Zhong Shan City Richsound Electronic Industrial Ltd.

Application
For
Certification

FCC ID: Z8M-TT366

2.1 CH TV SoundStand
Additional name: Stereo 2.1 Bluetooth Soundbase

Model: TT366
Additional Models: TT360, TT360K, TT390, TT390K, HG02955-US

2.4GHz Transceiver

Report No.: 170725127GZU-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 [10-1-15]

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: June 22, 2017

TRF No.: FCC 15C_TX_c

LIST OF EXHIBITS

MEASUREMENT/TECHNICAL REPORT

Zhong Shan City Richsound Electronic Industrial Ltd.

Model: TT366

FCC ID: Z8M-TT366

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 [10-1-15 Edition] provision.

Report prepared by:

Powell Bao
Intertek Testing Services Shenzhen Ltd.
Guangzhou Branch
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Tel / Fax: 86-20-8213 9688/86-20-3205 7538

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Test Report	Test Report	report.pdf
Operational Description	Technical Description	descri.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
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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 TV SoundStand with Bluetooth FHSS technology operating in 2402-2480MHz. The EUT is powered by AC 120V, 60Hz, 30W. For more detail information pls. refer to the user manual.

Bluetooth Version: 4.2
Antenna Type: Integral antenna
Antenna Gain: 1 dBi
Modulation Type: GFSK, π/4-DQPSK and 8-DPSK

The Model: TT360, TT360K, TT390, TT390K, HG02955-US are the same as the Model: TT366 in hardware and electrical aspect. The difference in model number and trademark serves as packaging and marketing purpose only.

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 TV SoundStand which has Bluetooth function, and for the other function was tested and demonstrated in report 170725127GZU-002.

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 used to collect the radiated data is **EMTEK (Shenzhen) Co., Ltd.** and located at Bldg. 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, 518052, China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: 406365).

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 AC120V, 60Hz during the test.

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, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The rear of unit shall be flushed with the rear of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was 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 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 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. Guangzhou 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	N/A	Unshielded, Length 180cm
USB Cable	N/A	Unshielded, Length 120cm
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

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. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 320.010 MHz

Judgement: Passed by 3.0 dB

TEST PERSONNEL:

Sign on file

Powell Bao, Engineer
Typed/Printed Name

May 27, 2017
Date

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: May 27, 2017
Model: TT366
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	240.005	41.8	20.0	10.9	32.7	46.0	-13.3
Horizontal	320.010	48.4	20.0	14.6	43.0	46.0	-3.0
Horizontal	800.180	35.0	20.0	19.9	34.9	46.0	-11.1
Vertical	319.999	45.3	20.0	7.3	32.6	46.0	-13.4
Vertical	560.105	31.6	20.0	19.2	30.8	46.0	-15.2
Vertical	720.155	41.9	20.0	13.0	34.9	46.0	-11.1

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. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 7440.000 MHz

Judgement: Passed by 16.6 dB

TEST PERSONNEL:

Sign on file

Powell Bao, Engineer
Typed/Printed Name

May 27, 2017
Date

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: May 27, 2017
Model: TT366
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	101.4	36.7	28.1	92.8	--	--
Horizontal	*4804.000	55.8	36.1	35.5	55.2	74.0	-18.8

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	101.4	36.7	28.1	22.5	70.3	--	--
Horizontal	*4804.000	55.8	36.1	35.5	22.5	32.7	54.0	-21.3

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: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: May 27, 2017
Model: TT366
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	55.6	36.1	35.5	55.0	74.0	-19.0
Horizontal	*7323.000	55.5	36.2	37.9	57.2	74.0	-16.8

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	55.6	36.1	35.5	22.5	32.5	54.0	-21.5
Horizontal	*7323.000	55.5	36.2	37.9	22.5	34.7	54.0	-19.3

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: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: May 27, 2017
Model: TT366
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	98.7	36.7	28.1	90.1	--	--
Horizontal	*4960.000	54.7	36.1	35.5	54.1	74.0	-19.9
Horizontal	*7440.000	55.4	36.2	38.2	57.4	74.0	-16.6

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	**2480.000	98.7	36.7	28.1	22.5	67.6	--	--
Horizontal	*4960.000	54.7	36.1	35.5	22.5	31.6	54.0	-22.4
Horizontal	*7440.000	55.4	36.2	38.2	22.5	34.9	54.0	-19.1

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 Live-Conducted Configuration
At

0.374 MHz

Judgement: Passed by 17.1 dB margin

TEST PERSONNEL:

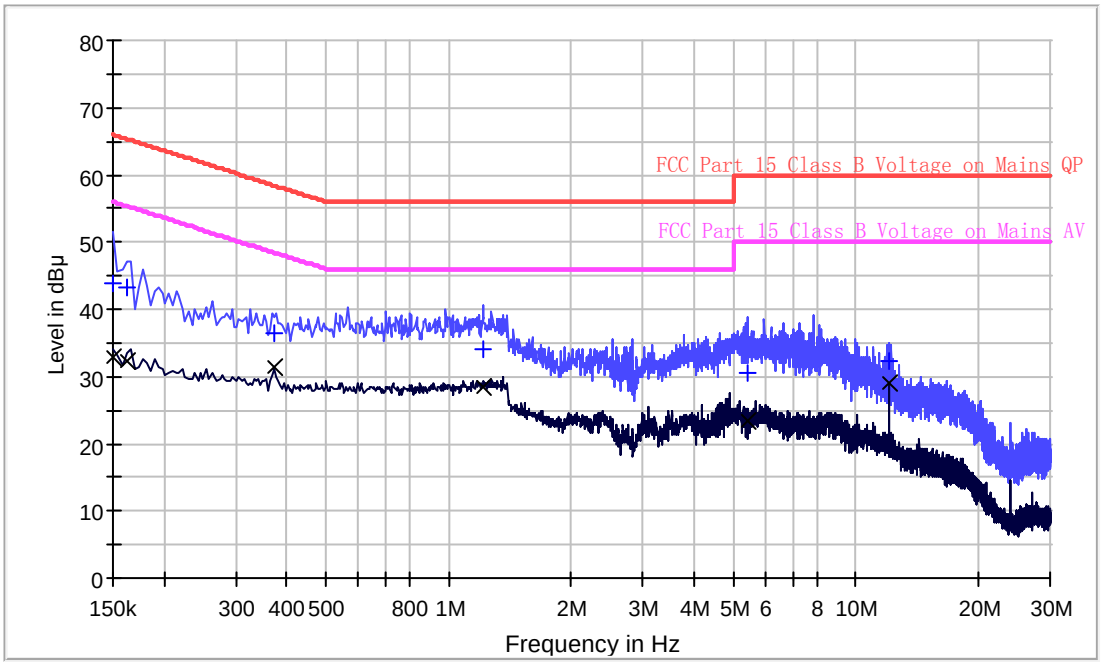
Sign on file

Powell Bao, Engineer
Typed/Printed Name

May 27, 2017
Date

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: May 27, 2017
Model: TT366
Sample: 1/1
Worst-case operating Mode: BT Link
Modulation type: GFSK
Phase: Live

Conducted Emission Test - FCC



Result Table QP

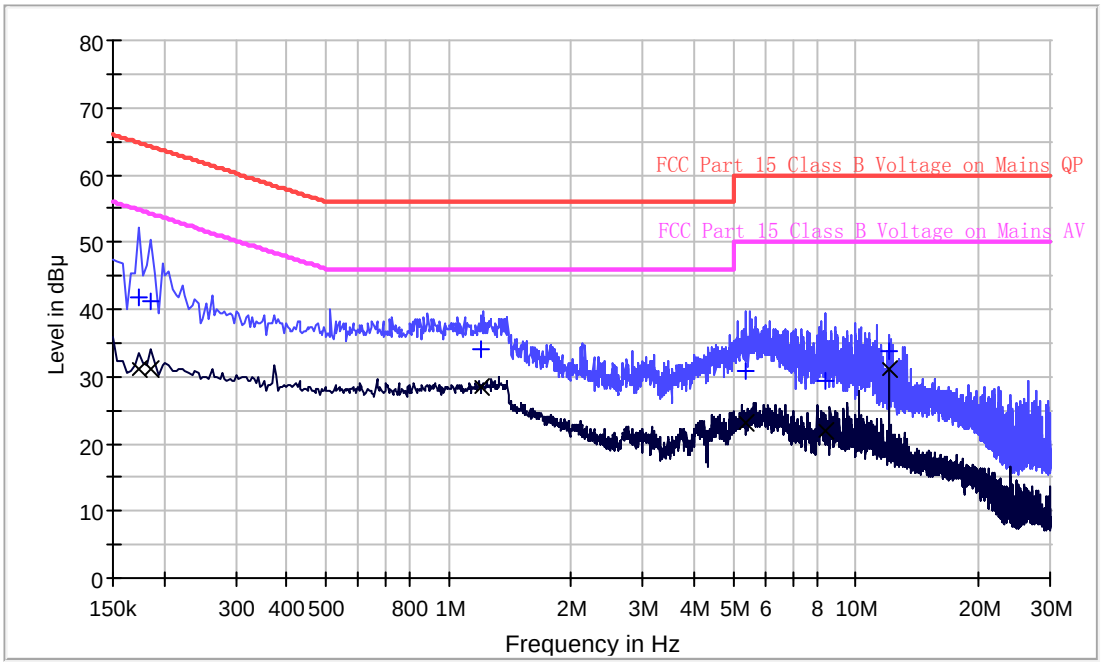
Frequency (MHz)	QuasiPeak (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.150	43.8	L1	9.5	22.2	66.0
0.162	43.2	L1	9.5	22.2	65.4
0.374	36.4	L1	9.6	22.0	58.4
1.218	34.0	L1	9.6	22.0	56.0
5.422	30.4	L1	9.7	29.6	60.0
12.010	32.2	L1	9.8	27.8	60.0

Result Table AV

Frequency (MHz)	Average (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.150	32.8	L1	9.5	23.2	56.0
0.162	32.4	L1	9.5	23.0	55.4
0.374	31.3	L1	9.6	17.1	48.4
1.218	28.4	L1	9.6	17.6	46.0
5.422	23.5	L1	9.7	26.5	50.0
12.010	29.1	L1	9.8	20.9	50.0

Applicant: Zhong Shan City Richsound Electronic Industrial Ltd.
Date of Test: May 27, 2017
Model: TT366
Sample: 1/1
Worst-case operating Mode: BT Link
Modulation type: GFSK
Phase: Neutral

Conducted Emission Test - FCC



Result Table QP

Frequency (MHz)	QuasiPeak (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.174	41.9	N	9.6	22.9	64.8
0.186	41.2	N	9.6	23.0	64.2
1.206	34.1	N	9.6	21.9	56.0
5.374	31.0	N	9.7	29.0	60.0
8.398	29.3	N	9.7	30.7	60.0
12.010	33.8	N	9.8	26.2	60.0

Result Table AV

Frequency (MHz)	Average (dB µ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.174	31.1	N	9.6	23.7	54.8
0.186	31.2	N	9.6	23.0	54.2
1.206	28.4	N	9.6	17.6	46.0
5.374	23.0	N	9.7	27.0	50.0
8.398	22.0	N	9.7	28.0	50.0
12.010	31.2	N	9.8	18.8	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	-1.30	0.74
	2441	-1.25	0.75
	2480	-1.07	0.78

Cable loss: 2.0 dB External Attenuation: 0 dB

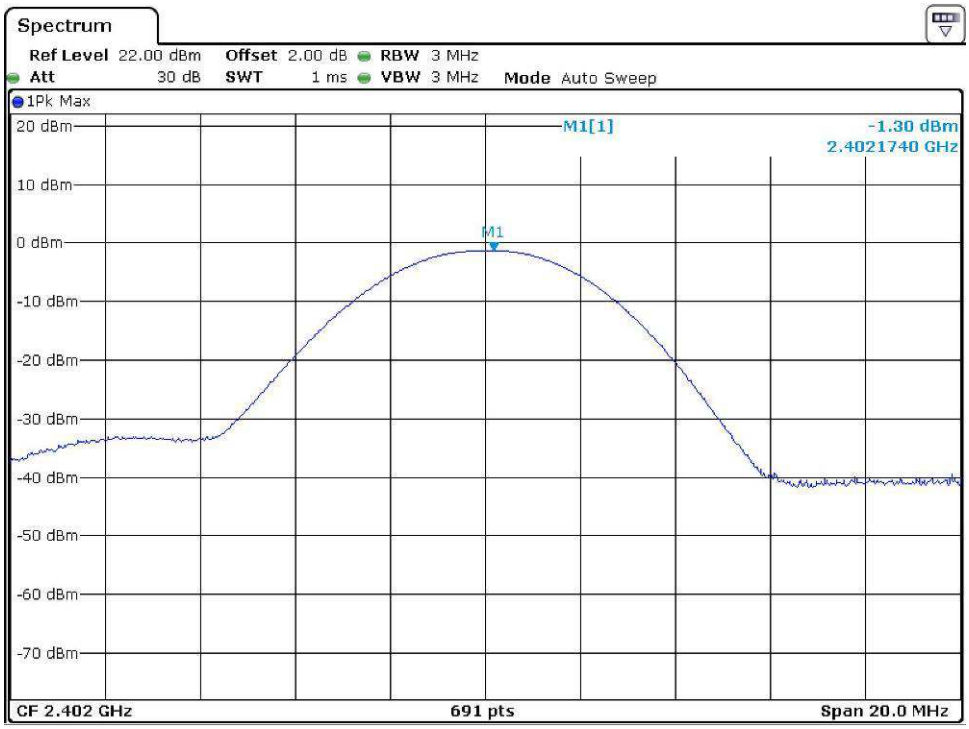
Cable Loss, External attenuation has been included in OFF SET function.

EUT max. output level = -1.07dBm

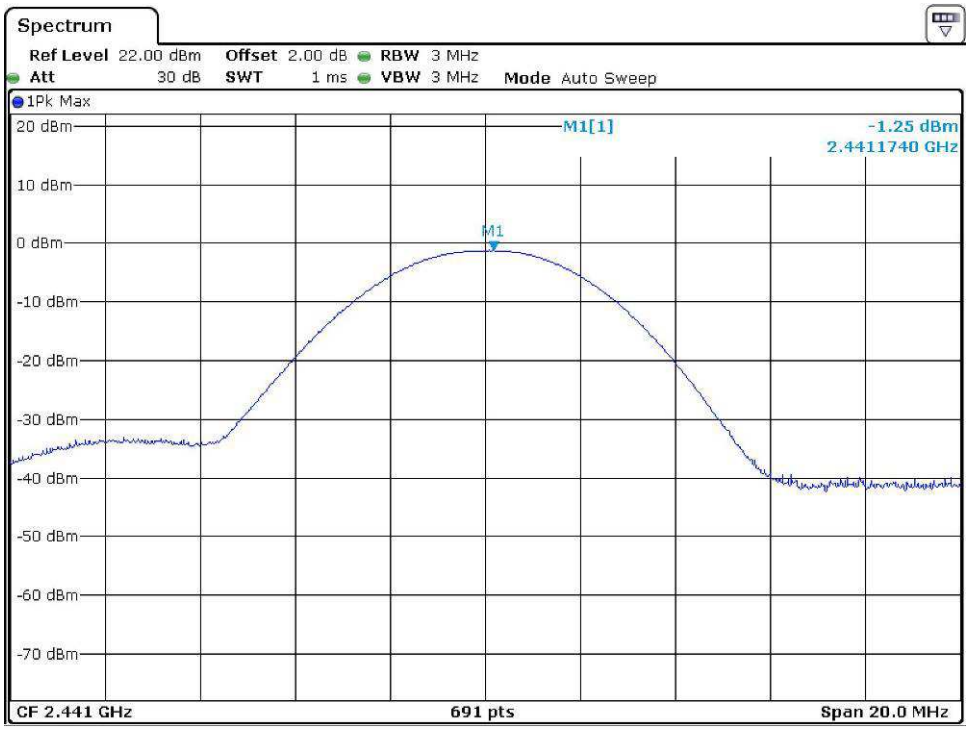
For RF exposure, the information is saved with filename: RF exposure.pdf.

Modulation Type: GFSK

CH00



CH39



CH78


Spectrum
Ref Level 22.00 dBm Offset 2.00 dB RBW 3 MHz
Att 30 dB SWT 1 ms VBW 3 MHz Mode Auto Sweep
1Pk Max
M1[1] -1.07 dBm
2.4801740 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
691 pts
Span 20.0 MHz

3.4 20dB Bandwidth

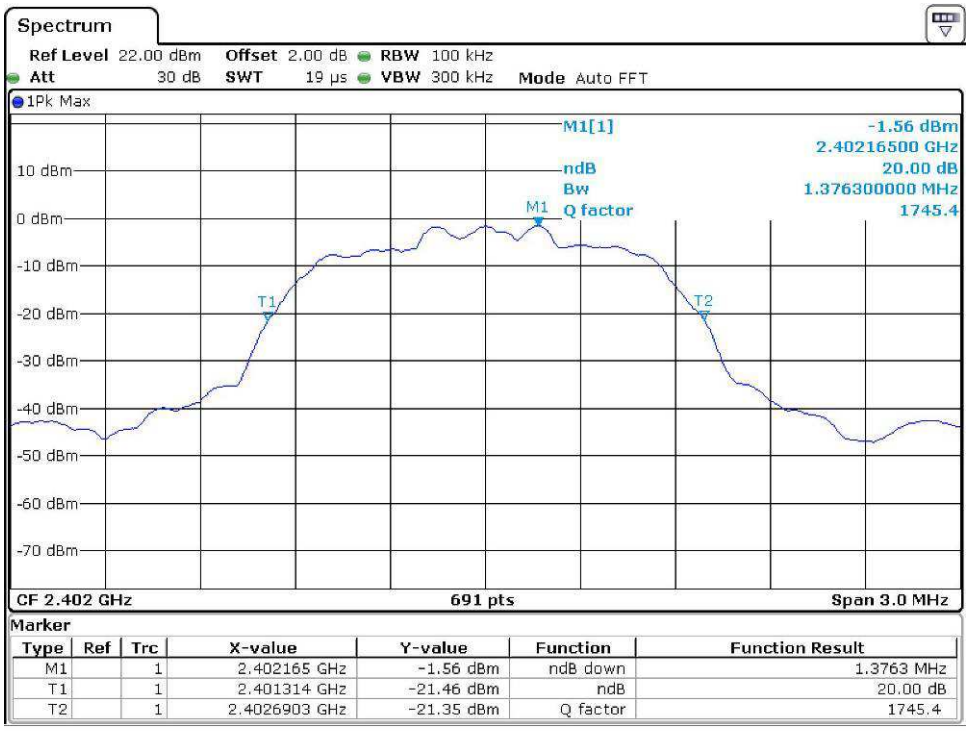
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

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.

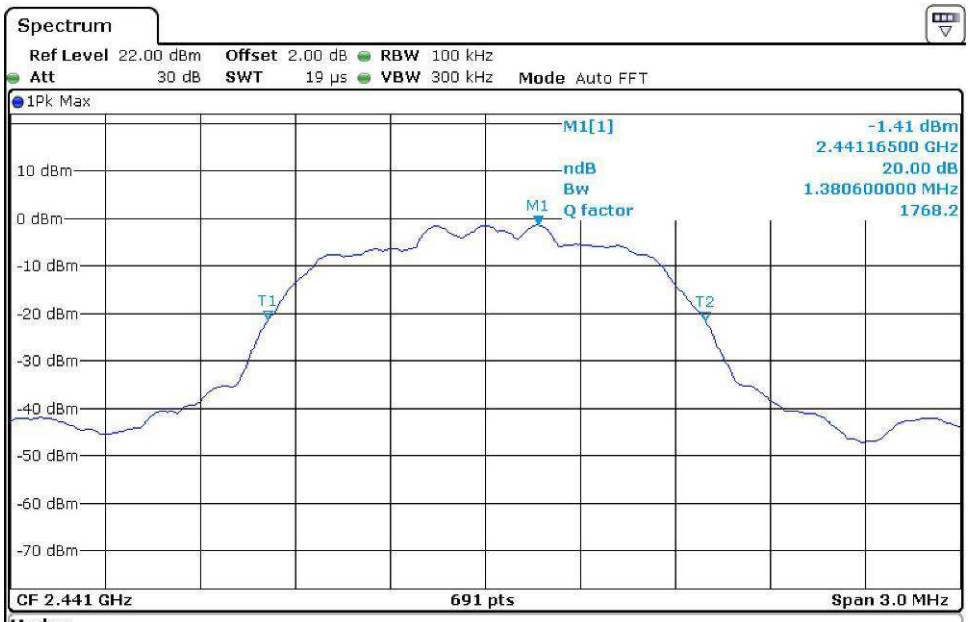
Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.3763
2441	1.3806
2480	1.3806

Modulation Type: 8DPSK

CH00



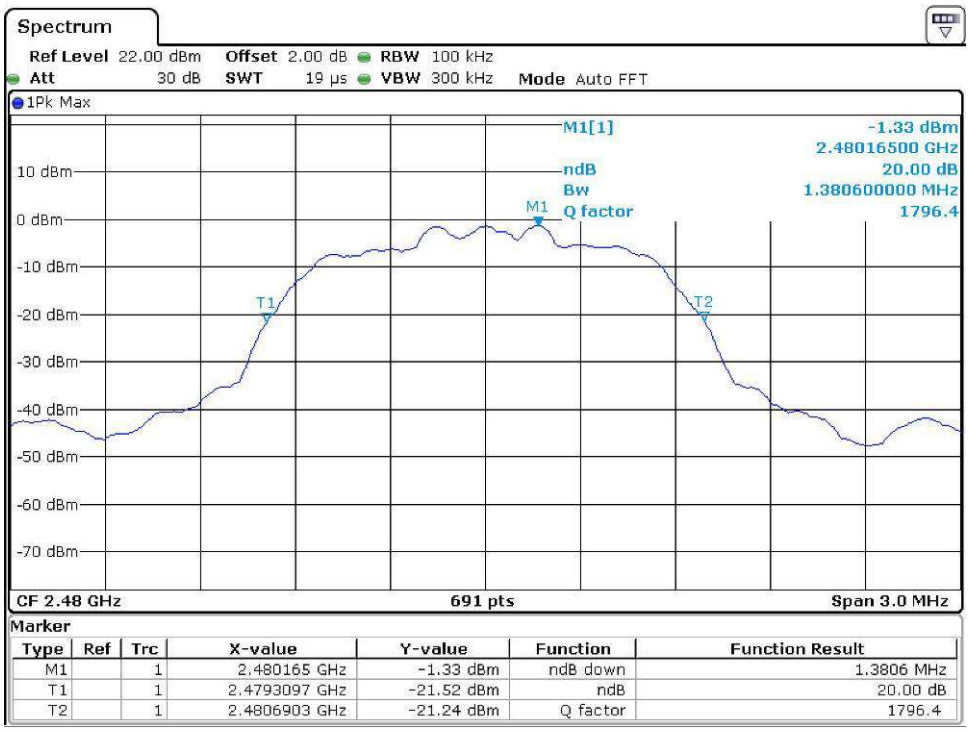
CH39



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.441165 GHz	-1.41 dBm	ndB down	1.3806 MHz
T1		1	2.440314 GHz	-21.32 dBm	ndB	20.00 dB
T2		1	2.4416946 GHz	-21.55 dBm	Q factor	1768.2

CH78



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480165 GHz	-1.33 dBm	ndB down	1.3806 MHz
T1		1	2.4793097 GHz	-21.52 dBm	ndB	20.00 dB
T2		1	2.4806903 GHz	-21.24 dBm	Q factor	1796.4

3.5 Channel Number (Number of Hopping Frequencies)

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

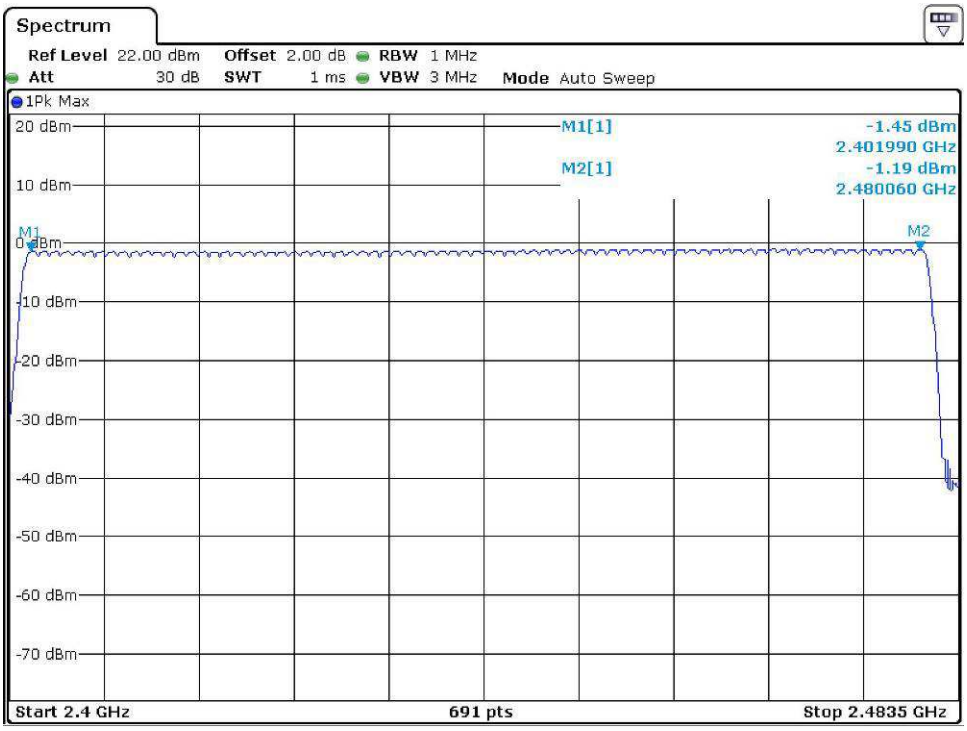
The RF passband of the EUT was divided into 3 approximately equal bands. With the analyzer set to MAX HOLD readings were taken for 2-3 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

Number of hopping channels =	79

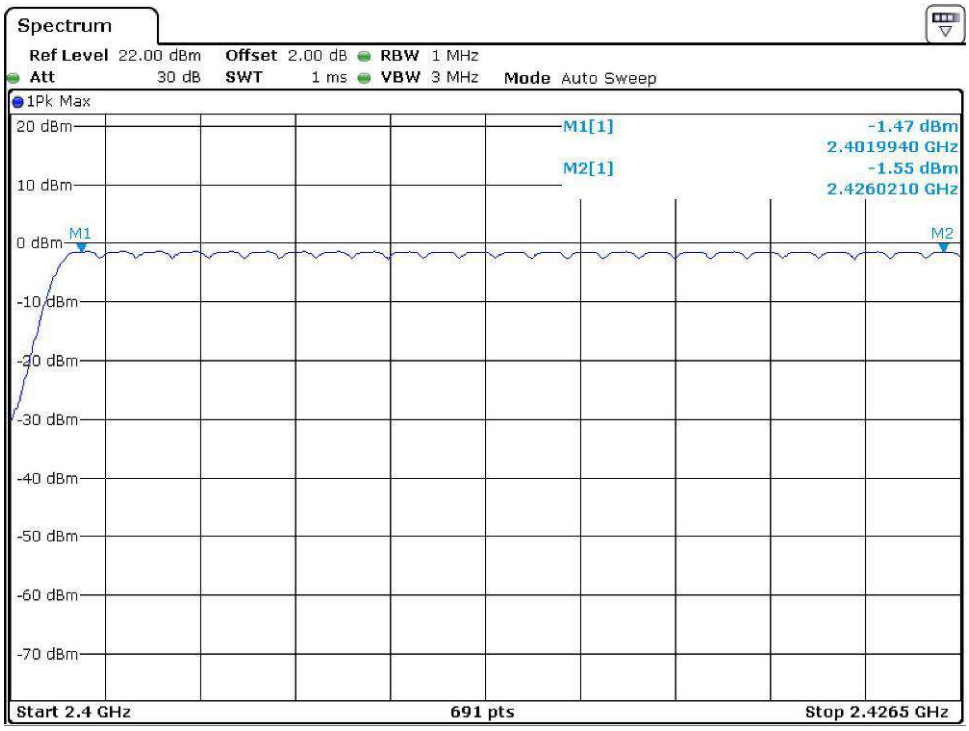
Note: In AFH mode, this device operates using 20 channels and it's satisfied the requirement of limit of minimum of 15 hopping channels.

Modulation Type: GFSK

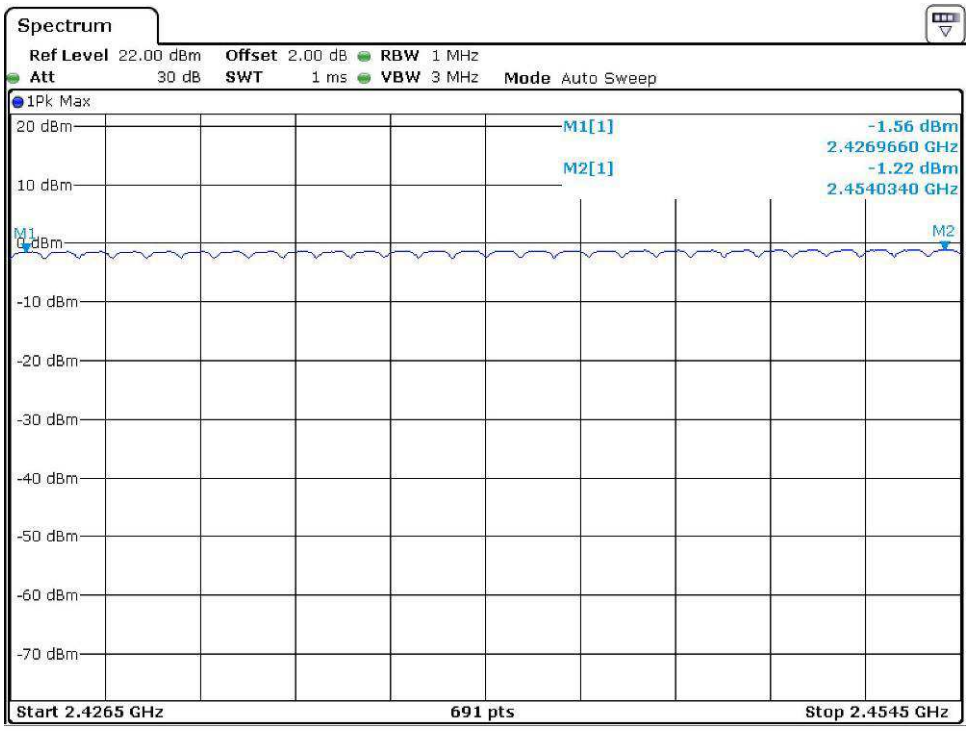
CH00-CH78



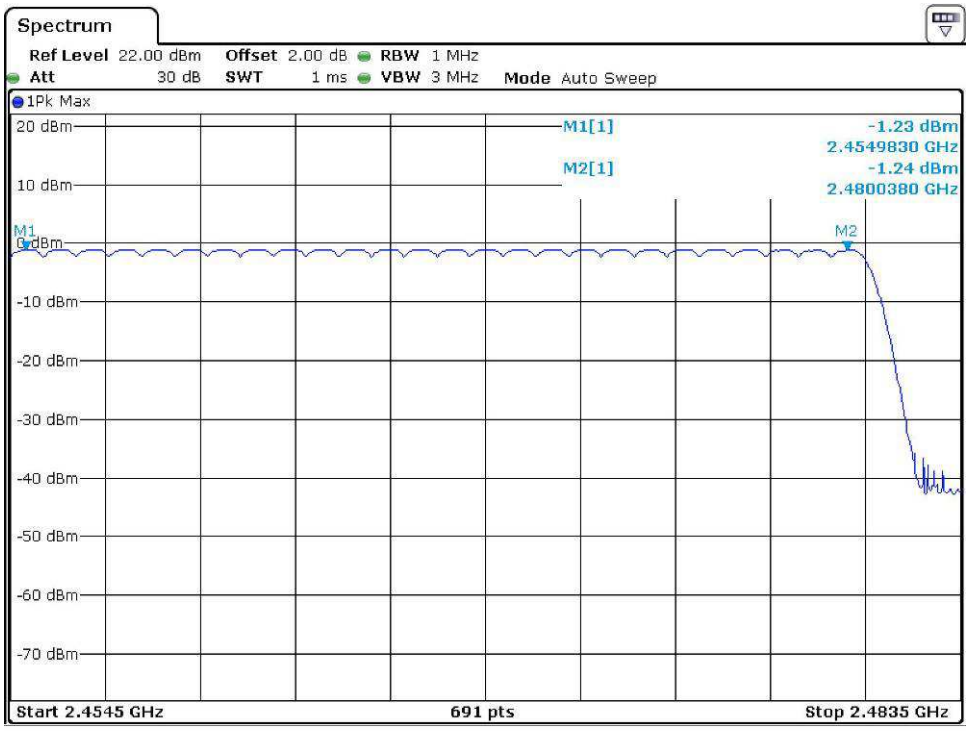
CH00-CH24



CH25-CH52



CH53-CH78


Spectrum
Ref Level 22.00 dBm Offset 2.00 dB RBW 1 MHz
Att 30 dB SWT 1 ms VBW 3 MHz Mode Auto Sweep
1Pk Max
M1[1] -1.23 dBm
2.4549830 GHz
M2[1] -1.24 dBm
2.4800380 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 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):

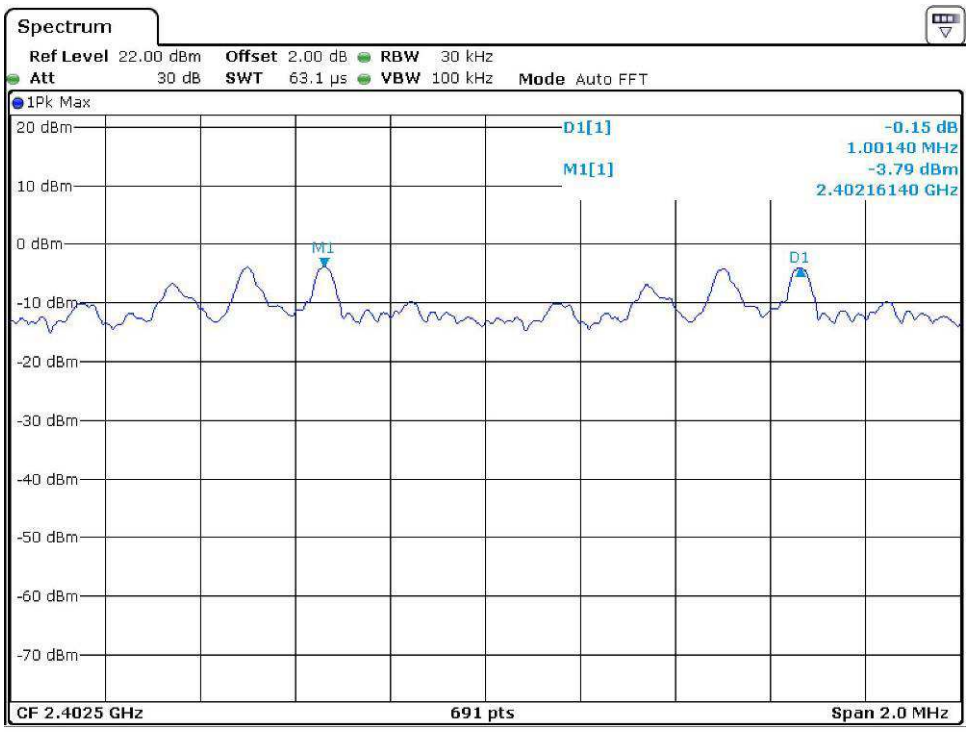
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: 1.3806 x 2/3 = 0.920MHz

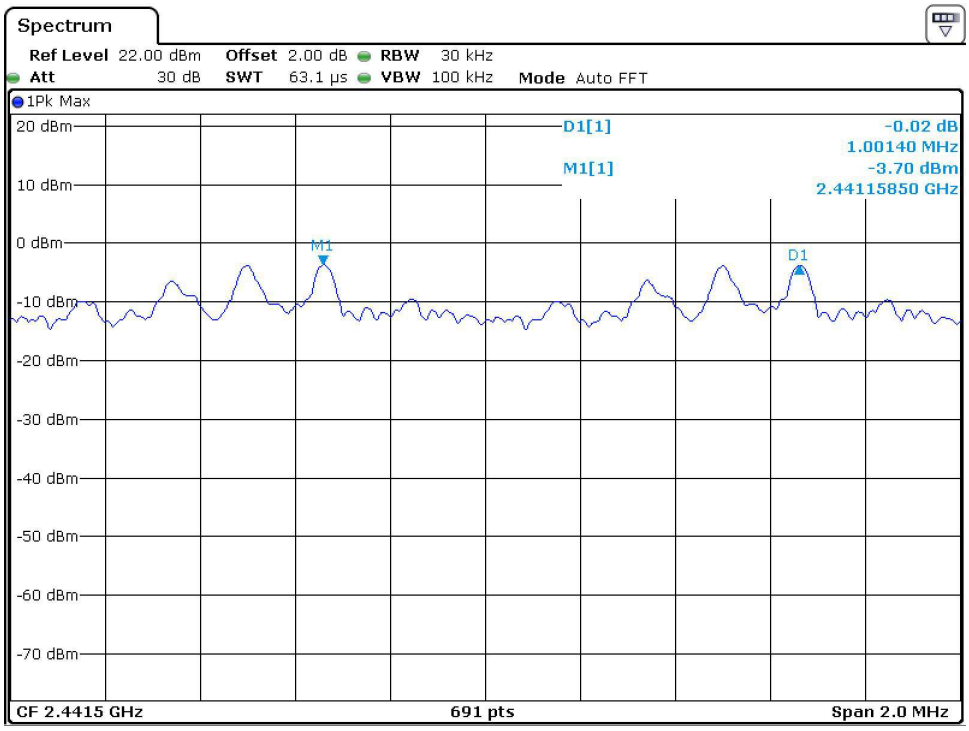
Minimum Channel Separation	1.0014 MHz

Modulation Type: 8DPSK

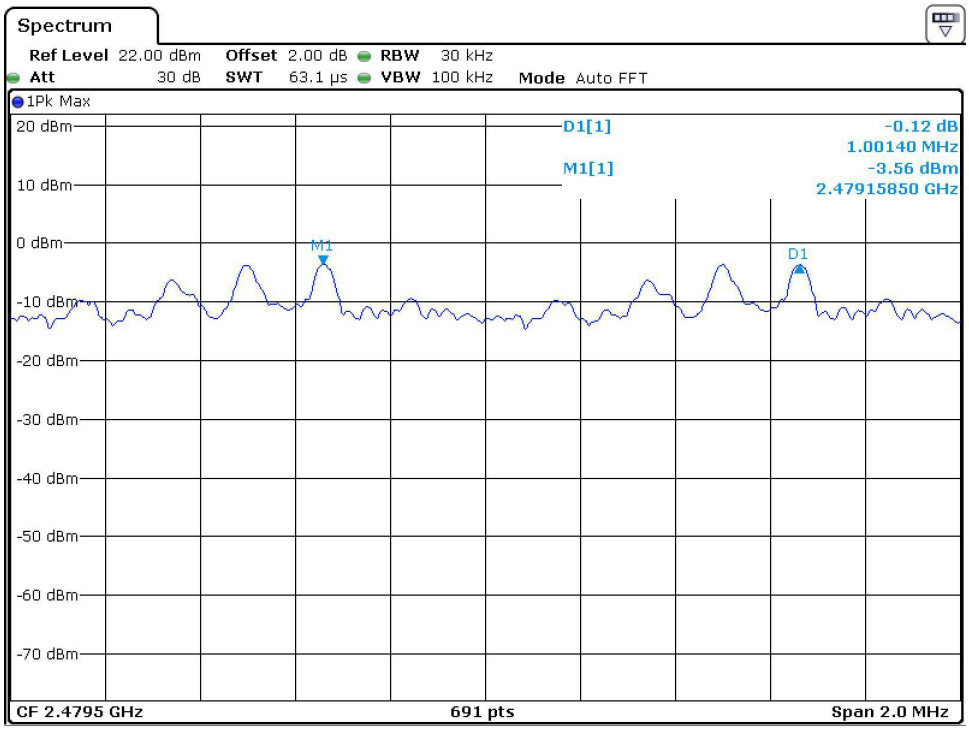
Low Channel



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 DH1
=1600 / 2 / 79 *31.6=320

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

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

Modulation Type	Packet	Max Dwell Time				Limit (s)	Result
8DPSK	DH1	0.393	ms * 320=	125.76	ms	0.4	Pass
	DH3	1.649	ms * 160=	263.84	ms	0.4	Pass
	DH5	2.893	ms * 107=	309.55	ms	0.4	Pass

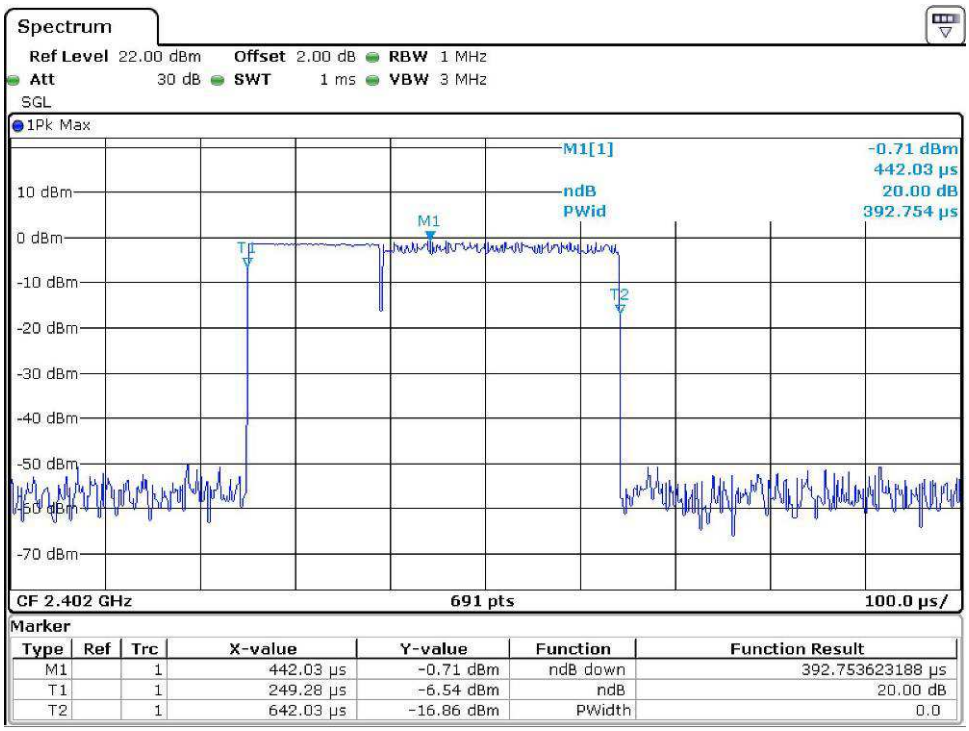
AFH mode:
The maximum number of hopping channels in 8s for DH1
=800 / 2 / 20 *8=160

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

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

Modulation Type	Packet	Max Dwell Time				Limit (s)	Result
8DPSK	DH1	0.393	ms * 160=	62.88	ms	0.4	Pass
	DH3	1.649	ms * 80=	131.92	ms	0.4	Pass
	DH5	2.893	ms * 53.33=	154.28	ms	0.4	Pass

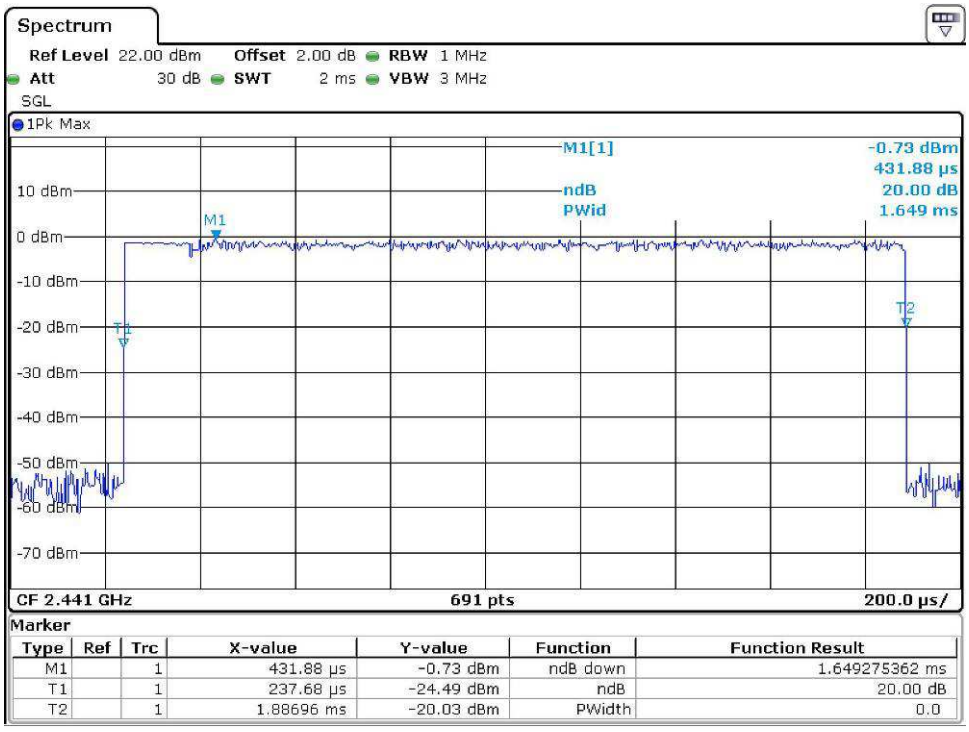
Modulation Type: 8DPSK
Packet: DH1



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	442.03 µs	-0.71 dBm	ndB down	392.753623188 µs
T1		1	249.28 µs	-6.54 dBm	ndB	20.00 dB
T2		1	642.03 µs	-16.86 dBm	PWidth	0.0

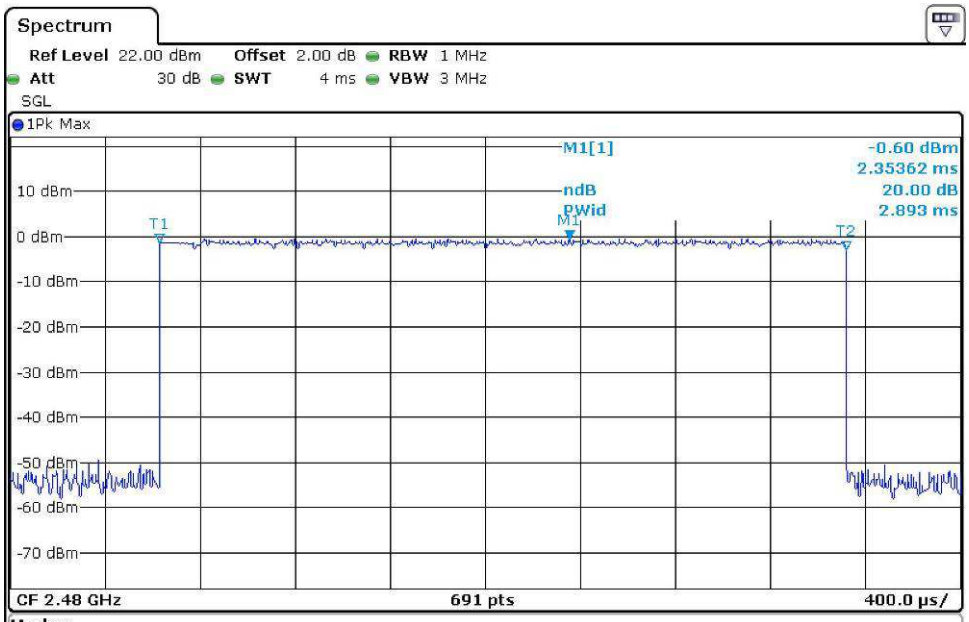
Packet: DH3



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	431.88 µs	-0.73 dBm	ndB down	1.649275362 ms
T1		1	237.68 µs	-24.49 dBm	ndB	20.00 dB
T2		1	1.88696 ms	-20.03 dBm	PWidth	0.0

Packet: DH5



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.35362 ms	-0.60 dBm	ndB down	2.892753623 ms
T1		1	626.09 µs	-1.31 dBm	ndB	20.00 dB
T2		1	3.51884 ms	-3.03 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
= 92.8dBµV/m-31.3dB
= 61.5dBµV/m

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

= 70.3 dBµV/m–31.3 dB
= 39.0 dBµV/m

(ii) Upper channel 2480MHz:

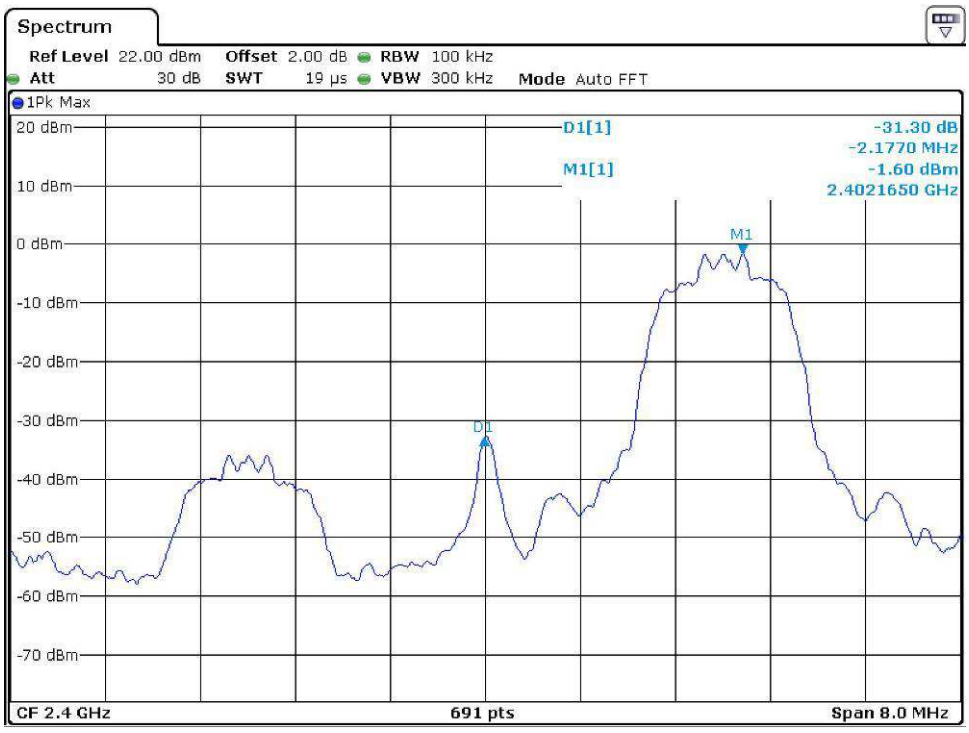
Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 90.1dBµV/m-48.5dB
= 41.6dBµV/m

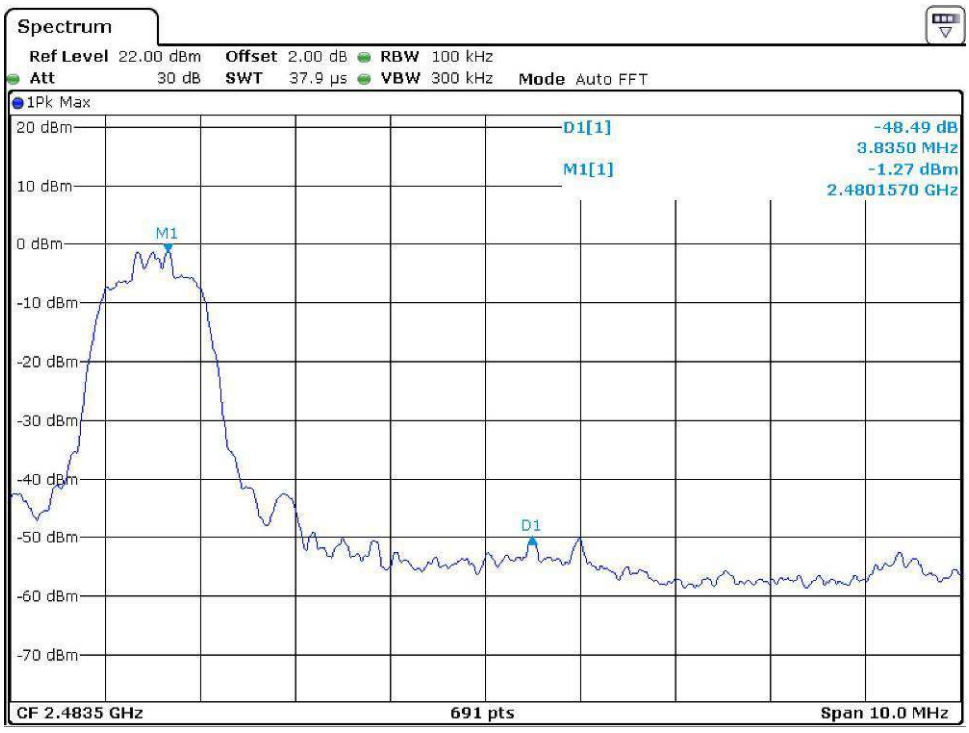
Average Resultant field strength = Fundamental emissions (Average value) – delta from the bandedge plot

= 67.6 dBµV/m–48.5 dB
= 19.1 dBµV/m

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

Modulation Type: 8DPSK





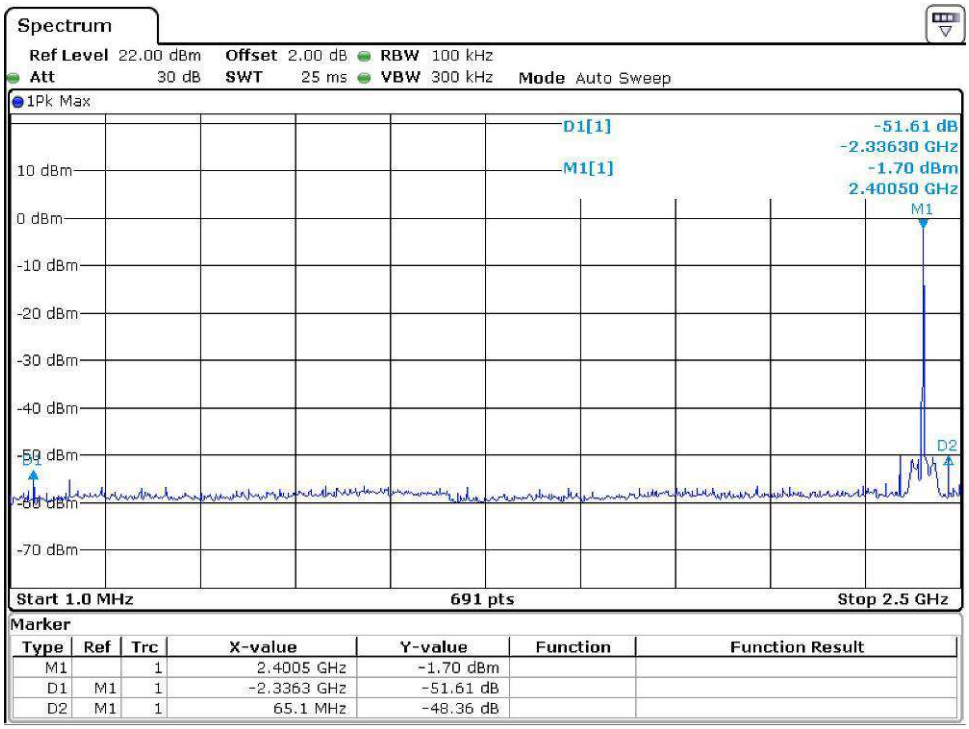
3.9 Transmitter Spurious Emissions (Conducted)

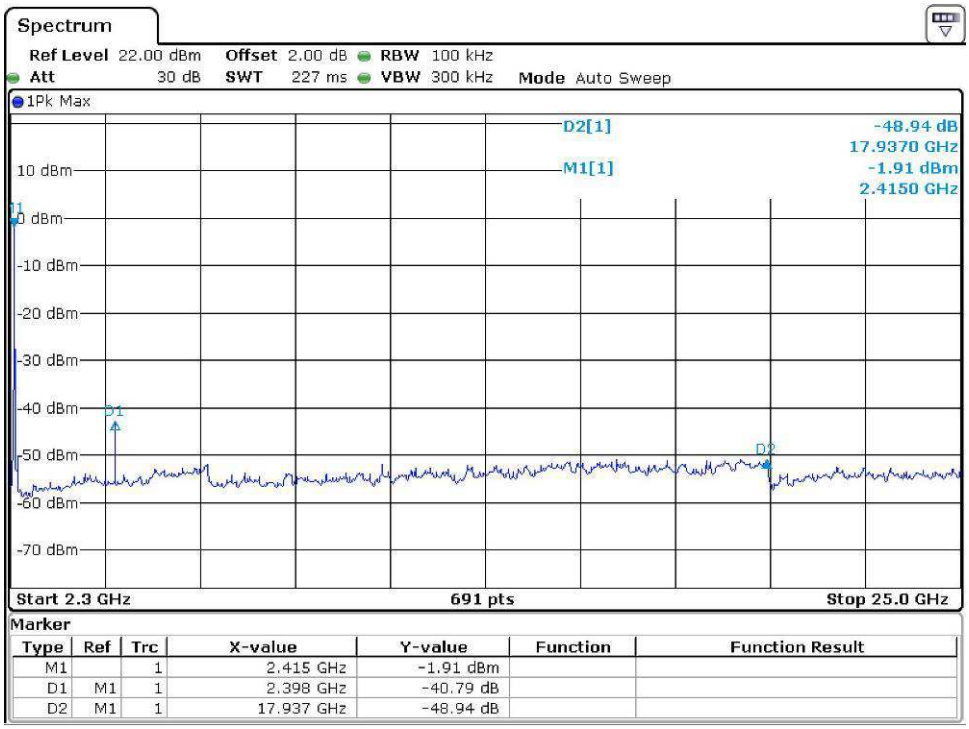
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

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.

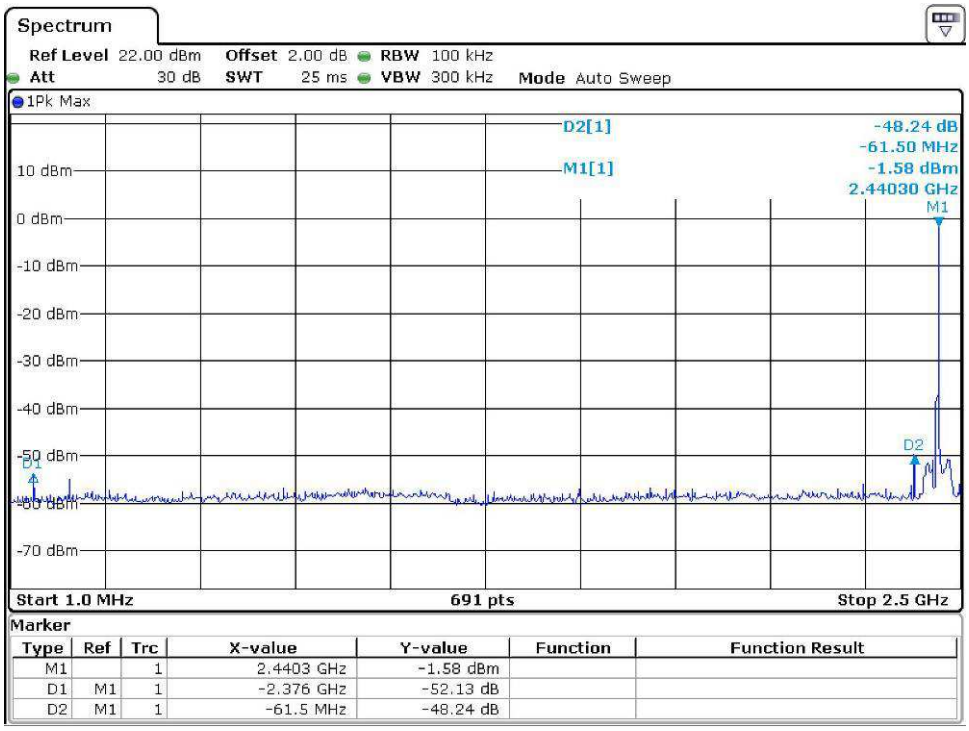
Modulation Type: GFSK

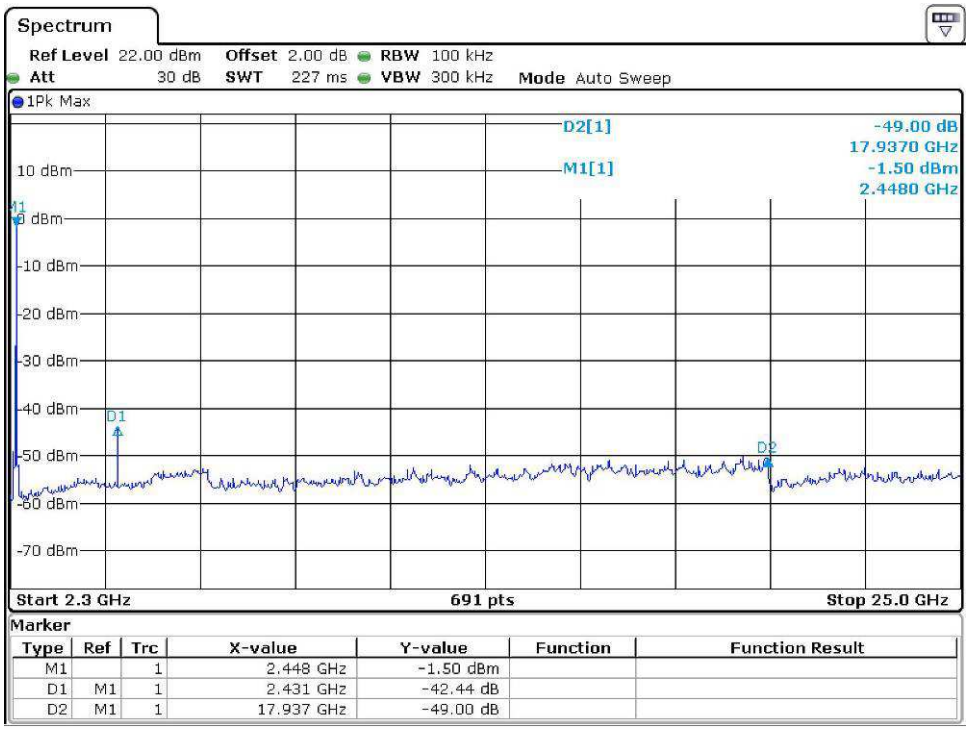
CH00



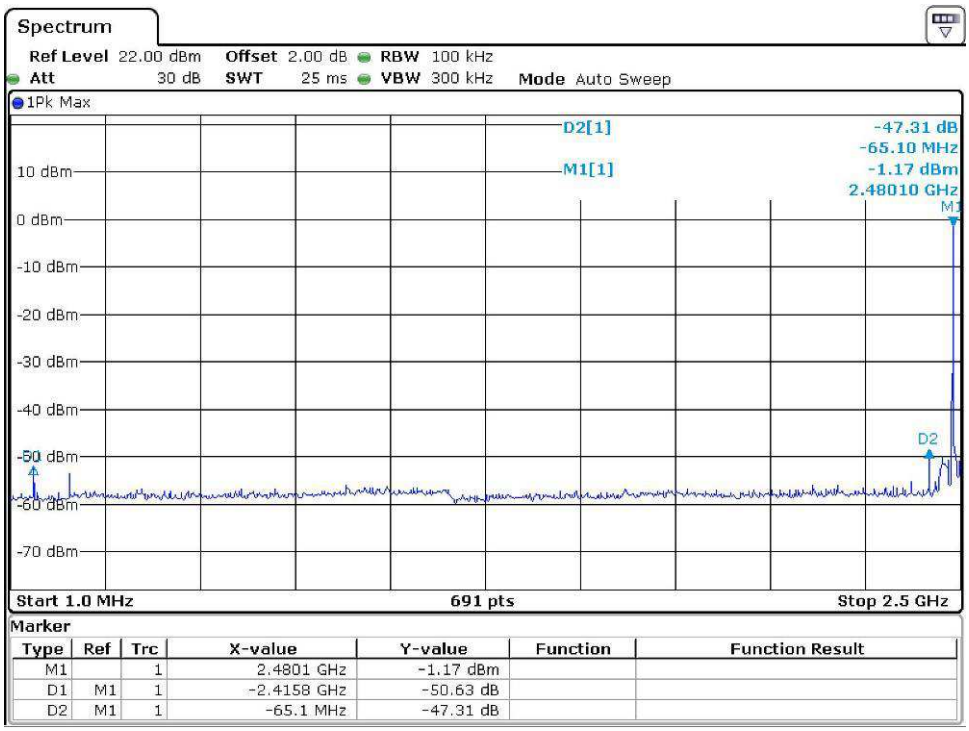


CH39


Spectrum
Ref Level 22.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D2[1] -48.24 dB
-61.50 MHz
M1[1] -1.58 dBm
2.44030 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 MHz
691 pts
Stop 2.5 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4403 GHz -1.58 dBm
D1 M1 1 -2.376 GHz -52.13 dB
D2 M1 1 -61.5 MHz -48.24 dB


Spectrum
Ref Level 22.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D2[1] -49.00 dB
17.9370 GHz
M1[1] -1.50 dBm
2.4480 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 2.3 GHz
691 pts
Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.448 GHz -1.50 dBm
D1 M1 1 2.431 GHz -42.44 dB
D2 M1 1 17.937 GHz -49.00 dB

CH78


Spectrum
Ref Level 22.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D2[1] -47.31 dB
-65.10 MHz
M1[1] -1.17 dBm
2.48010 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D2
Start 1.0 MHz 691 pts Stop 2.5 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4801 GHz -1.17 dBm
D1 M1 1 -2.4158 GHz -50.63 dB
D2 M1 1 -65.1 MHz -47.31 dB

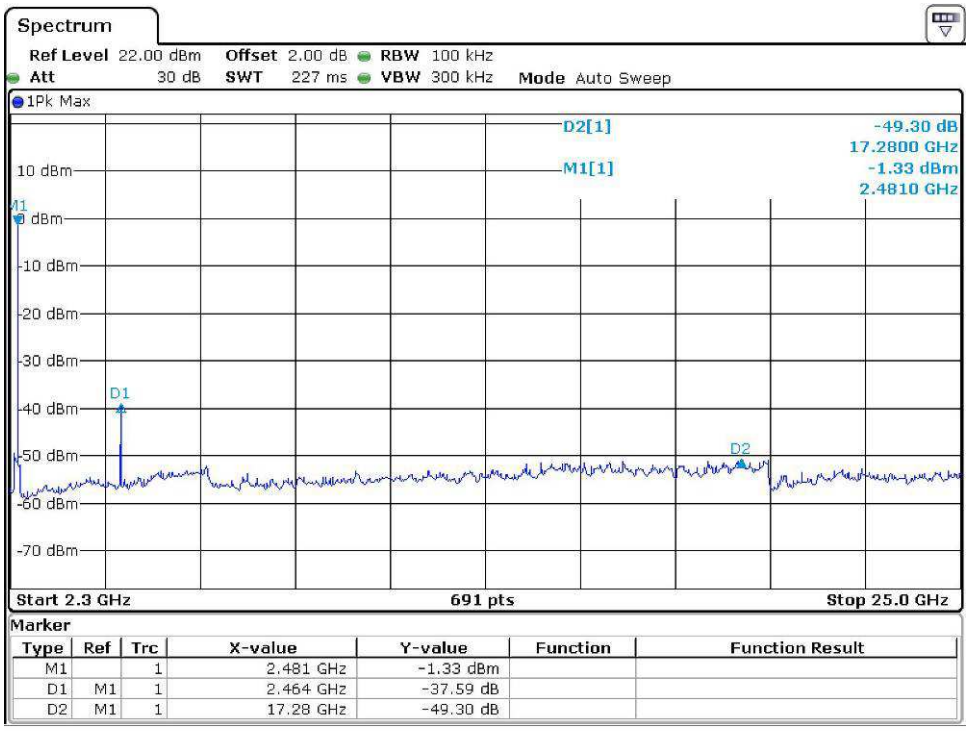

Spectrum
Ref Level 22.00 dBm Offset 2.00 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D2[1] -49.30 dB
17.2800 GHz
M1[1] -1.33 dBm
2.4810 GHz
10 dBm
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
D1
-40 dBm
-50 dBm
D2
-60 dBm
-70 dBm
Start 2.3 GHz 691 pts Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.481 GHz -1.33 dBm
D1 M1 1 2.464 GHz -37.59 dB
D2 M1 1 17.28 GHz -49.30 dB

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.

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
EE089	EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	17-May-2017	17-May-2018
EE040	Pre-Amplifier	HP	8447F	2944A07999	17-May-2017	17-May-2018
EE043	Bilog Antenna	Schwarzbeck	VULB9163	142	17-May-2017	17-May-2018
EE147	Cable	Schwarzbeck	AK9513	ACRX1	17-May-2017	17-May-2018
EE169	Cable	Rosenberger	N/A	FP2RX2	17-May-2017	17-May-2018
EE168	Cable	Schwarzbeck	AK9513	CRPX1	17-May-2017	17-May-2018
EE170	Cable	Schwarzbeck	AK9513	CRRX2	17-May-2017	17-May-2018
EE096	Pre-Amplifier	A.H.	PAM-0126	1415261	17-May-2017	17-May-2018
EE094	Horn Antenna	Schwarzbeck	BBHA 9120	707	17-May-2017	17-May-2018
EE097	Cable	H+B	0.5M SF104-26.5	289147/4	17-May-2017	17-May-2018
EE100	Cable	H+B	3M SF104-26.5	295838/4	17-May-2017	17-May-2018
EE101	Cable	H+B	6M SF104-26.5	295840/4	17-May-2017	17-May-2018
EE095	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	17-May-2017	17-May-2018
EE343	EMI Test Receiver	Rohde & Schwarz	FSV40	132.1-3008K39-100967-AP	17-May-2017	17-May-2018
EE240	Pre-Amplifier	Lunar EM	LNA26G40-40	J1013131028001	17-May-2017	17-May-2018
EE234	Horn Antenna	AHS/USA	SAS-573	184	17-May-2017	17-May-2018
EE312	Cable	A.H	SAC-40G-1	414	17-May-2017	17-May-2018
EE313	Cable	A.H	SAC-40G-1	413	17-May-2017	17-May-2018
EE023	Test Receiver	Rohde & Schwarz	ESCS30	879	29-May-2016	29-May-2017
EE145	L.I.S.N.	Rohde & Schwarz	ENV216	590	29-May-2016	29-May-2017
EE021	L.I.S.N.	ROHDE & SCHWARZ	ESH2-Z5	236	29-May-2016	29-May-2017