Lenovo (Beijing) Limited

Application For Certification

FCC ID: A5MC100

Lenovo new glass C100

Model: C100

Brand name: Lenovo

2.4GHz Transceiver

Report No.: 150701028SZN-003

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-14]

Prepared and Checked by:	Approved by:
Sign on file	Digitally signed by Andy Yan Location: Intertek Testing Services
Leo Lai Project Engineer	Andy Yan Senior Project Engineer Date: December 13, 2015

TRF No.: FCC 15C_TX_b

Intertek Testing Services Shenzhen Ltd. Kejiyuan Branch
6F, D Block, Huahan Building, Langshan Road, Nanshan District, Shenzhen, P. R. China
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LIST OF EXHIBITS

INTERTEK TESTING SERVICES

MEASUREMENT/TECHNICAL REPORT

Lenovo (Beijing) Limited

Model: C100

FCC ID: A5MC100

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 [10-1-14 Edition] provision.

Report prepared by:

Leo Lai
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Table of Contents

List of attached file

Exhibit type	File Description	filename
Test Report	Test Report	report.pdf
Operational Description	Technical Description	descri.pdf
Test Setup Photo	Conducted Emission	conducted photos.pdf
Test Setup Photo	Radiated Emission	radiated 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	letter of agency.pdf

EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

The Equipment under Test (EUT) is a Lenovo new glass C100 model C100 with Bluetooth function operating at 2402-2480MHz includes 79 channels with 1MHz channel spacing. It is powered by D.C. 3.7V from internal rechargeable battery. For more detailed features description, please refer to the user's manual.

Antenna Type: Integral antenna
Bluetooth Version: Classic (3.0, 2.1 with EDR)
Modulation Type: GFSK, $\pi/4$ –DQPSK and 8-DPSK

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:
DSS- Part 15 Spread Spectrum Transmitter (Bluetooth FHSS portion)

Remaining certification portion is subject to the following procedure: Other digital functions were reported in the verification report: 151023010SZN-001
Computer peripheral: 150701028SZN-002
Bluetooth 4.0 LE: 150701028SZN-004
WiFi 802.11 b/g/n: 150701028SZN-005

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 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.

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. Kejiyuan Branch** and located at 6F, Block D, Huahan Building, Langshan Road, Nanshan District, Shenzhen, P. R. China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: 242492).

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 a fully charged 3.7V internal rechargeable battery and charged by AC/DC adapter with AC 120/60Hz input during the test.

All packets DH1, DH3 & DH5 mode in all modulation types 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 for emission up to 1GHz and in the centre of the table above 1GHz.

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

No software is used.

2.3 Special Accessories

Attached shielded USB Cable was used.

2.4 Equipment Modification

Any modifications installed previous to testing by Lenovo (Beijing) Limited will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Kejiyuan 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

This product was tested in the following configuration:

Refer List:

Description	Manufacturer	Model No.
Adapter	Asian Power	WA-05M05FU (Input: 100V-240V~ / 50-50Hz Output: 5V/1A)
USB Cable	Lenovo	Shielded, Length 92cm
Earphone	Lenovo	Length 30cm

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 Data and Configuration Photograph - FCC section 15.209

Worst Case Radiated Emission
At
86.287 MHz

Judgement: Passed by 5.7 dB

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

TEST PERSONNEL:

Sign on file

Leo Lai, Project Engineer
Typed / Printed Name

August 10, 2015
Date

Applicant: Lenovo (Beijing) Limited Date of Test: August 10, 2015
Model: C100
Worst Case Operating Mode: Transmitting (2402MHz)

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	84.351	29.9	20.0	19.3	29.2	40.0	-10.8
Horizontal	120.004	38.3	20.0	13.5	31.8	43.5	-11.7
Horizontal	211.220	37.1	20.0	17.0	34.1	43.5	-9.4
Vertical	86.287	36.1	20.0	18.2	34.3	40.0	-5.7
Vertical	96.008	48.2	20.0	7.1	35.3	43.5	-8.2
Vertical	605.760	28.1	20.0	24.7	32.8	46.0	-13.2

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.

Test Engineer: Leo Lai

3.1.3 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
7323 MHz

Judgement: Passed by 10.7 dB

TEST PERSONNEL:

Sign on file

Leo Lai, Project Engineer
Typed/Printed Name

August 10, 2015
Date

Applicant: Lenovo (Beijing) Limited
Model: C100
Mode: Transmitting (2402MHz)

Date of Test: August 10, 2015

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	*4804.000	55.4	36.1	33.1	52.4	74.0	-21.6
Horizontal	*2387.200	57.7	36.7	28.5	49.5	74.0	-24.5

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	*4804.000	55.4	36.1	33.1	22.5	29.9	54.0	-24.1
Horizontal	*2387.200	57.7	36.7	28.5	22.5	27.0	54.0	-27.0

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.

Test Engineer: Leo Lai

Applicant: Lenovo (Beijing) Limited Date of Test: August 10, 2015
Model: C100
Mode: Transmitting (2441MHz)

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	58.7	36.1	33.3	55.9	74.0	-18.1
Horizontal	*7323.000	61.6	36.2	37.9	63.3	74.0	-10.7

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)
Horizontal	*4882.000	58.7	36.1	33.3	22.5	33.4	54.0	-20.6
Horizontal	*7323.000	61.6	36.2	37.9	22.5	40.8	54.0	-13.2

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.

Test Engineer: Leo Lai

Applicant: Lenovo (Beijing) Limited Date of Test: August 10, 2015
Model: C100
Mode: Transmitting (2480MHz)

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	*4960.000	55.6	36.1	33.4	52.9	74.0	-21.1
Horizontal	*7440.000	55.0	36.2	38.2	57.0	74.0	-17.0
Horizontal	*2483.500	66.6	36.7	28.6	58.5	74.0	-15.5

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	*4960.000	55.6	36.1	33.4	22.5	30.4	54.0	-23.6
Horizontal	*7440.000	55.0	36.2	38.2	22.5	34.5	54.0	-19.5
Horizontal	*2483.500	66.6	36.7	28.6	22.5	36.0	54.0	-18.0

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.

Test Engineer: Leo Lai

3.2 **Conducted Emission at Mains Terminal**

3.2.1 Conducted Emissions and Data Configuration Photograph

Worst Case Conducted Configuration
at
0.485 MHz

Judgement: Passed by 8.4 dB

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

TEST PERSONNEL:

Sign on file

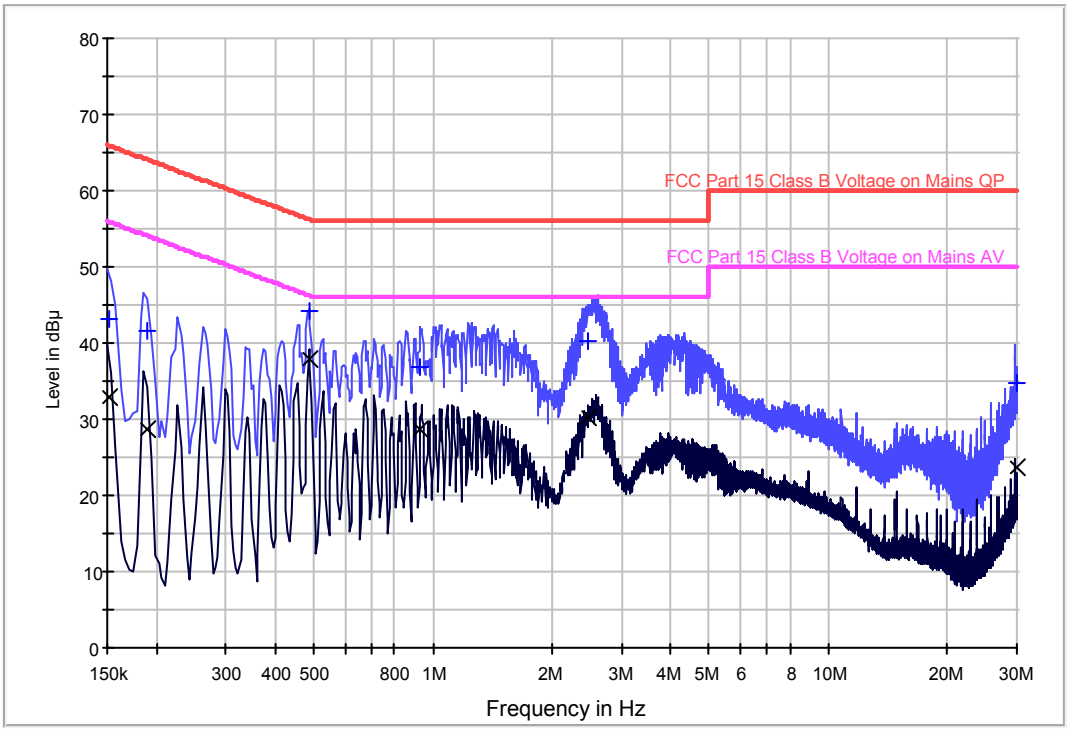
Leo Lai, Project Engineer
Typed/Printed Name

August 10, 2015
Date

Applicant: Lenovo (Beijing) Limited Date of Test: August 10, 2015
Model: C100
Worst Case Operating Mode: Transmitting (2402MHz)

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.152000	43.2	L1	9.8	22.7	65.9
0.189000	41.7	L1	9.9	22.4	64.1
0.485000	44.2	L1	10.2	12.1	56.3
0.930000	36.9	L1	10.0	19.1	56.0
2.483000	40.3	L1	10.0	15.7	56.0
29.910000	34.7	L1	10.4	25.3	60.0

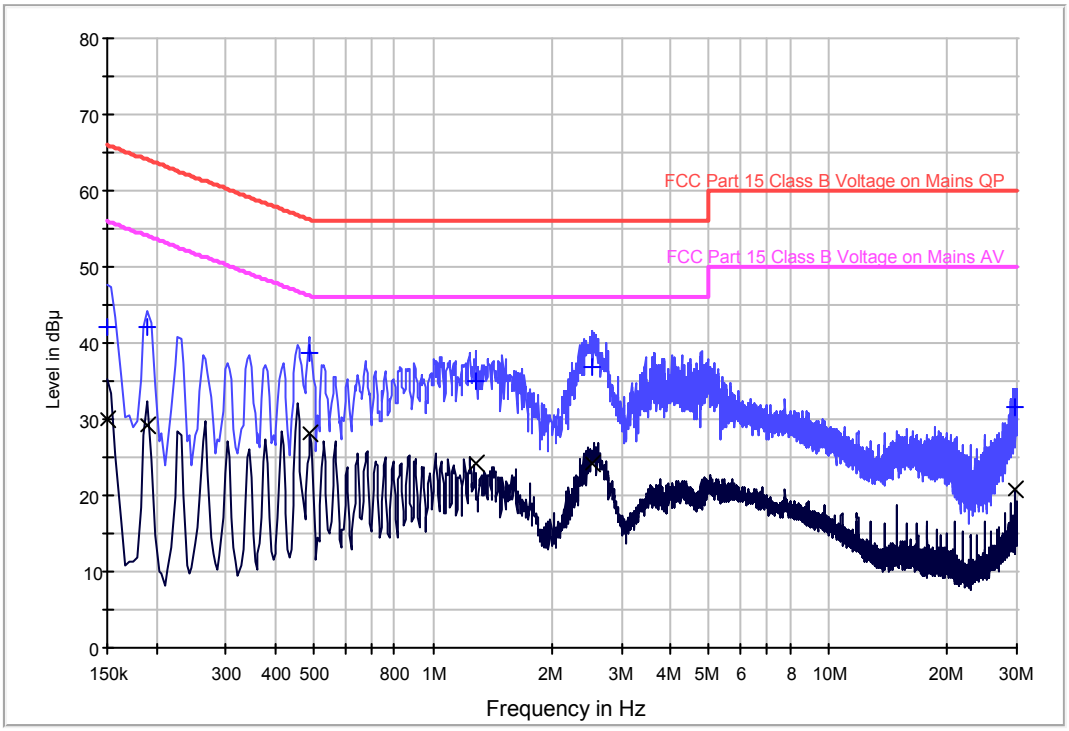
Limit and Margin AV

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.152000	33.0	L1	9.8	22.9	55.9
0.189000	28.8	L1	9.9	25.3	54.1
0.485000	37.9	L1	10.2	8.4	46.3
0.930000	28.6	L1	10.0	17.4	46.0
2.483000	30.2	L1	10.0	15.8	46.0
29.910000	23.7	L1	10.4	26.3	50.0

Applicant: Lenovo (Beijing) Limited Date of Test: August 10, 2015
Model: C100
Worst Case Operating Mode: Transmitting (2402MHz)

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	42.1	N	10.1	23.9	66.0
0.190000	42.0	N	10.2	22.0	64.0
0.486000	38.7	N	10.2	17.5	56.2
1.282000	35.1	N	10.3	20.9	56.0
2.530000	36.9	N	10.3	19.1	56.0
29.638000	31.6	N	10.4	28.4	60.0

Limit and Margin AV

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	30.1	N	10.1	25.9	56.0
0.190000	29.3	N	10.2	24.7	54.0
0.486000	28.2	N	10.2	18.0	46.2
1.282000	24.1	N	10.3	21.9	46.0
2.530000	24.3	N	10.3	21.7	46.0
29.638000	20.8	N	10.4	29.2	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 broadband peak RF power meter. The power meter have a Resolution bandwidth that is greater than OBW and utilize a fast-responding diode detector. Power was read directly at the EUT antenna terminals for using to OFFSET function of the power meter.

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 125mW.

Antenna Gain = 0.9dBi			
Modulation Type	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
GFSK	2402	6.3	4.27
	2441	6.0	3.98
	2480	5.6	3.63
π/4-DQPSK	2402	5.3	3.39
	2441	4.7	2.95
	2480	4.5	2.82
8DPSK	2402	4.4	2.75
	2441	3.7	2.34
	2480	3.6	2.29

Cable loss, external attenuation has been included in OFFSET(1.0dB) function

EUT max. output level = 6.3dBm

For RF Exposure, the information is saved with filename: sar report.pdf.

3.4 20dB Bandwidth

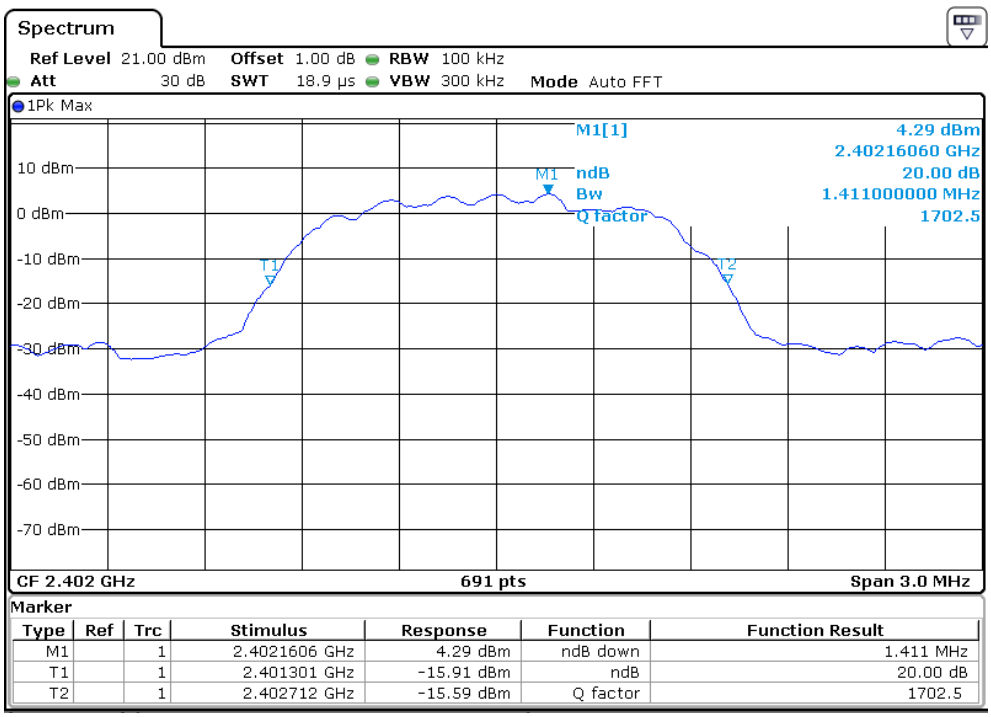
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

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.

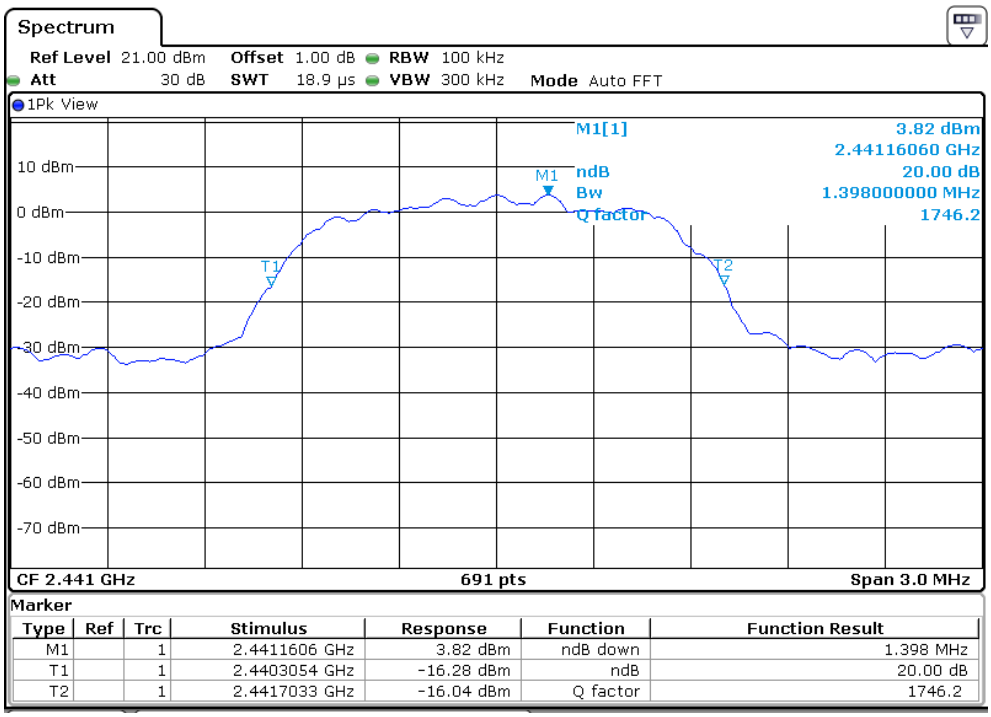
Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.411
2441	1.398
2480	1. 398

Modulation Type: 8DPSK

CH00



CH39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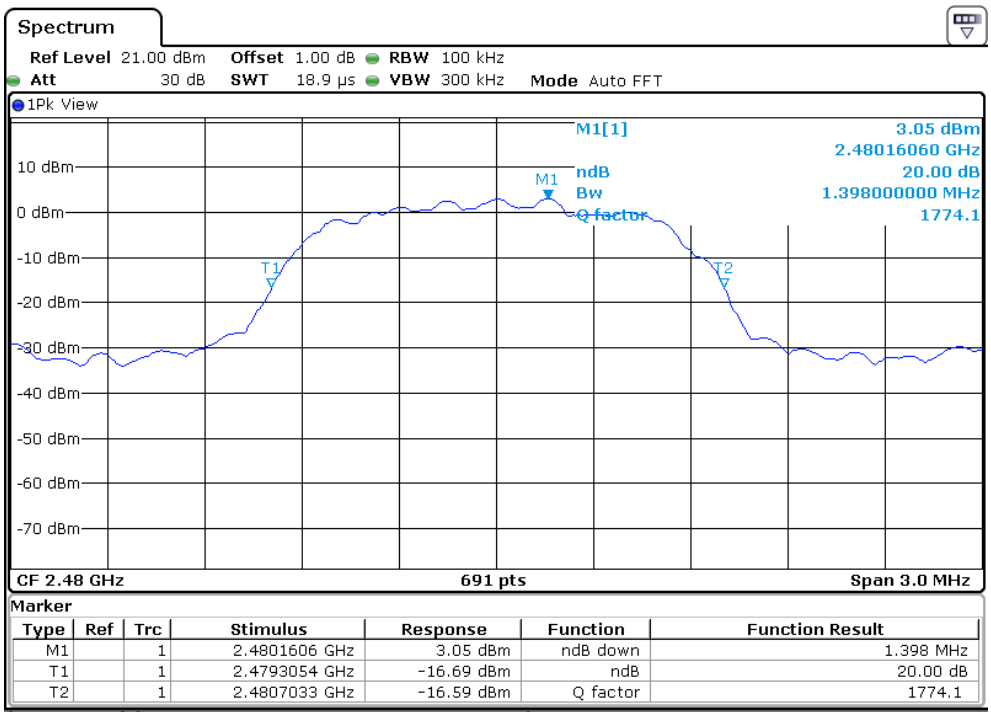
Att 30 dB SWT 18.9 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 3.82 dBm
2.44116060 GHz
ndB 20.00 dB
Bw 1.398000000 MHz
Q factor 1746.2
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 2.4411606 GHz 3.82 dBm ndB down 1.398 MHz
T1 1 2.4403054 GHz -16.28 dBm ndB 20.00 dB
T2 1 2.4417033 GHz -16.04 dBm Q factor 1746.2

CH78


Spectrum
Ref Level 21.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 18.9 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 3.05 dBm
2.48016060 GHz
ndB 20.00 dB
Bw 1.398000000 MHz
Q factor 1774.1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 2.4801606 GHz 3.05 dBm ndB down 1.398 MHz
T1 1 2.4793054 GHz -16.69 dBm ndB 20.00 dB
T2 1 2.4807033 GHz -16.59 dBm Q factor 1774.1

3.5 Channel Number (Number of Hopping Frequencies)

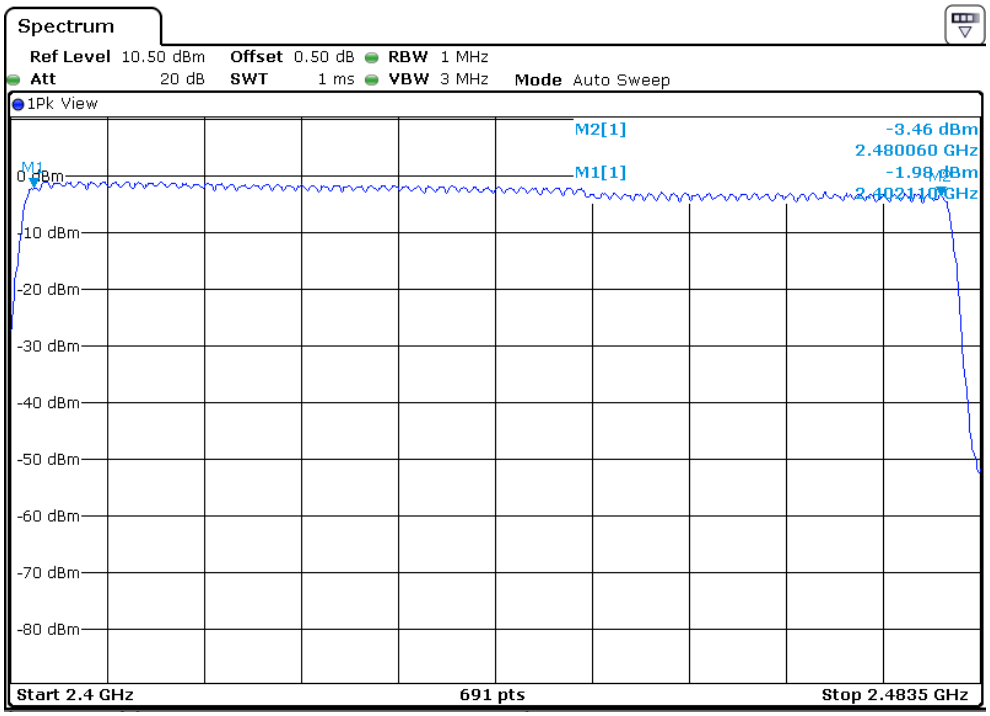
Minimum Number of Hopping Frequencies, FCC Rule 15.247(a) (1) (iii):

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.

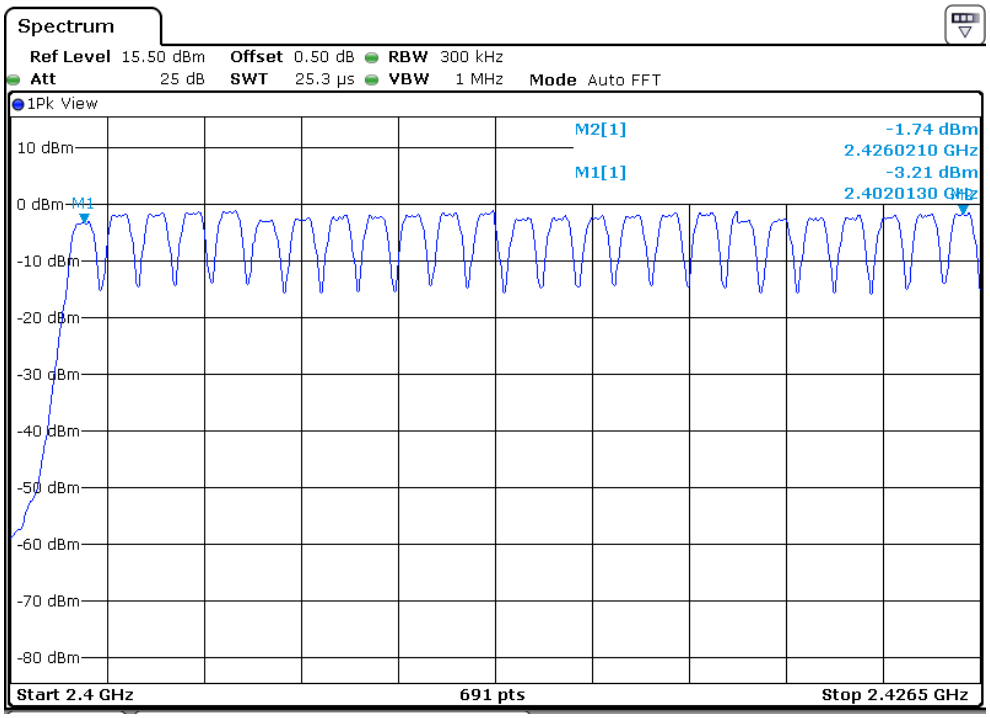
Number of hopping channels =	79

Modulation Type: GFSK

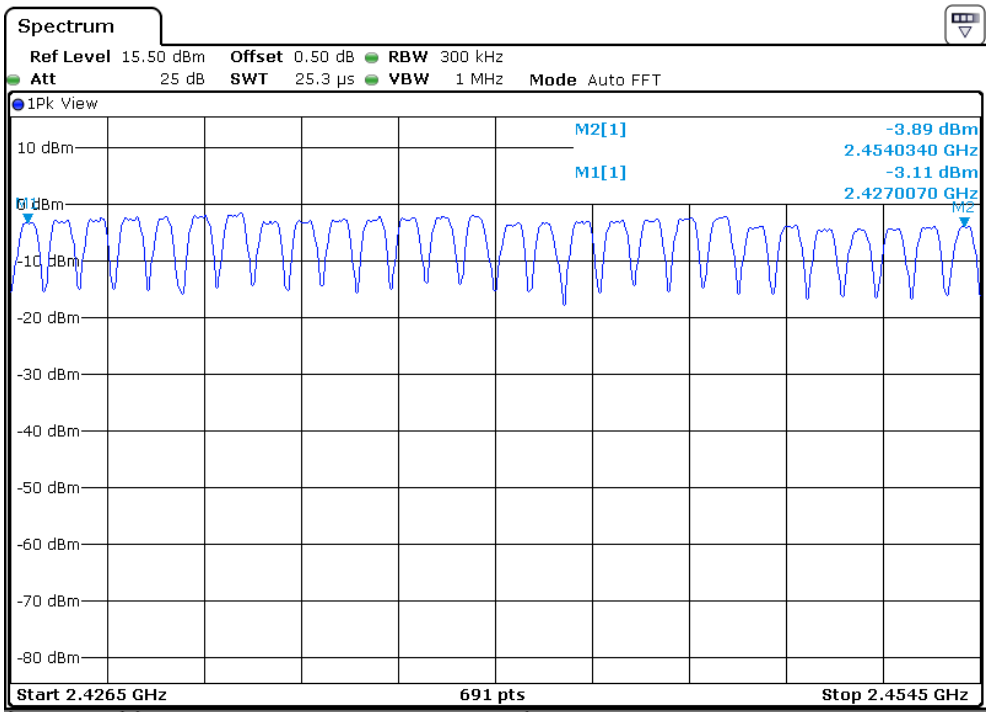
CH00-CH78



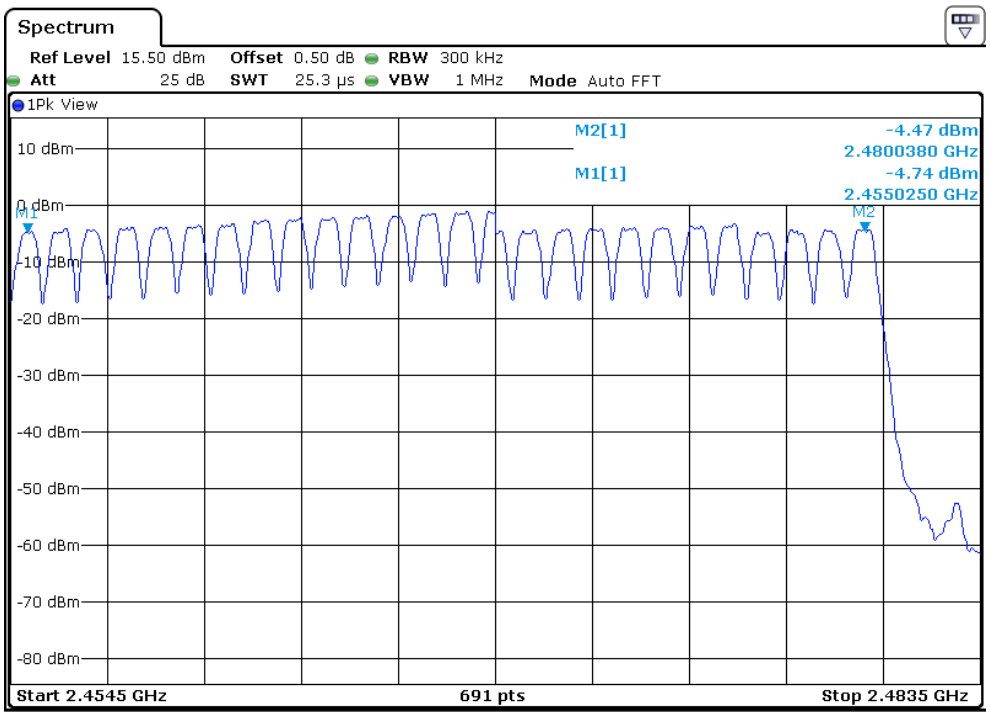
CH00-CH24



CH25-CH52



CH53-CH78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Att 25 dB SWT 25.3 µs VBW 1 MHz Mode Auto FFT
1Pk View
M2[1] -4.47 dBm
2.4800380 GHz
M1[1] -4.74 dBm
2.4550250 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):

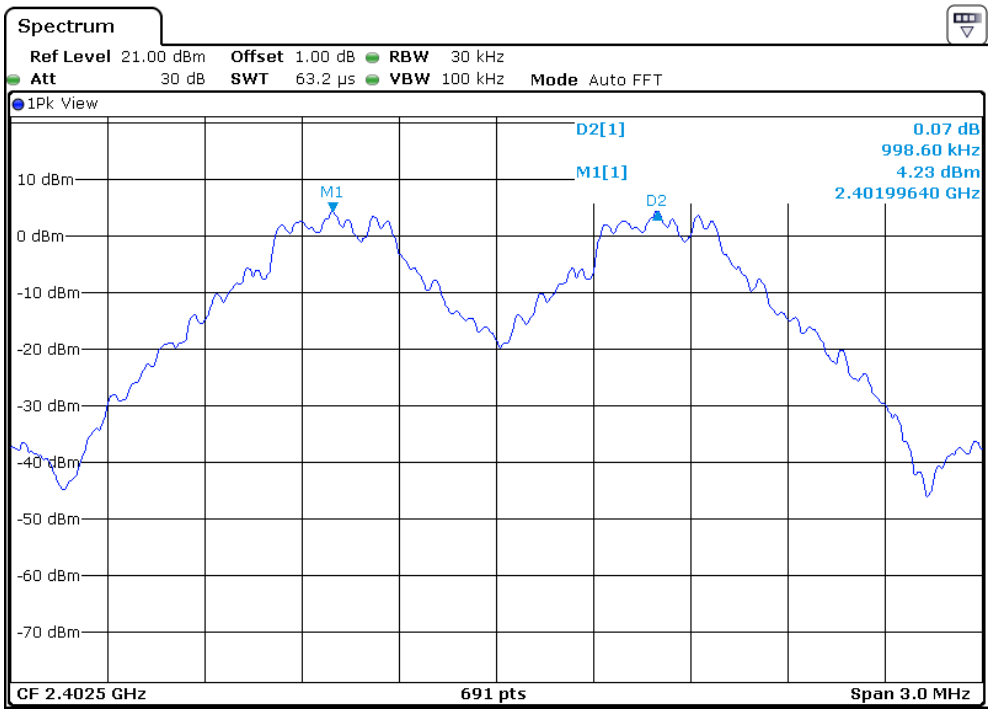
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: 1.411× 2/3 = 0.941MHz

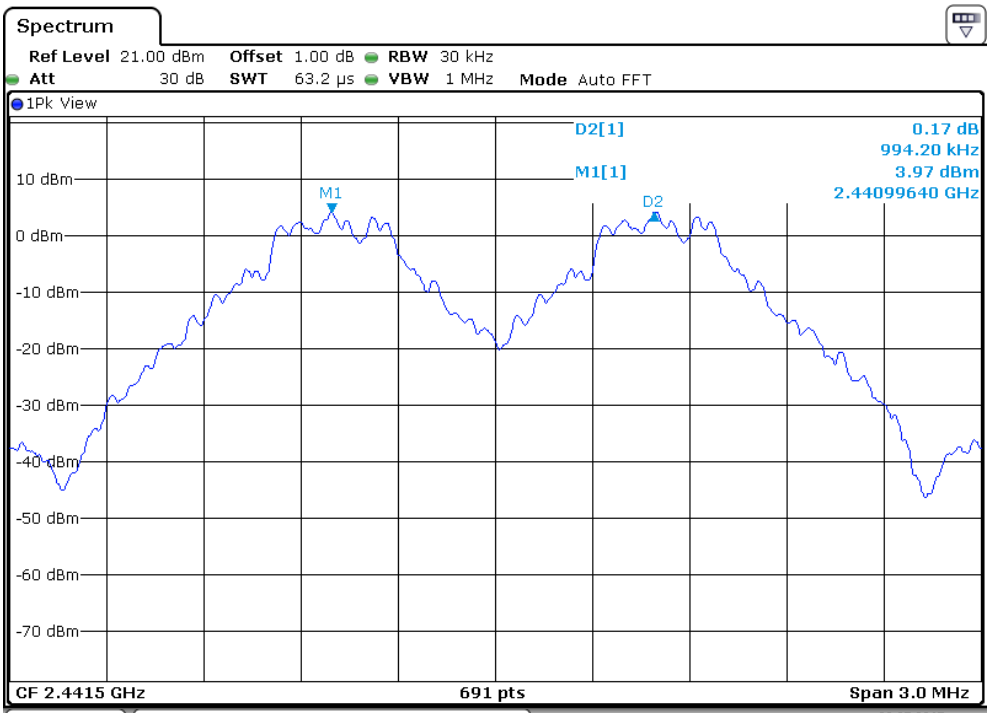
Channel Separation	0.994 MHz

Modulation Type: GFSK

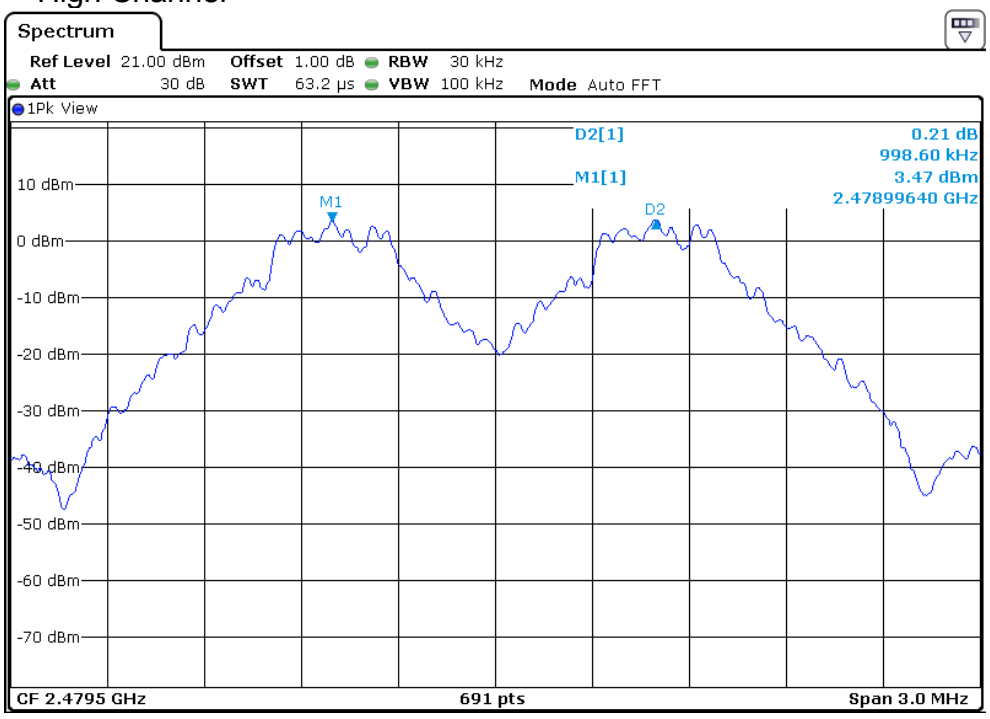
Low Channel



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 TRGGER was set to VIDEO. The time duration of the transmissions so captured was measured with the MARKER DELTA function.

The Worst Case Mode:

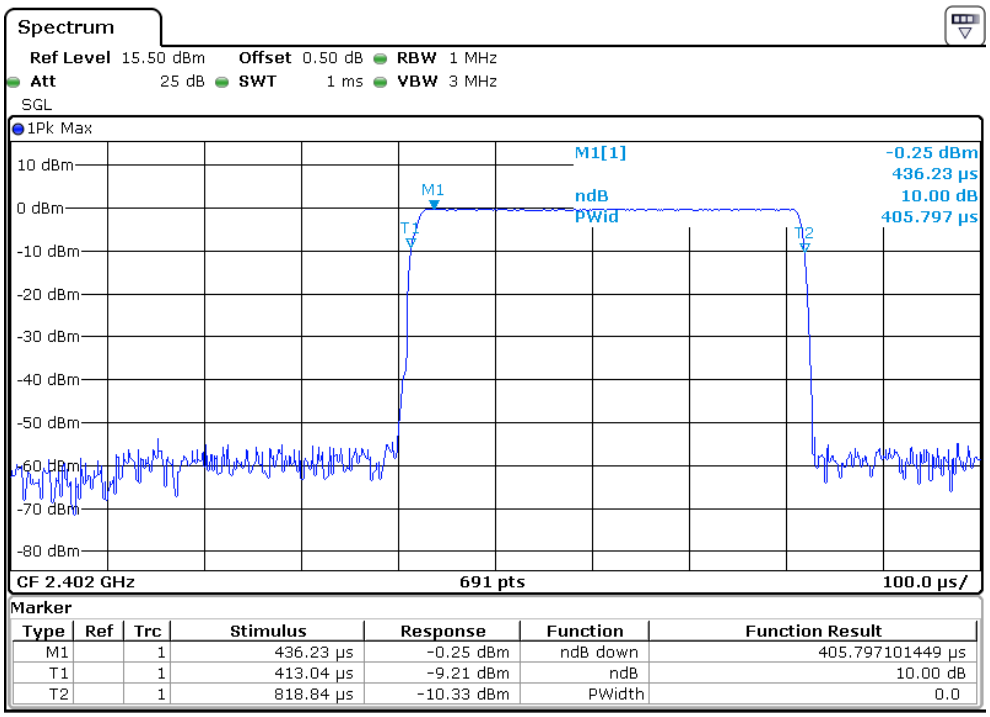
The maximum number of hopping channels in 31.6s for DH1
=1600 / 2 / 79 *31.6=320

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

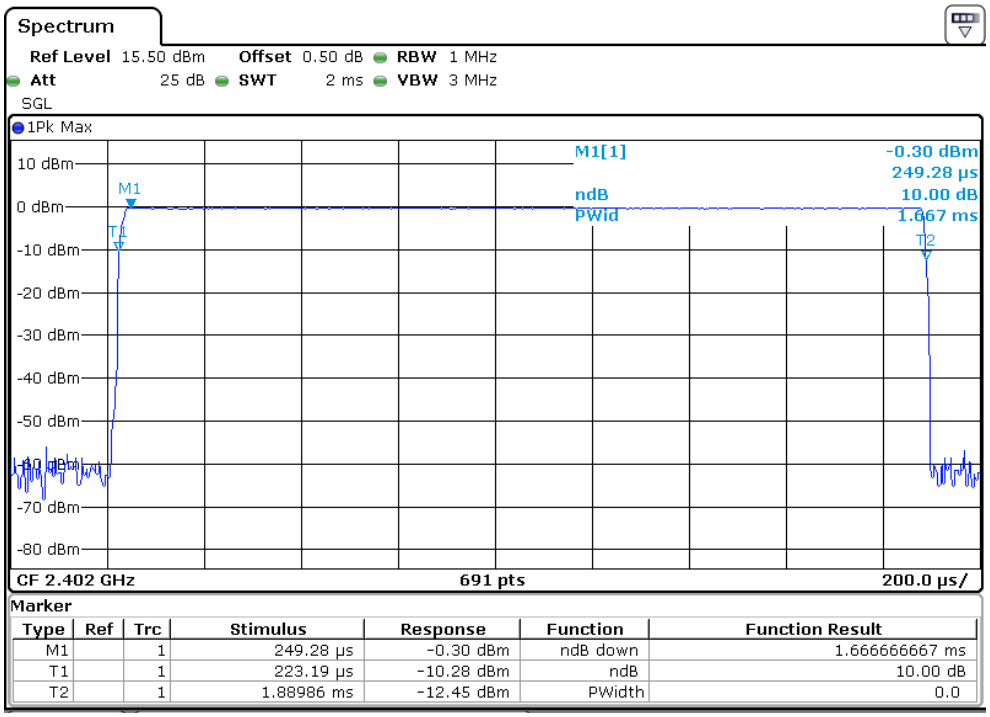
The maximum number of hopping channels in 31.6s for DH5
=1600 / 6 / 79 *31.6=107

Modulation Type	Packet	Max Dwell Time				Limit (s)	Result
GFSK	DH1	0.406	ms * 320=	129.9	ms	0.4	Pass
	DH3	1.667	ms * 160=	266.7	ms	0.4	Pass
	DH5	2.912	ms * 107=	311.6	ms	0.4	Pass
π/4-DQPSK	DH1	0.409	ms * 320=	130.9	ms	0.4	Pass
	DH3	1.667	ms * 160=	266.7	ms	0.4	Pass
	DH5	2.917	ms * 107=	312.1	ms	0.4	Pass
8DPSK	DH1	0.407	ms * 320=	130.2	ms	0.4	Pass
	DH3	1.667	ms *160=	266.7	ms	0.4	Pass
	DH5	2.912	ms *107=	311.6	ms	0.4	Pass

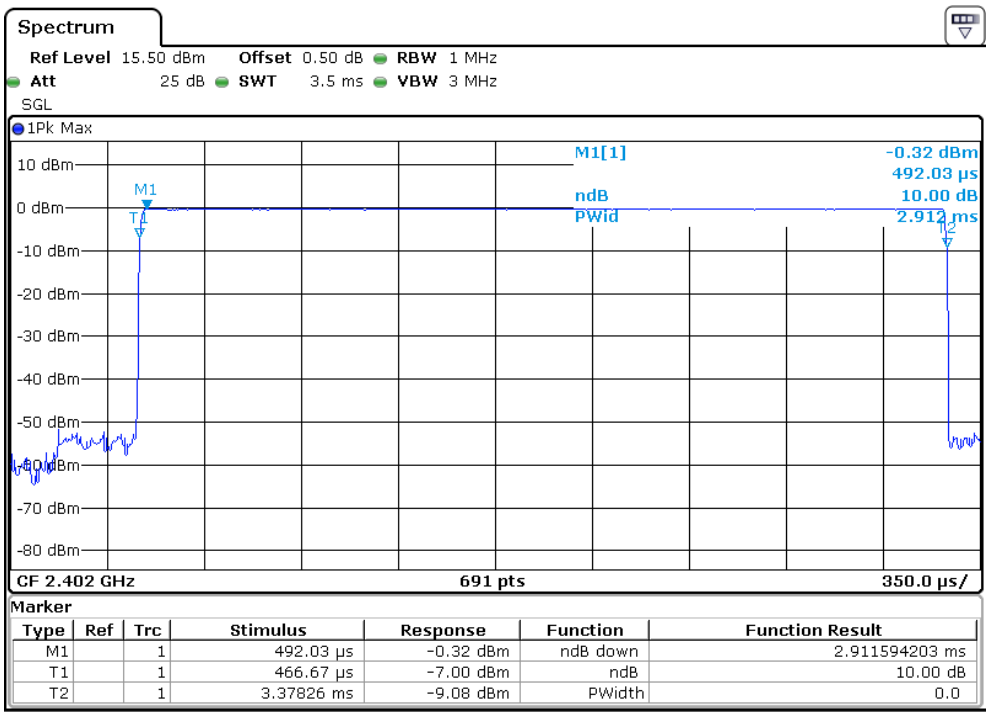
Modulation Type: GFSK
Packet: DH1



Packet: DH3



Packet: DH5

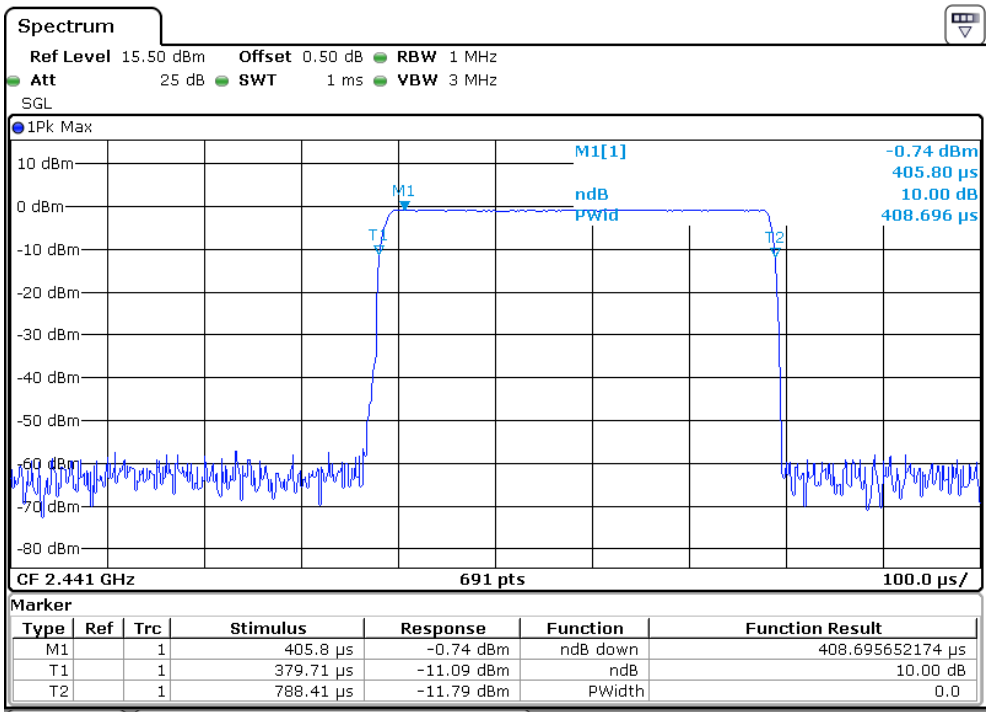


Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	492.03 µs	-0.32 dBm	ndB down	2.911594203 ms
T1		1	466.67 µs	-7.00 dBm	ndB	10.00 dB
T2		1	3.37826 ms	-9.08 dBm	PWidth	0.0

Modulation Type: π/4 –DQPSK

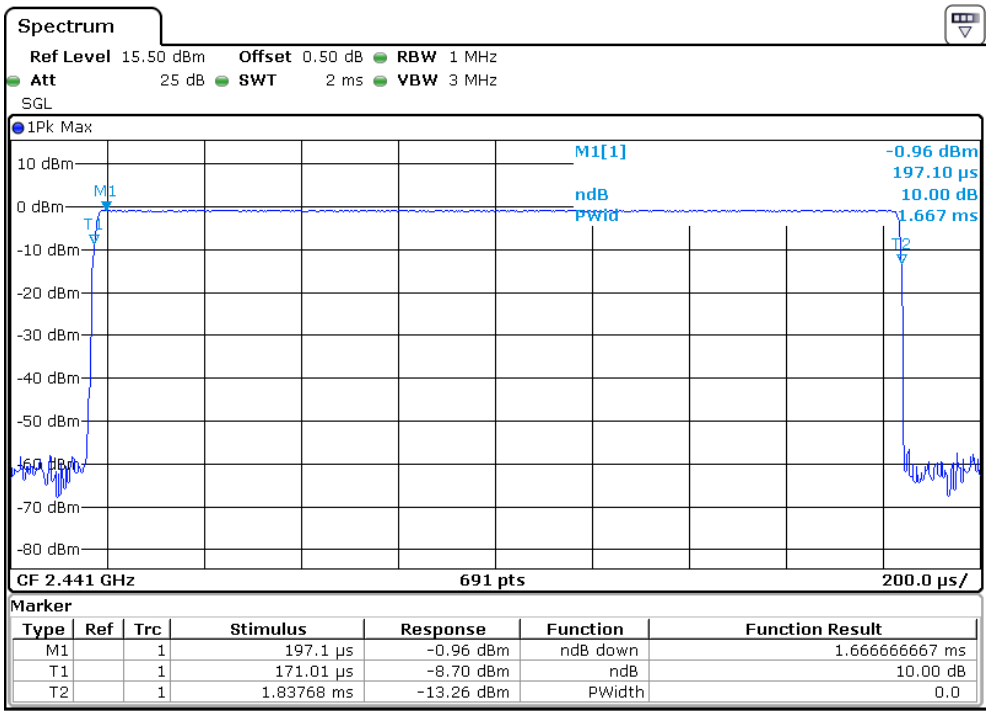
Packet: DH1



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	405.8 µs	-0.74 dBm	ndB down	408.695652174 µs
T1		1	379.71 µs	-11.09 dBm	ndB	10.00 dB
T2		1	788.41 µs	-11.79 dBm	PWidth	0.0

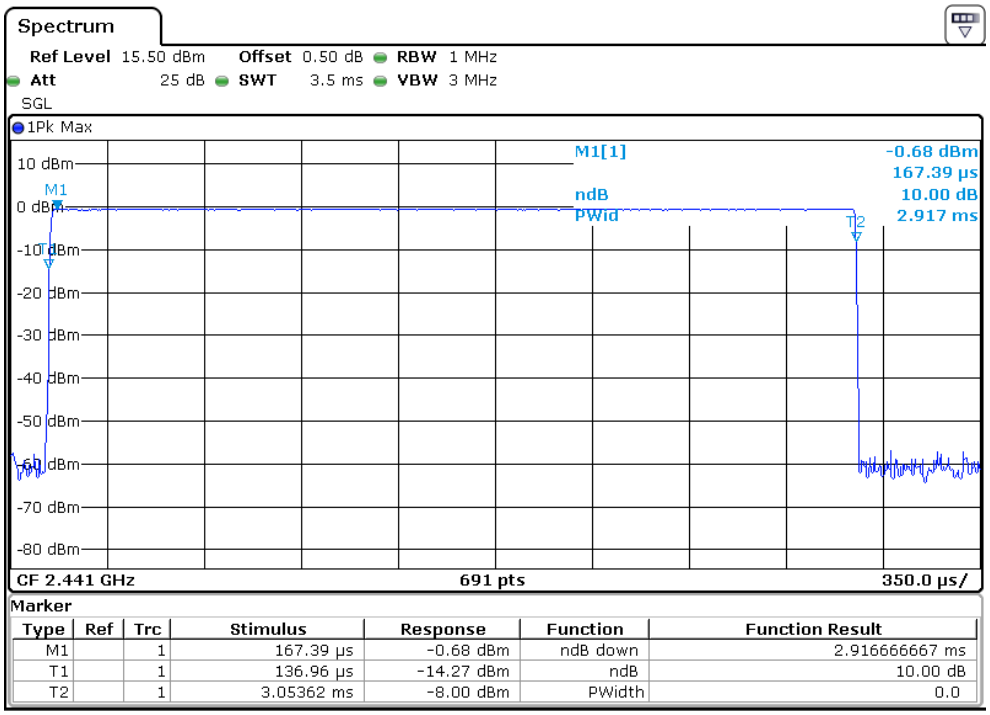
Packet: DH3



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	197.1 µs	-0.96 dBm	ndB down	1.666666667 ms
T1		1	171.01 µs	-8.70 dBm	ndB	10.00 dB
T2		1	1.83768 ms	-13.26 dBm	PWidth	0.0

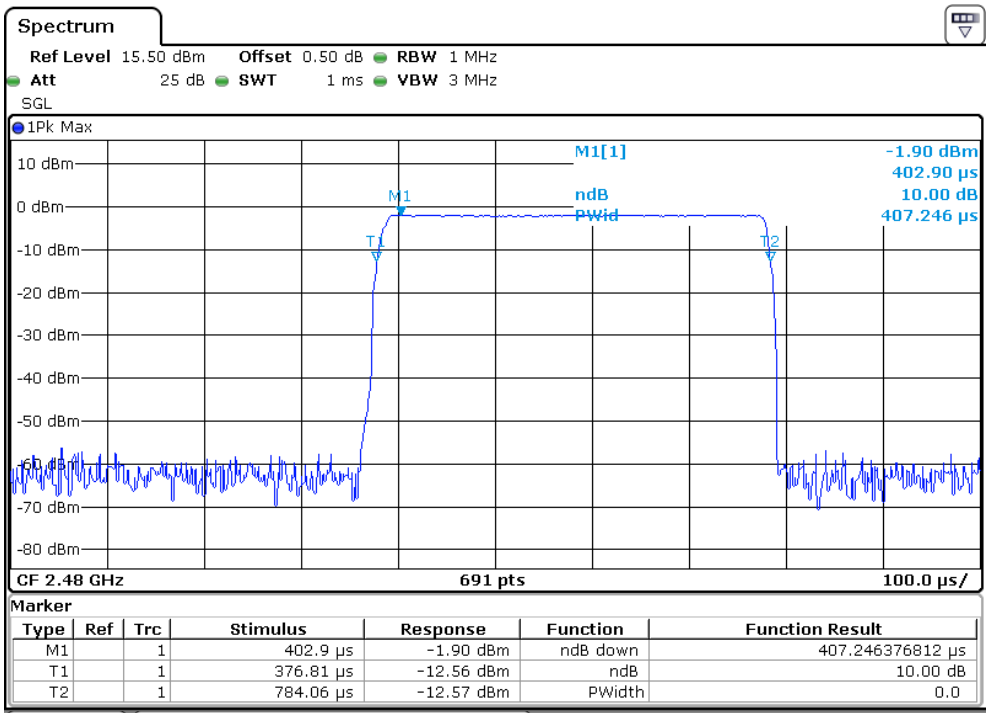
Packet: DH5



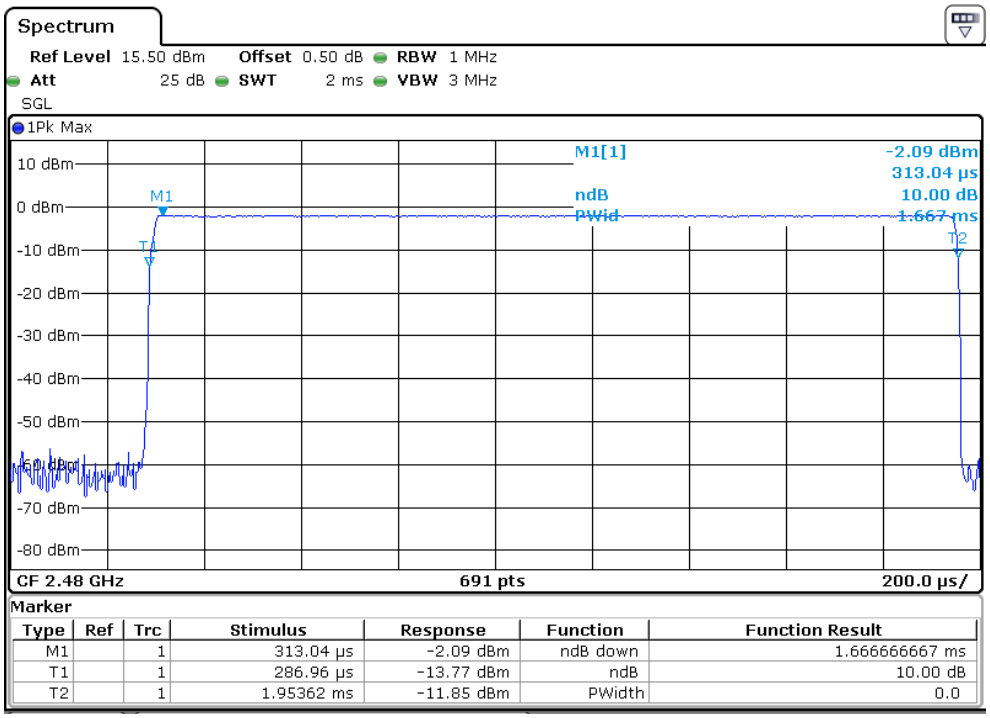
Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	167.39 µs	-0.68 dBm	ndB down	2.916666667 ms
T1		1	136.96 µs	-14.27 dBm	ndB	10.00 dB
T2		1	3.05362 ms	-8.00 dBm	PWidth	0.0

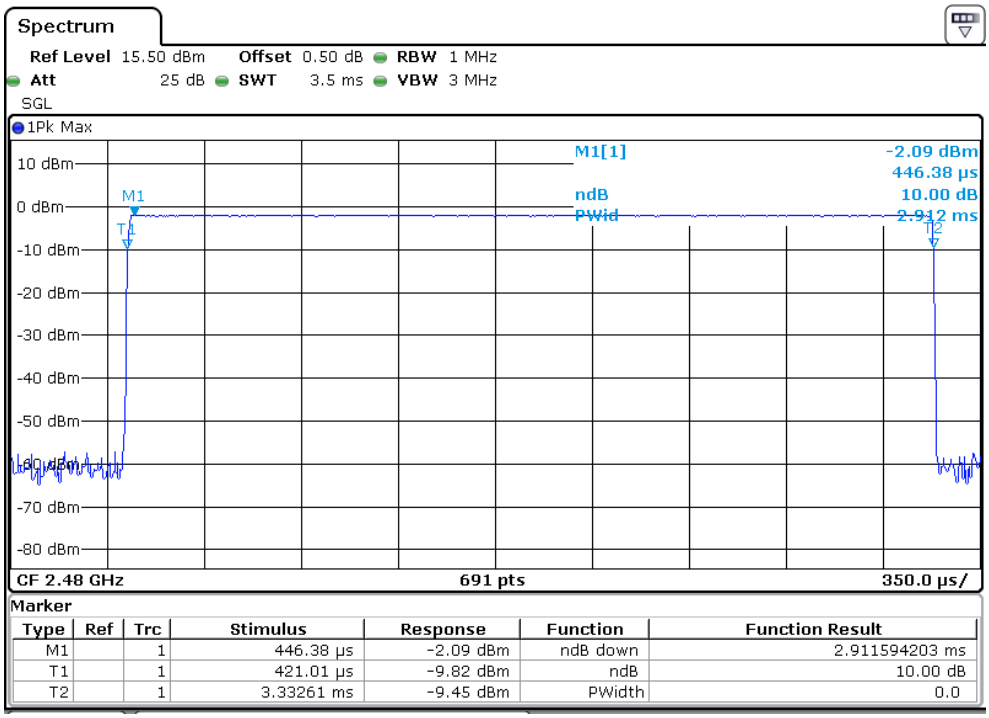
Modulation Type: 8DPSK
Packet: DH1



Packet: DH3



Packet: DH5


Spectrum
Ref Level 15.50 dBm Offset 0.50 dB RBW 1 MHz
Att 25 dB SWT 3.5 ms VBW 3 MHz
SGL
1Pk Max
M1[1]
-2.09 dBm
446.38 µs
ndB 10.00 dB
PWid 2.912 ms
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
350.0 µs/
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 446.38 µs -2.09 dBm ndB down 2.911594203 ms
T1 1 421.01 µs -9.82 dBm ndB 10.00 dB
T2 1 3.33261 ms -9.45 dBm PWidth 0.0

3.8 Band Edge

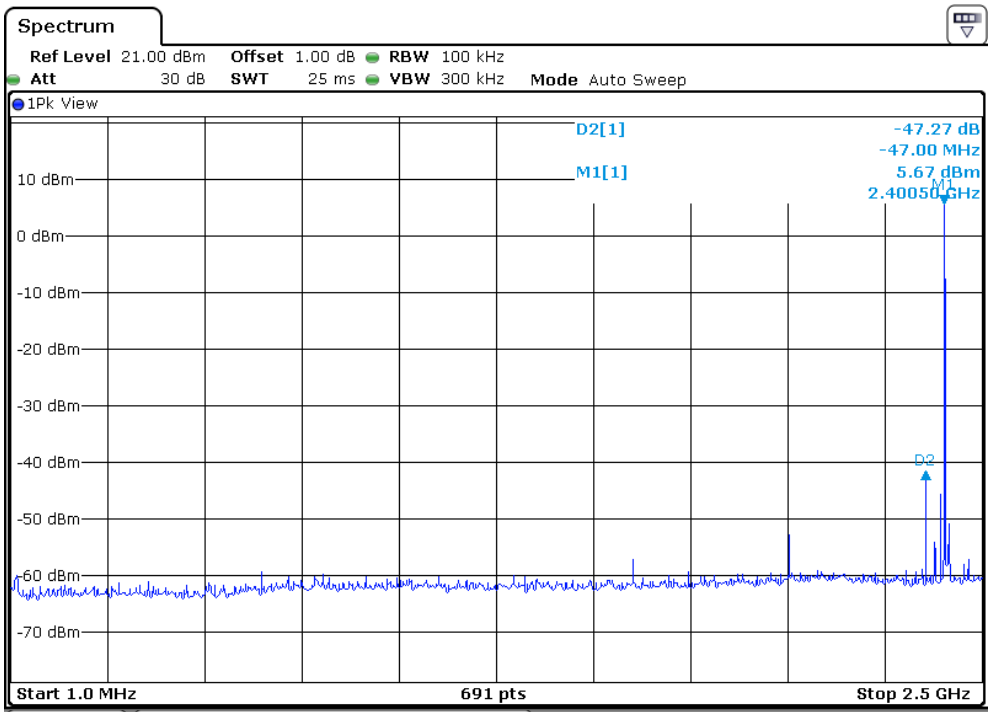
Out of Band Conducted Emissions, FCC Rule 15.247(d):

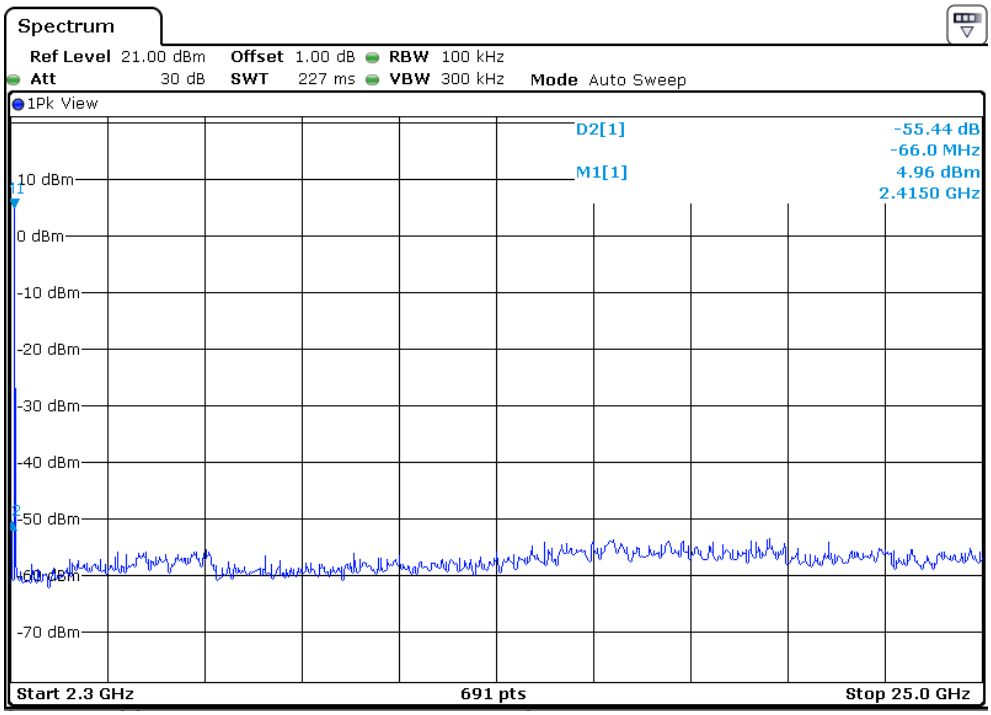
In any 100 KHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission.

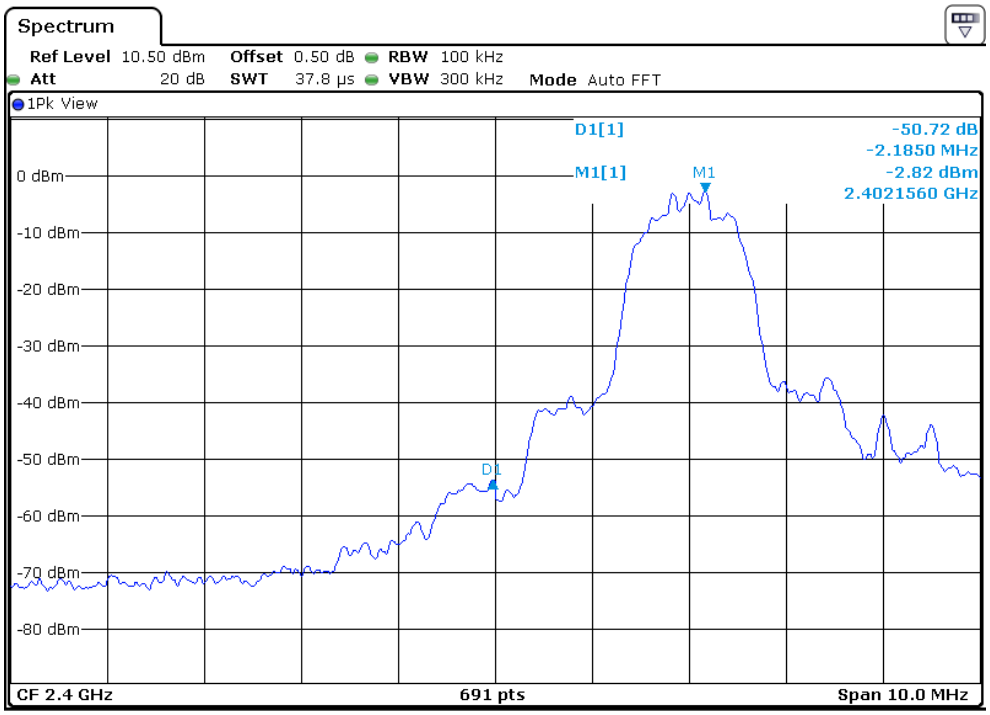
All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

Modulation Type: 8DPSK

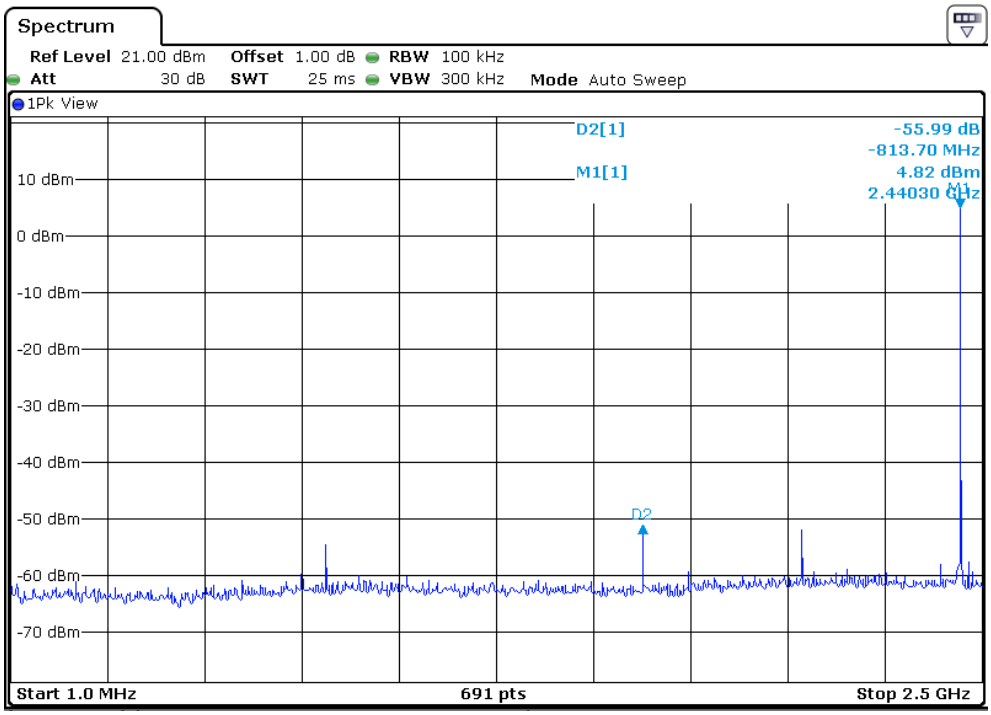
CH00

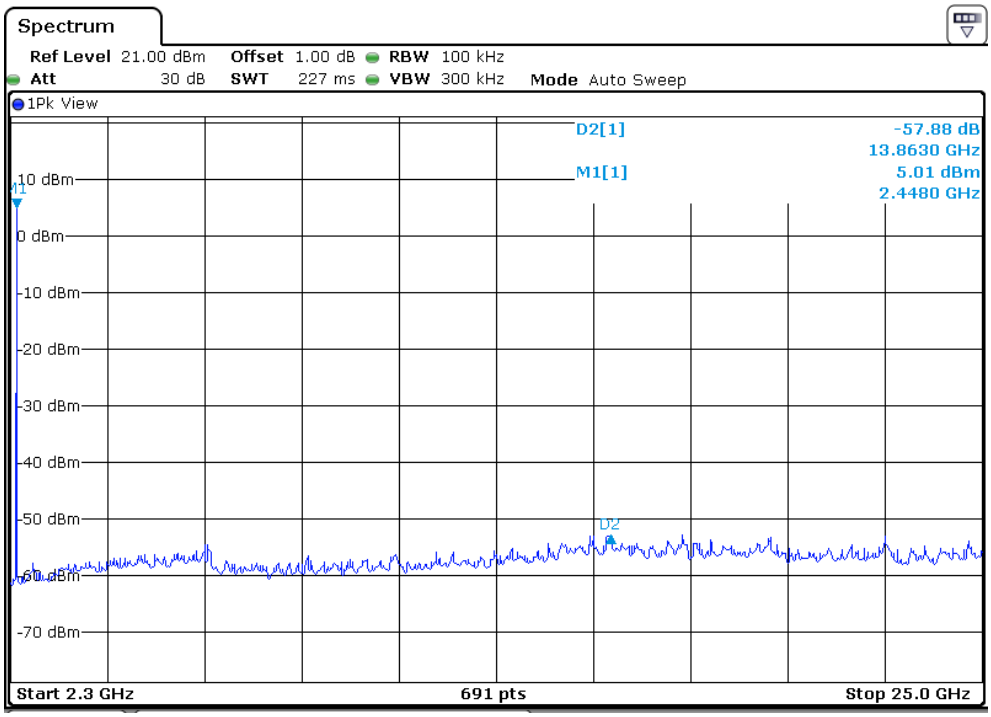




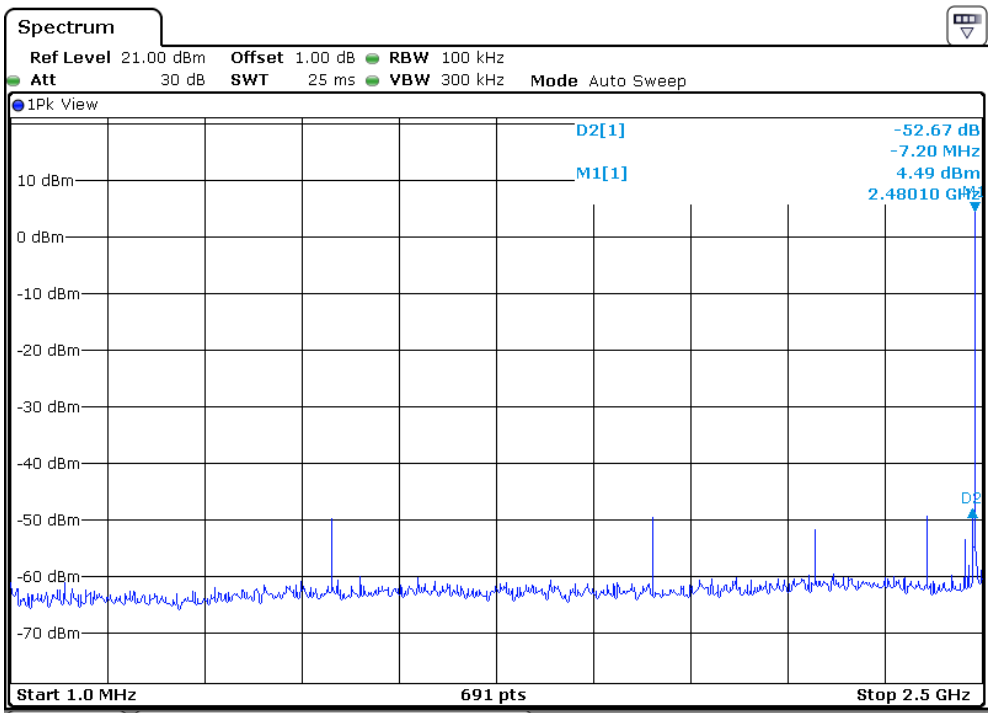

Spectrum
Ref Level 10.50 dBm Offset 0.50 dB RBW 100 kHz
Att 20 dB SWT 37.8 µs VBW 300 kHz Mode Auto FFT
1Pk View
D1[1] -50.72 dB
-2.1850 MHz
M1[1] -2.82 dBm
2.4021560 GHz
M1
D1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.4 GHz
691 pts
Span 10.0 MHz

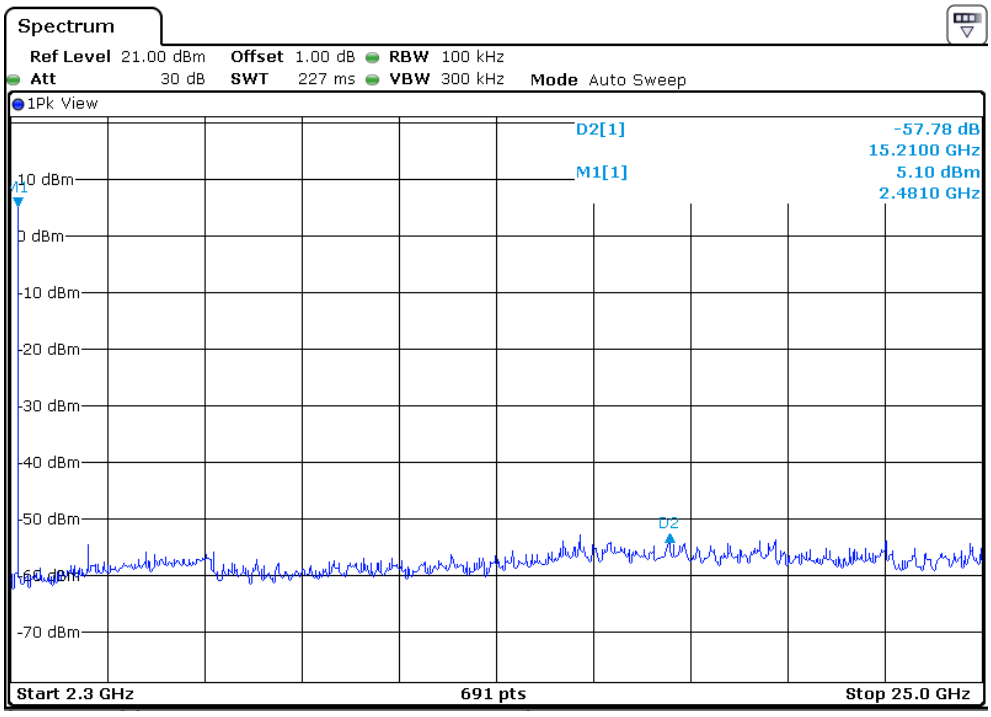
CH39


Spectrum
Ref Level 21.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D2[1] -55.99 dB
-813.70 MHz
M1[1] 4.82 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


Spectrum
Ref Level 21.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D2[1] -57.88 dB
13.8630 GHz
M1[1] 5.01 dBm
2.4480 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
Start 2.3 GHz
691 pts
Stop 25.0 GHz

CH78


Spectrum
Ref Level 21.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D2[1] -52.67 dB
-7.20 MHz
M1[1] 4.49 dBm
2.48010 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


Spectrum
Ref Level 21.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D2[1] -57.78 dB
15.2100 GHz
M1[1] 5.10 dBm
2.4810 GHz
10 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
Start 2.3 GHz
691 pts
Stop 25.0 GHz


Spectrum
Ref Level 10.50 dBm Offset 0.50 dB RBW 100 kHz
Att 20 dB SWT 37.8 µs VBW 300 kHz Mode Auto FFT
1Pk View
D1[1] -61.33 dB
3.7340 MHz
M1[1] -4.23 dBm
2.4798240 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D1
CF 2.4835 GHz
691 pts
Span 10.0 MHz

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 Version 3.0 (HS) and 2.1 with EDR, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length

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 = $20\log_{10}(7.5\text{ms} / 100\text{ms}) = -22.5$ 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) was placed on the styrene turntable with 0.8m up to 1GHz and 1.5 m above 1GHz. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is 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.

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.

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

TEST EQUIPMENT LIST

9.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ182-02	RF Power Meter	Anritsu	ML2496A	1302005	20-May-2015	20-May-2016
SZ182-02-01	Power Sensor	Anritsu	MA2411B	1207429	20-May-2015	20-May-2016
SZ061-04	BiConiLog Antenna	ETS	3142C	00066460	19-Oct-2014	19-Oct-2015
SZ185-01	EMI Receiver	R&S	ESCI	100547	07-Feb-2015	07-Feb-2016
SZ061-09	Horn Antenna	ETS	3115	00092346	01-Nov-2014	01-Nov-2015
SZ061-07	Pyramidal Horn Antenna	ETS	3160-09	00083067	01-Sep-2014	01-Sep-2015
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	29-Apr-2015	29-Apr-2016
SZ056-06	Spectrum Analyzer	R&S	FSV40	101101	08-Jul-2015	08-Jul-2016
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	07-Feb-2015	07-Feb-2016
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	19-Apr-2014	19-Apr-2016
SZ062-02	RF Cable	RADIALL	RG 213U	--	30-Jun-2015	30-Dec-2015
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	07-Apr-2015	07-Oct-2015
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	07-Apr-2015	07-Oct-2015
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	20-May-2015	20-May-2016
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	01-Nov-2014	01-Nov-2015
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	01-Nov-2014	01-Nov-2015
SZ187-02	Two-Line V-Network	R&S	ENV216	100073	24-Jun-2015	24-Jun-2016
SZ188-03	Shielding Room	ETS	RFD-100	4100	23-Aug-2014	23-Aug-2016