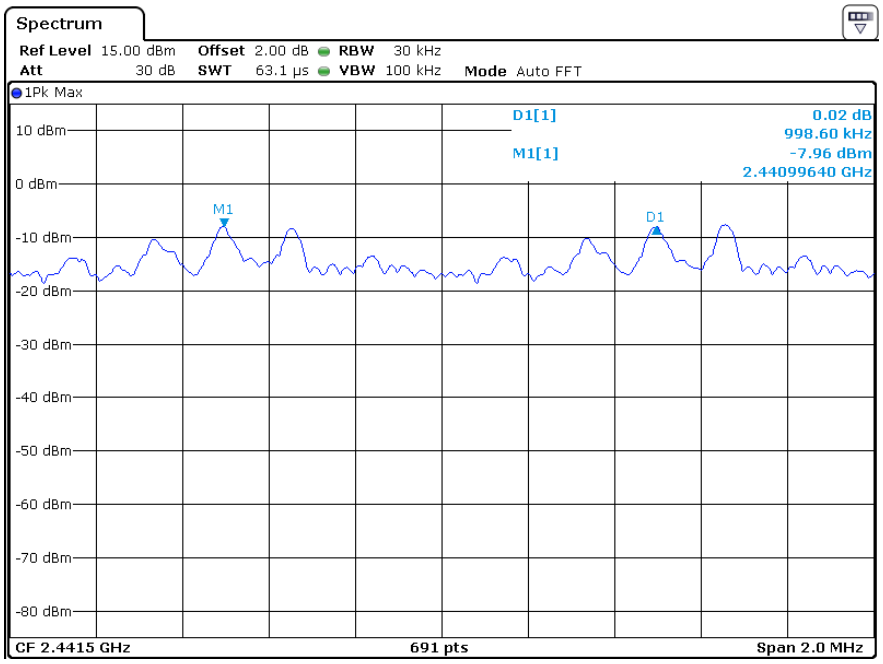
Minimum Channel Separation	0.9986 MHz

Modulation Type: π/4-DQPSK

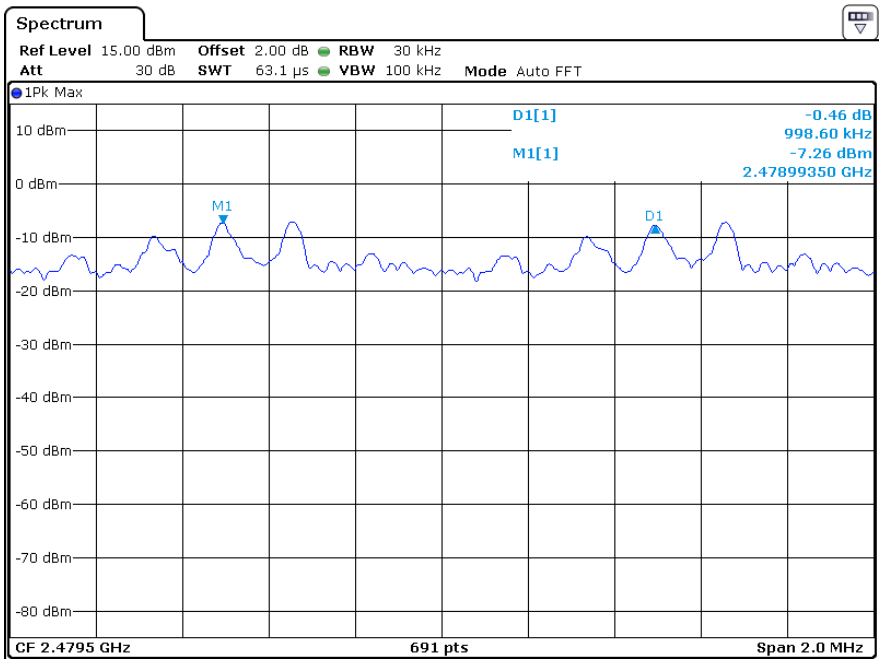
Low Channel



Middle Channel



High Channel



3.7 Dwell Time (Time of Occupancy)

Average Channel Occupancy Time, FCC Ref: 15.247(a)(1)(iii):

The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 10ms, the SPAN was set to ZERO SPAN, and the TRIGGER was set to VIDEO. The time duration of the transmissions so captured was measured with the MARKER DELTA function.

The maximum number of hopping channels in 31.6s for 2DH1
=1600 / 2 / 79 *31.6=320

The maximum number of hopping channels in 31.6s for 2DH3
=1600 / 4 / 79 *31.6=160

The maximum number of hopping channels in 31.6s for 2DH5
=1600 / 6 / 79 *31.6=107

Modulation Type	Packet	Max Dwell Time				Limit (s)	Result
π/4-DQPSK	2DH1	0.393	ms * 320=	125.76	ms	0.4	Pass
	2DH3	1.646	ms * 160=	263.36	ms	0.4	Pass
	2DH5	2.899	ms * 107=	310.19	ms	0.4	Pass

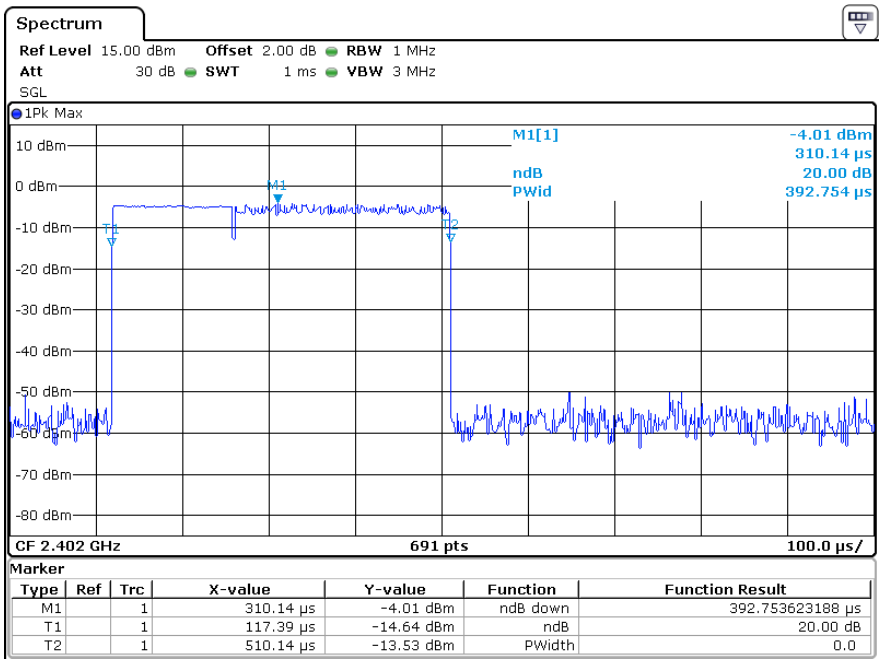
AFH mode:
The maximum number of hopping channels in 8s for 2DH1
=800 / 2 / 20 *8=160

The maximum number of hopping channels in 8s for 2DH3
=800 / 4 / 20 *8=80

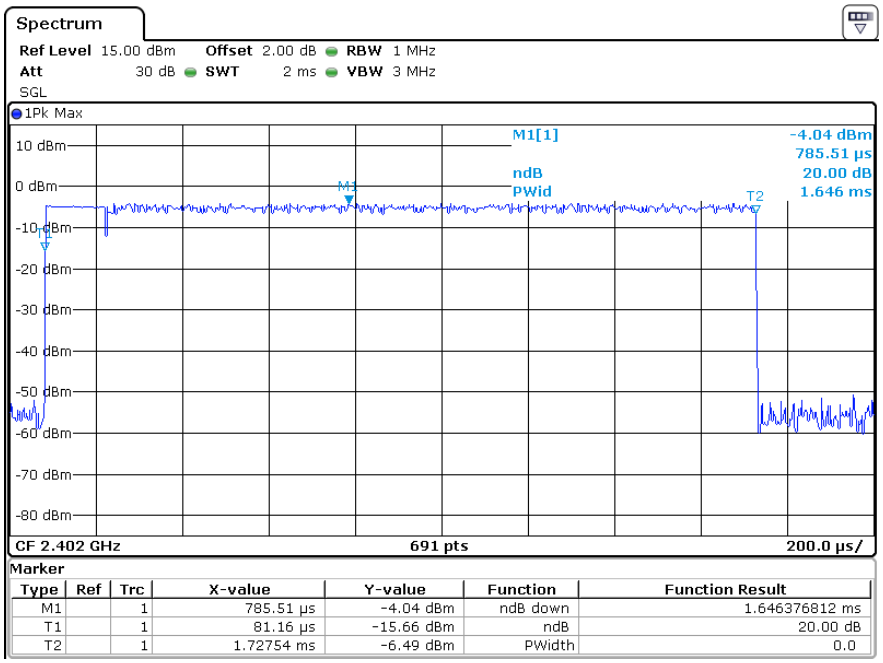
The maximum number of hopping channels in 8s for 2DH5
=800 / 6 / 20 *8=53.33

Modulation Type	Packet	Max Dwell Time				Limit (s)	Result
π/4-DQPSK	2DH1	0.393	ms * 160=	62.88	ms	0.4	Pass
	2DH3	1.646	ms * 80=	131.68	ms	0.4	Pass
	2DH5	2.899	ms * 53.33=	154.60	ms	0.4	Pass

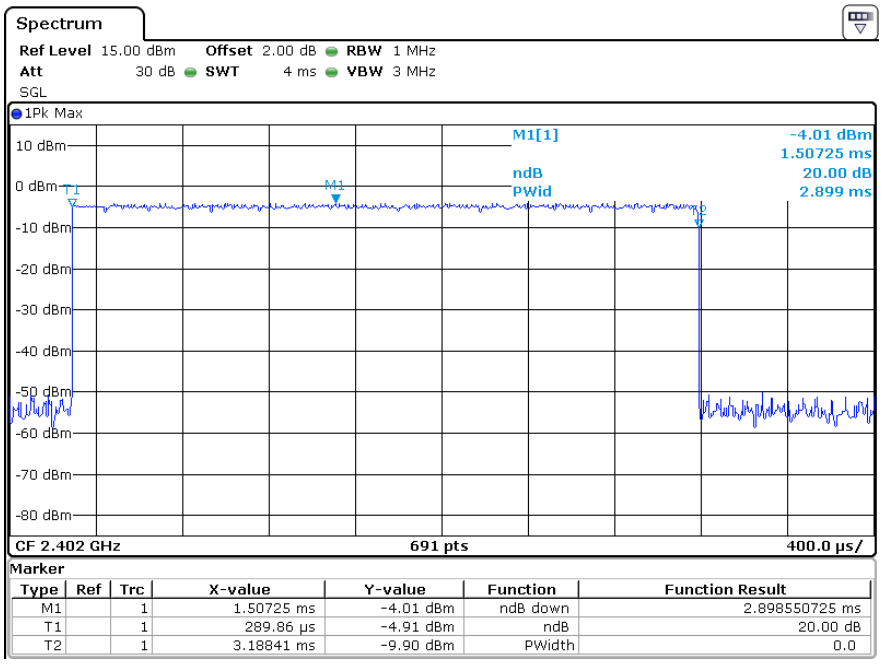
Modulation Type: π/4-DQPSK
Packet: 2DH1



Packet: 2DH3



Packet: 2DH5


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 1 MHz
Att 30 dB SWT 4 ms VBW 3 MHz
SGL
1Pk Max
M1[1]
-4.01 dBm
1.50725 ms
ndB 20.00 dB
PWid 2.899 ms
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
691 pts
400.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 1.50725 ms -4.01 dBm ndB down 2.898550725 ms
T1 1 289.86 µs -4.91 dBm ndB 20.00 dB
T2 1 3.18841 ms -9.90 dBm PWidth 0.0

3.8 Band Edge

Out of Band Conducted Emissions, FCC Rule 15.247(d):

In any 100 KHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

Furthermore, delta measurement technique for measuring bandage emissions was shown as below:

(i) Lower channel 2402MHz:

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 94.6dBµv/m-32.5dB
= 62.1dBµv/m

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

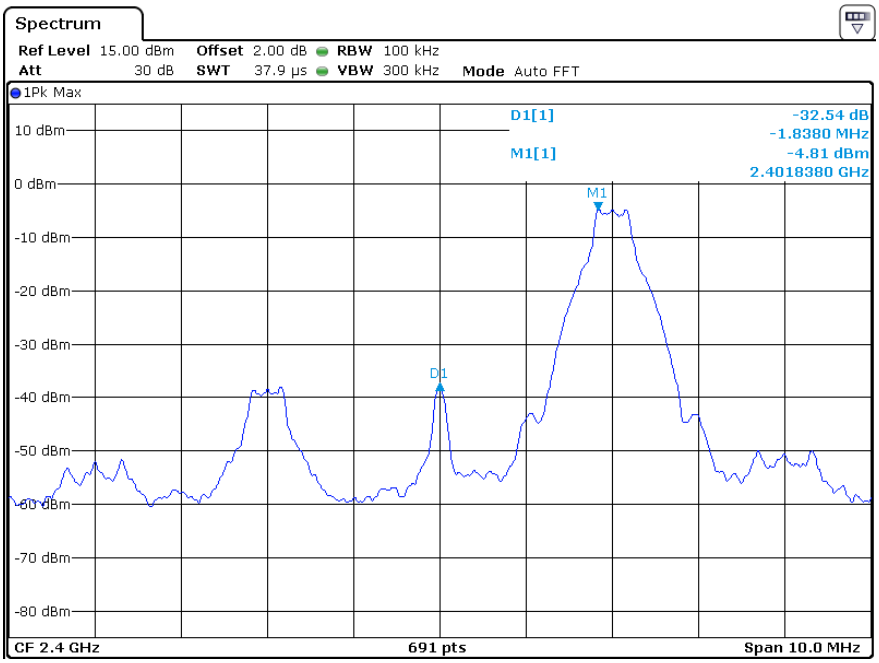
= 72.1 dBµV/m–32.5dB
= 39.6 dBµV/m

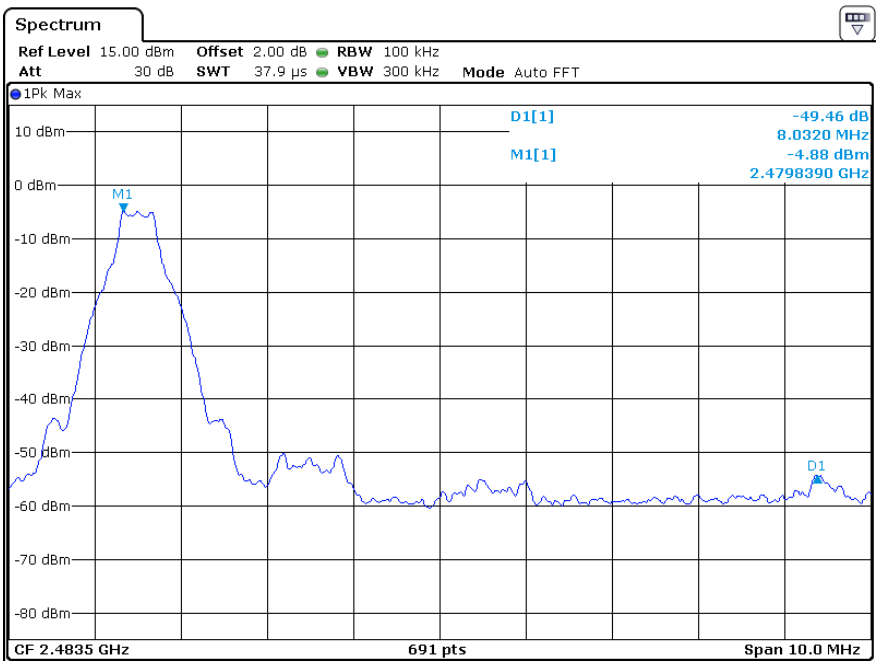
(ii) Upper channel 2480MHz:

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 94.8dBµv/m-49.5dB
= 45.3dBµv/m

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

Modulation Type: GFSK





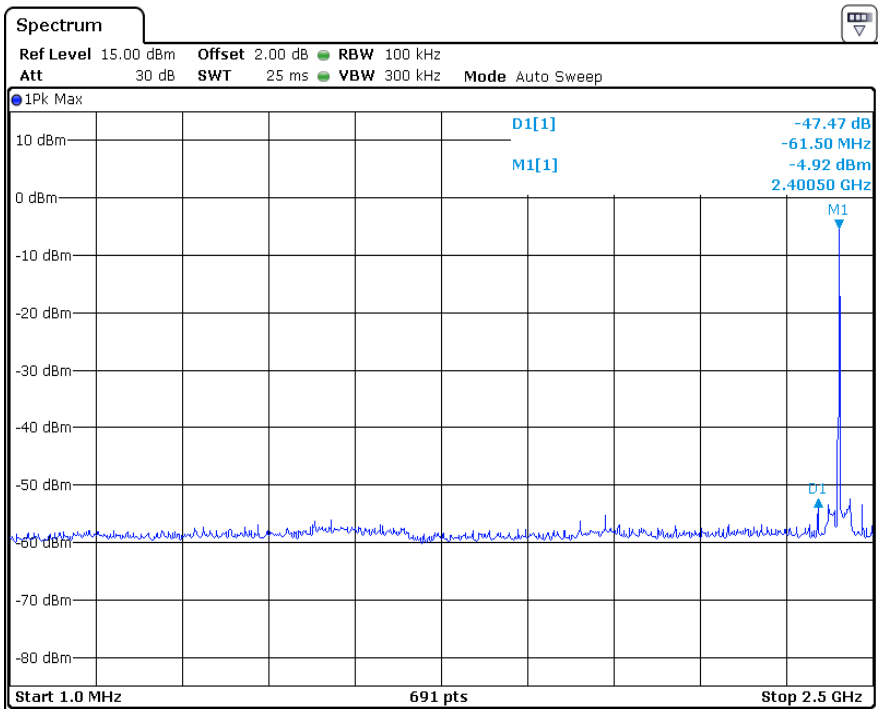
3.9 Transmitter Spurious Emissions (Conducted)

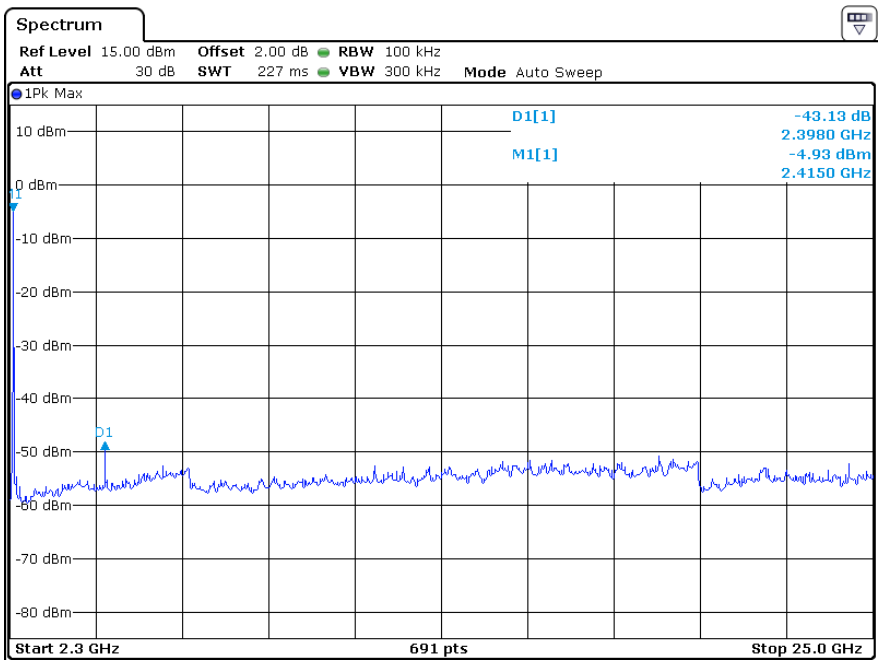
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

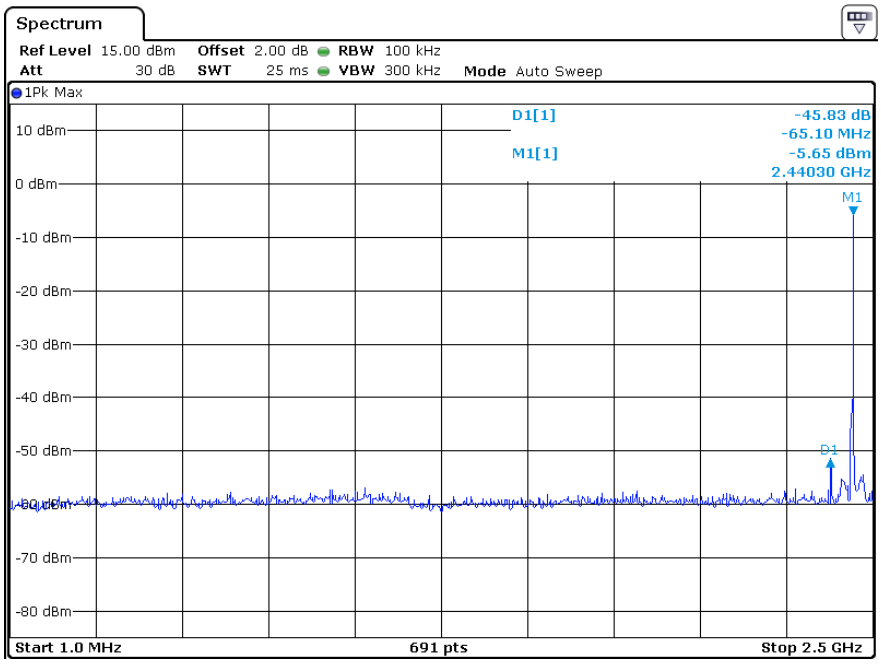
Modulation Type: GFSK

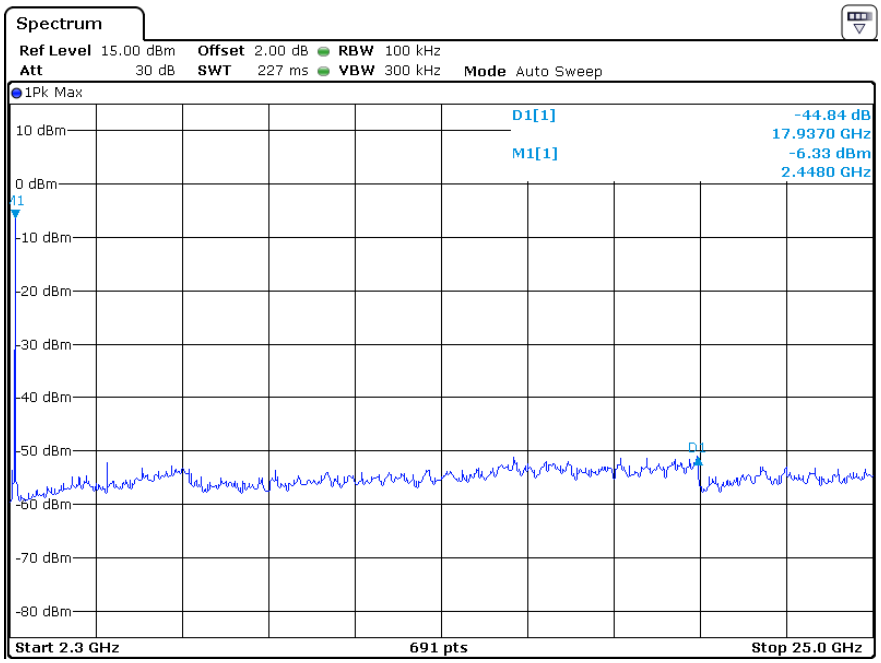
CH00



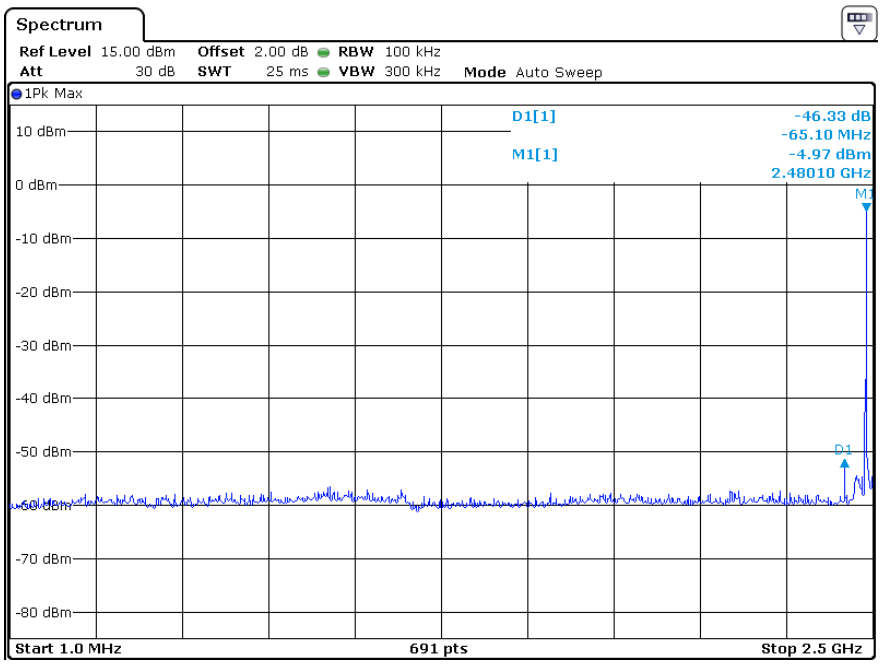


CH39


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -45.83 dB
-65.10 MHz
M1[1] -5.65 dBm
2.44030 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
Start 1.0 MHz
691 pts
Stop 2.5 GHz


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -44.84 dB
17.9370 GHz
M1[1] -6.33 dBm
2.4480 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
Start 2.3 GHz
691 pts
Stop 25.0 GHz

CH78


Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -46.33 dB
-65.10 MHz
M1[1] -4.97 dBm
2.48010 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
-80 dBm
Start 1.0 MHz
691 pts
Stop 2.5 GHz

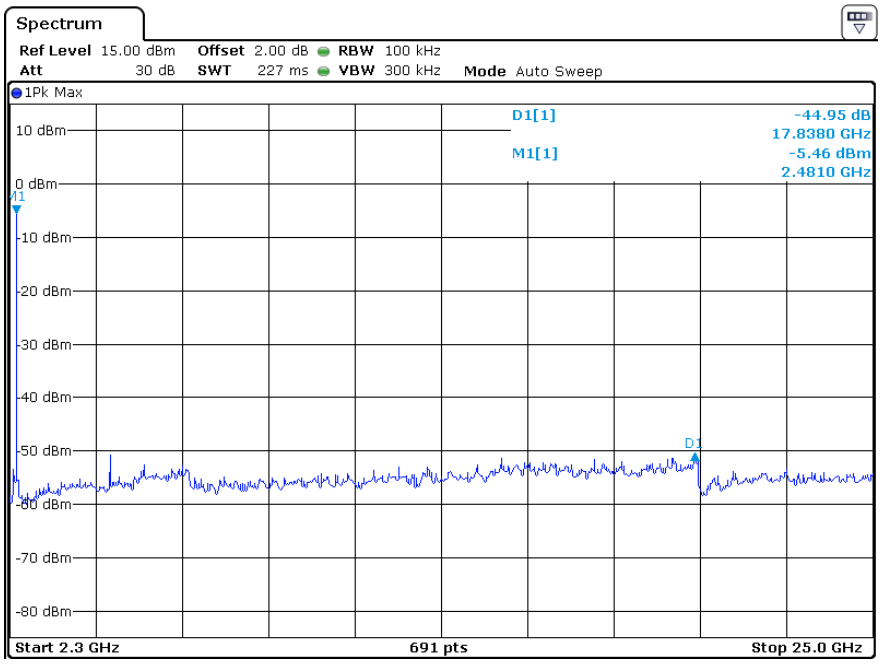

Spectrum
Ref Level 15.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -44.95 dB
17.8380 GHz
M1[1] -5.46 dBm
2.4810 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
-80 dBm
Start 2.3 GHz
691 pts
Stop 25.0 GHz

EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

4.0 Equipment Photographs

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

EXHIBIT 5

PRODUCT LABELLING

5.0 Product Labelling

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

EXHIBIT 6

TECHNICAL SPECIFICATIONS

6.0 Technical Specifications

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

EXHIBIT 7

INSTRUCTION MANUAL

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.

EXHIBIT 8

MISCELLANEOUS INFORMATION

8.0 Miscellaneous Information

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

8.1 Discussion of Pulse Desensitization

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

8.2 Transmitter Duty Cycle Calculation, FCC Rule 15.35(b, c)

Based on the Bluetooth Specification, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length (single-slot and multi-slot). The maximum transmitter ON time for the Bluetooth is 625µs.

Each TX and RX time slot is 625µs in length. A TDD scheme is used where master and slave alternately transmit. For one period for a pseudo-random hopping through all 79 RF channels, for DH5:

Normal Mode:
Channel hop rate=1600 hops/second
Time of 1 hopset (5 TX slots + 1 RX slot) = 0.625 ms x 6 = 3.75 ms
Time of 1 cycle =3.75 ms x 79 = 296.25 ms
Average factor = 20 log (3.125 / 100) = -30.1 dB

AFH Mode:
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

8.3 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, up to 1GHz 0.8m and above 1GHz 1.5m 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.

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 with RBW 9KHz used.

8.3 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.

EXHIBIT 9

CONFIDENTIALITY REQUEST

9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.

EXHIBIT 10

TEST EQUIPMENT LIST

10 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-03	BiConiLog Antenna	ETS	3142C	00078828	12-Oct-2016	12-Oct-2017
SZ185-01	EMI Receiver	R&S	ESCI	100547	9-Feb-2017	9-Feb-2018
SZ061-08	Horn Antenna	ETS	3115	00092346	27-Oct-2016	27-Oct-2017
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	26-May-2017	26-May-2018
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	7-Jul-2017	7-Jul-2018
EM031-03	Spectrum Analyzer	R&S	FSV 40	101506	9-Feb-2017	9-Feb-2018
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	16-Apr-2016	16-Apr-2018
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	8-Jul-2017	8-Jan-2018
SZ062-02	RF Cable	RADIALL	RG 213U	--	16-Mar-2017	16-Sep-2017
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	16-Mar-2017	16-Sep-2017
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	14-Jun-2017	14-Jun-2018
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	1-Nov-2016	1-Nov-2017
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	1-Nov-2016	1-Nov-2017
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	12-Jul-2017	12-Jul-2018
SZ187-02	Two-Line V-Network	R&S	ENV216	100073	12-Jul-2017	12-Jul-2018
SZ188-03	Shielding Room	ETS	RFD-100	4100	17-Aug-2016	17-Aug-2018