



Lenovo (Beijing) Limited

**Application
For
Certification**

FCC ID: A5MBT500

Lenovo 500 2.0 Bluetooth Speaker

Model: BT500

2.4GHz Transceiver

Report No.: 150212033SZN-001

Prepared and Checked by:

Approved by:

Sign on file

Leo Lai
Project Engineer

Andy Yan
Senior Project Engineer
Date: April 27, 2015

- The test results reported in this test report shall refer only to the sample actually tested and shall not refer or be deemed to refer to bulk from which such a sample may be said to have been obtained.
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TRF No.: FCC 15C_TX_b

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MEASUREMENT/TECHNICAL REPORT

Lenovo (Beijing) Limited

Model: BT500

FCC ID: A5MBT500

This report concerns (check one:) Original Grant ☒ Class II Change ☐

Equipment Type: DSS - Part 15 Spread Spectrum Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes ☐ No ☒

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 ☒

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [10-1-13 Edition] provision.

Report prepared by:

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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 |
| RF Exposure | RF Exposure | RF Exposure.pdf |

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EXHIBIT 1

GENERAL DESCRIPTION

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1.0 General Description

1.1 Product Description

The Equipment under Test (EUT) is a Lenovo 500 2.0 Bluetooth Speaker model BT500. It is powered by D.C. 3.7V from internal rechargeable battery.

Antenna Type: Integral antenna

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:

Bluetooth LE 4.0: 150212033SZN-002

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4: 2009 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

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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 C63.4: 2009.

The EUT was powered by a fully charged 3.7V internal rechargeable battery and charged by AC/DC adapter through AC 120/60Hz input during the test.

All packets DH1, DH3 & DH5 mode in all modulation types GFSK, $\pi/4$ -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 when it was powered by adapter.

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

No Special Accessory attached.

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.

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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. |
|-------------|--------------|------------------|
| Ipod | Apple | A1509 |
| AC Adapter | TP Link | T050100-2AS |
| USB Cable | N/A | Unshielded 120cm |

EXHIBIT 3
TEST RESULTS

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3.0 **Test Results**

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

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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 dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- 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 dB μ V 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 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 62.0 dB μ V
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB

AV = -10 dB

$$FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm} [(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$$

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3.1.2 Radiated Emission Data and Configuration Photograph - FCC section 15.209

Worst Case Radiated Emission

At

37.760 MHz

Judgement: Passed by 7.9 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

March 4, 2015

Date

INTERTEK TESTING SERVICES

Applicant: Lenovo (Beijing) Limited
Model: BT500
Worst Case Operating Mode: BT Link

Date of Test: March 4, 2015

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 | 30.000 | 25.9 | 20.0 | 18.6 | 24.5 | 40.0 | -15.5 |
| Horizontal | 65.405 | 31.8 | 20.0 | 13.5 | 25.3 | 40.0 | -14.7 |
| Horizontal | 101.780 | 26.1 | 20.0 | 17.0 | 23.1 | 43.5 | -20.4 |
| Vertical | 30.485 | 33.1 | 20.0 | 18.2 | 31.3 | 40.0 | -8.7 |
| Vertical | 37.760 | 45.0 | 20.0 | 7.1 | 32.1 | 40.0 | -7.9 |
| Vertical | 54.735 | 26.3 | 20.0 | 22.1 | 28.4 | 40.0 | -11.6 |

- 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

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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
4960 MHz

Judgement: Passed by 9.9 dB

TEST PERSONNEL:

Sign on file

Leo Lai, Project Engineer

Typed/Printed Name

March 4, 2015

Date

INTERTEK TESTING SERVICES

Applicant: Lenovo (Beijing) Limited
Model: BT500
Mode: TX-CH00 (2402MHz)

Date of Test: March 4, 2015

Table 2

Radiated Emissions

| Polarization | Frequency (MHz) | Reading (dB μ V) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dB μ V/m) | Peak Limit at 3m (dB μ V/m) | Margin (dB) |
|--------------|-----------------|----------------------|-------------------|---------------------|--------------------------|---------------------------------|-------------|
| Vertical | **2402.000 | 103.0 | 36.7 | 28.5 | 94.8 | -- | -- |
| Vertical | *4804.000 | 63.4 | 36.1 | 33.1 | 60.4 | 74.0 | -13.6 |

| Polarization | Frequency (MHz) | Reading (dB μ V) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dB μ V/m) | Average Limit at 3m (dB μ V/m) | Margin (dB) |
|--------------|-----------------|----------------------|-------------------|---------------------|----------------------|--------------------------|------------------------------------|-------------|
| Vertical | *4804.000 | 63.4 | 36.1 | 33.1 | 22.5 | 37.9 | 54.0 | -16.1 |

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.

Test Engineer: Leo Lai

TRF No.: FCC 15C_TX_b
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INTERTEK TESTING SERVICES

Applicant: Lenovo (Beijing) Limited
Model: BT500
Mode: TX-CH39 (2441MHz)

Date of Test: March 4, 2015

Table 3

Radiated Emissions

| Polarization | Frequency (MHz) | Reading (dB μ V) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dB μ V/m) | Peak Limit at 3m (dB μ V/m) | Margin (dB) |
|--------------|-----------------|----------------------|-------------------|---------------------|--------------------------|---------------------------------|-------------|
| Vertical | *4882.000 | 66.0 | 36.1 | 33.3 | 63.2 | 74.0 | -10.8 |
| Vertical | *7323.000 | 60.2 | 36.2 | 37.9 | 61.9 | 74.0 | -12.1 |

| Polarization | Frequency (MHz) | Reading (dB μ V) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dB μ V/m) | Average Limit at 3m (dB μ V/m) | Margin (dB) |
|--------------|-----------------|----------------------|-------------------|---------------------|----------------------|--------------------------|------------------------------------|-------------|
| Vertical | *4882.000 | 66.0 | 36.1 | 33.3 | 22.5 | 40.7 | 54.0 | -13.3 |
| Vertical | *7323.000 | 60.2 | 36.2 | 37.9 | 22.5 | 39.4 | 54.0 | -14.6 |

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

INTERTEK TESTING SERVICES

Applicant: Lenovo (Beijing) Limited
 Model: BT500
 Mode: TX-CH78 (2480MHz)

Date of Test: March 4, 2015

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) |
|--------------|-----------------|----------------|-------------------|---------------------|--------------------|---------------------------|-------------|
| Vertical | **2480.000 | 102.2 | 36.7 | 28.6 | 94.1 | -- | -- |
| Vertical | *4960.000 | 66.8 | 36.1 | 33.4 | 64.1 | 74.0 | -9.9 |
| Vertical | *7440.000 | 59.5 | 36.2 | 38.2 | 61.5 | 74.0 | -12.5 |

| 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) |
|--------------|-----------------|----------------|-------------------|---------------------|----------------------|--------------------|------------------------------|-------------|
| Vertical | *4960.000 | 66.8 | 36.1 | 33.4 | 22.5 | 41.6 | 54.0 | -12.4 |
| Vertical | *7440.000 | 59.5 | 36.2 | 38.2 | 22.5 | 39.0 | 54.0 | -15.0 |

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

Test Engineer: Leo Lai

TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
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3.2 Conducted Emission at Mains Terminal

3.2.1 Conducted Emissions and Data Configuration Photograph

Worst Case Conducted Configuration
at
0.414 MHz

Judgement: Passed by 6.0 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

March 4, 2015
Date

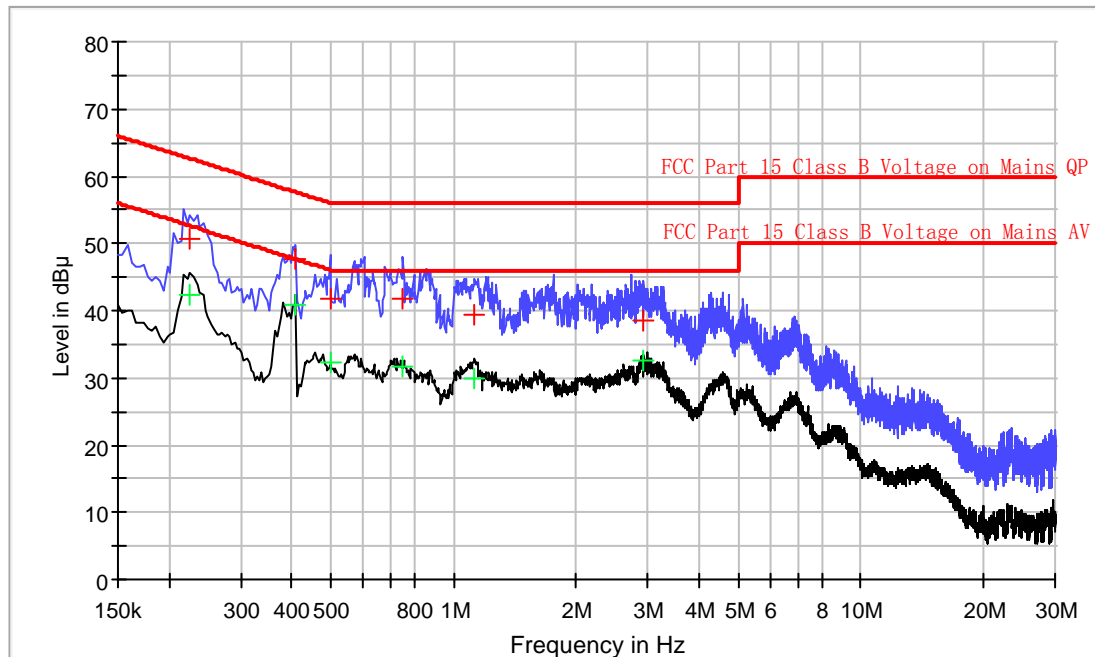
INTERTEK TESTING SERVICES

Applicant: Lenovo (Beijing) Limited
Model: BT500
Worst Case Operating Mode: BT Link

Date of Test: March 4, 2015

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

| Frequency (MHz) | QuasiPeak (dB μV) | Line | Corr. (dB) | Margin (dB) | Limit (dB μV) |
|-----------------|-------------------|------|------------|-------------|---------------|
| 0.226 | 50.7 | L1 | 9.8 | 11.9 | 62.6 |
| 0.410 | 47.8 | L1 | 9.8 | 9.8 | 57.6 |
| 0.498 | 41.9 | L1 | 9.8 | 14.1 | 56.0 |
| 0.750 | 41.8 | L1 | 10.0 | 14.2 | 56.0 |
| 1.126 | 39.5 | L1 | 9.9 | 16.5 | 56.0 |
| 2.938 | 38.5 | L1 | 9.9 | 17.5 | 56.0 |

Result Table AV

| Frequency (MHz) | Average (dB μV) | Line | Corr. (dB) | Margin (dB) | Limit (dB μV) |
|-----------------|-----------------|------|------------|-------------|---------------|
| 0.226 | 42.5 | L1 | 9.8 | 10.1 | 52.6 |
| 0.410 | 41.0 | L1 | 9.8 | 6.6 | 47.6 |
| 0.498 | 32.2 | L1 | 9.8 | 13.8 | 46.0 |
| 0.750 | 31.7 | L1 | 10.0 | 14.3 | 46.0 |
| 1.126 | 29.9 | L1 | 9.9 | 16.1 | 46.0 |
| 2.938 | 32.6 | L1 | 9.9 | 13.4 | 46.0 |

TRF No.: FCC 15C_TX_b
FCC ID: A5MBT500
150212033SZN-001

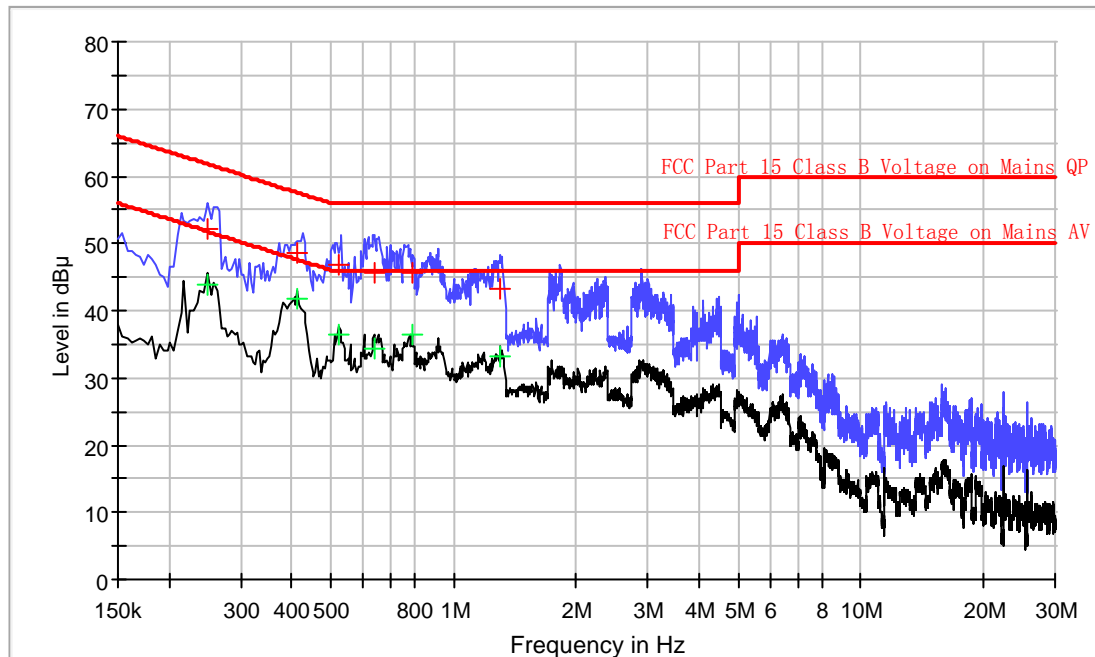
INTERTEK TESTING SERVICES

Applicant: Lenovo (Beijing) Limited
Model: BT500
Worst Case Operating Mode: BT Link

Date of Test: March 4, 2015

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

| Frequency (MHz) | QuasiPeak (dB μV) | Line | Corr. (dB) | Margin (dB) | Limit (dB μV) |
|-----------------|-------------------|------|------------|-------------|---------------|
| 0.250 | 52.1 | N | 10.1 | 9.7 | 61.8 |
| 0.414 | 48.6 | N | 10.1 | 9.0 | 57.6 |
| 0.522 | 46.7 | N | 10.1 | 9.3 | 56.0 |
| 0.638 | 45.7 | N | 10.2 | 10.3 | 56.0 |
| 0.790 | 45.7 | N | 10.2 | 10.3 | 56.0 |
| 1.302 | 43.3 | N | 10.2 | 12.7 | 56.0 |

Result Table AV

| Frequency (MHz) | Average (dB μV) | Line | Corr. (dB) | Margin (dB) | Limit (dB μV) |
|-----------------|-----------------|------|------------|-------------|---------------|
| 0.250 | 43.9 | N | 10.1 | 7.9 | 51.8 |
| 0.414 | 41.6 | N | 10.1 | 6.0 | 47.6 |
| 0.522 | 36.6 | N | 10.1 | 9.4 | 46.0 |
| 0.638 | 34.5 | N | 10.2 | 11.5 | 46.0 |
| 0.790 | 36.4 | N | 10.2 | 9.6 | 46.0 |
| 1.302 | 33.1 | N | 10.2 | 12.9 | 46.0 |

TRF No.: FCC 15C_TX_b
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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 = 0dBi | | | |
|---------------------|-----------------|--------------------|-------------------|
| Modulation Type | Frequency (MHz) | Output Power (dBm) | Output Power (mW) |
| GFSK | 2402 | -0.27 | 0.94 |
| | 2441 | -0.60 | 0.87 |
| | 2480 | -1.19 | 0.76 |
| $\pi/4$ -DQPSK | 2402 | -0.54 | 0.88 |
| | 2441 | -0.79 | 0.83 |
| | 2480 | -1.21 | 0.76 |
| 8DPSK | 2402 | -1.22 | 0.76 |
| | 2441 | -1.28 | 0.74 |
| | 2480 | -2.54 | 0.56 |

Cable loss, external attenuation has been included in OFFSET(0.5dB) function

EUT max. output level = -0.27dBm

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

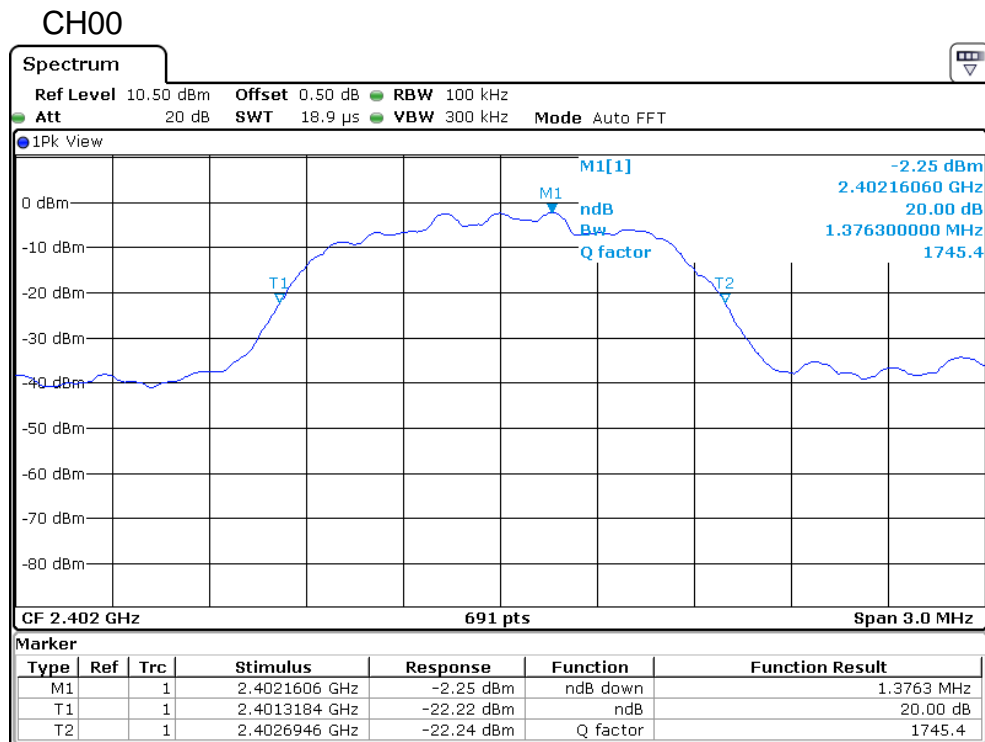
3.4 20dB Bandwidth

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.

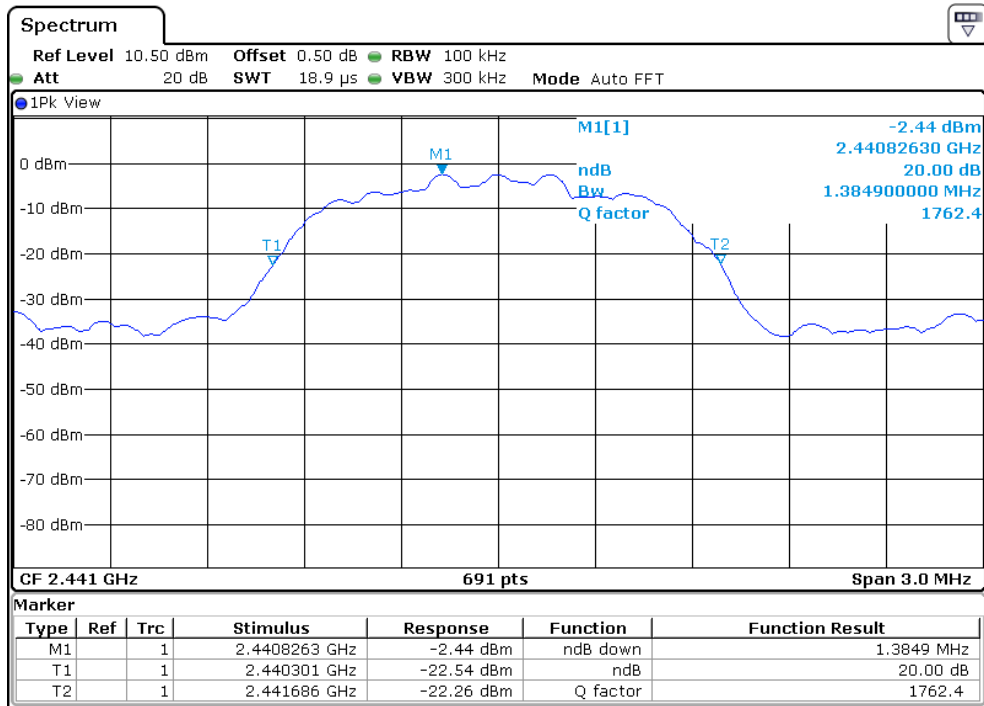
| Frequency (MHz) | 20 dB Bandwidth (MHz) |
|-----------------|-----------------------|
| 2402 | 1.376 |
| 2441 | 1.385 |
| 2480 | 1.376 |

Modulation Type: 8DPSK

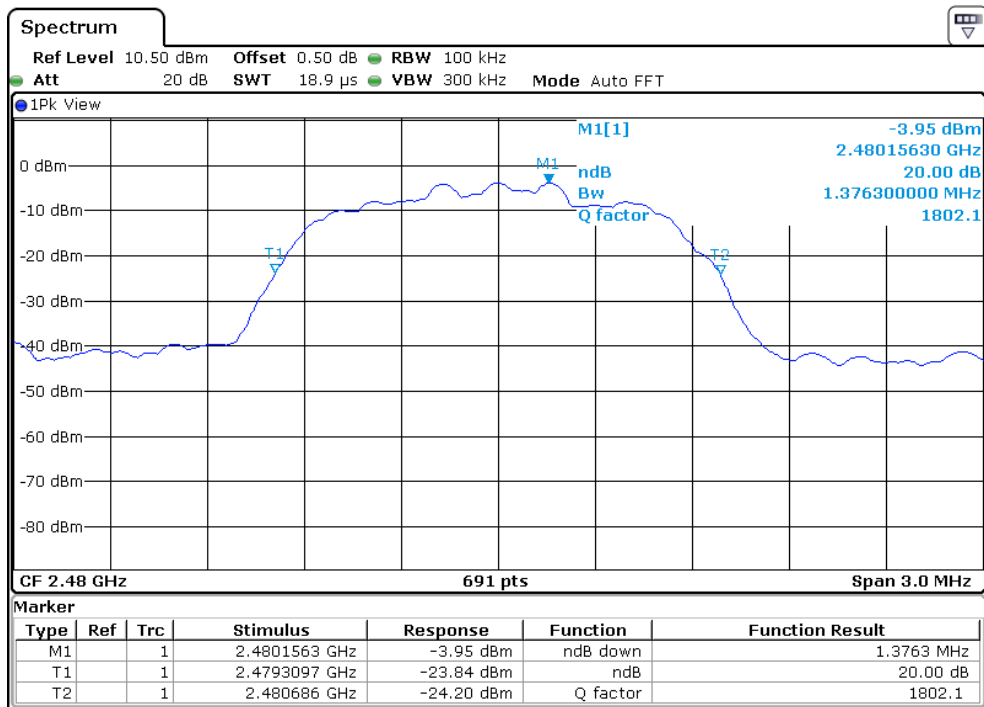


INTERTEK TESTING SERVICES

CH39



CH78



TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
 150212033SZN-001

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3.5 Channel Number (Number of Hopping Frequencies)

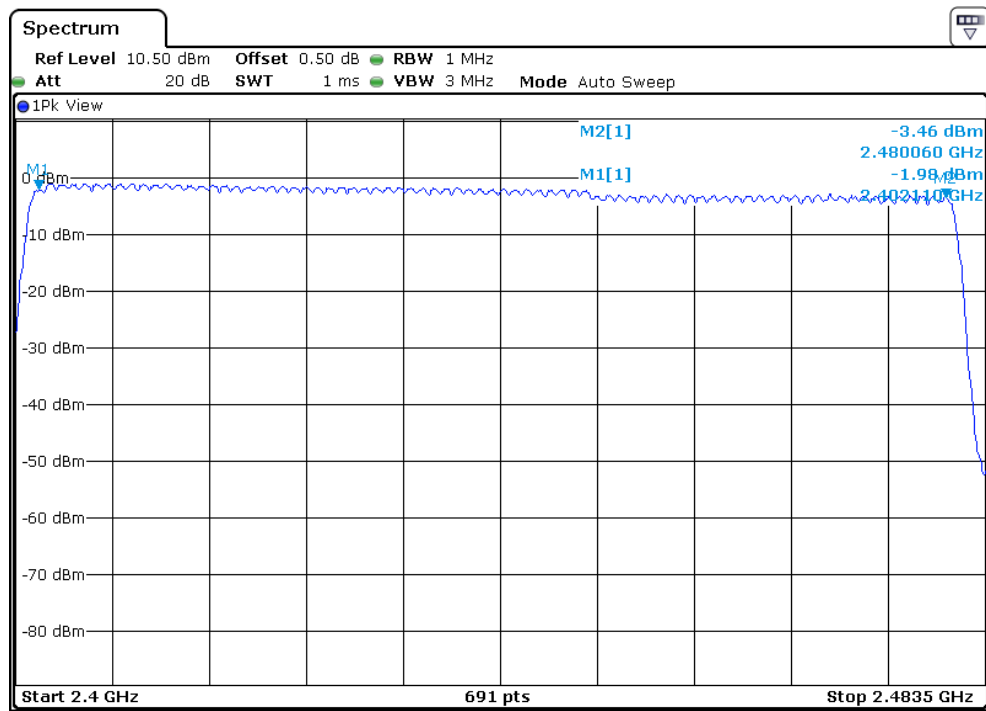
Minimum Number of Hopping Frequencies, FCC Rule 15.247(a) (1) (iii):

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 |
|------------------------------|----|

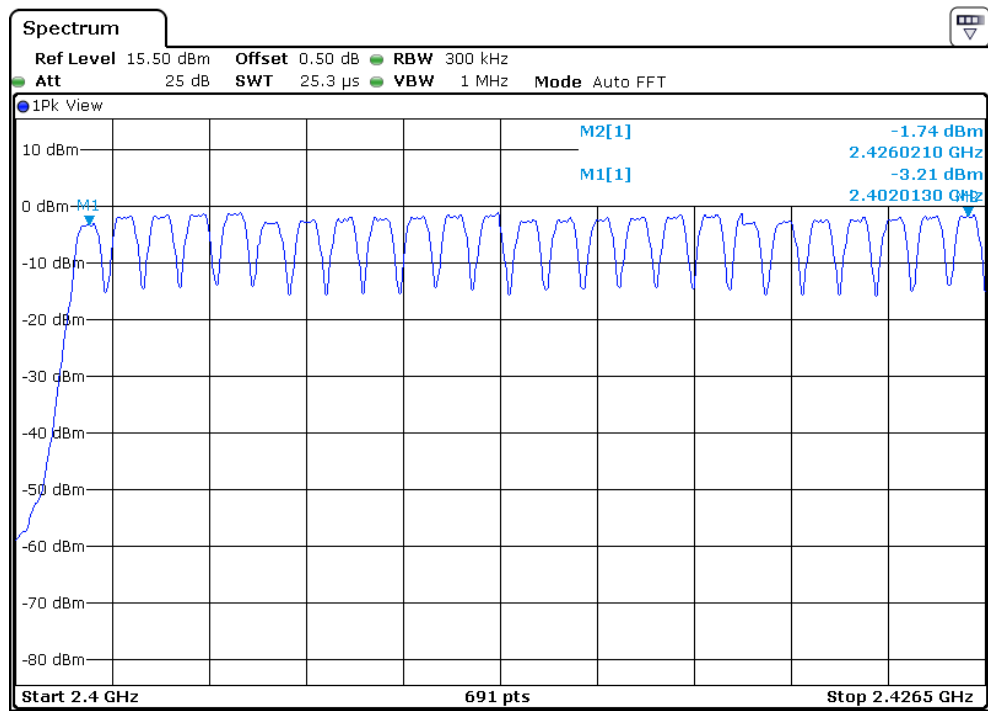
Modulation Type: GFSK

CH00-CH78

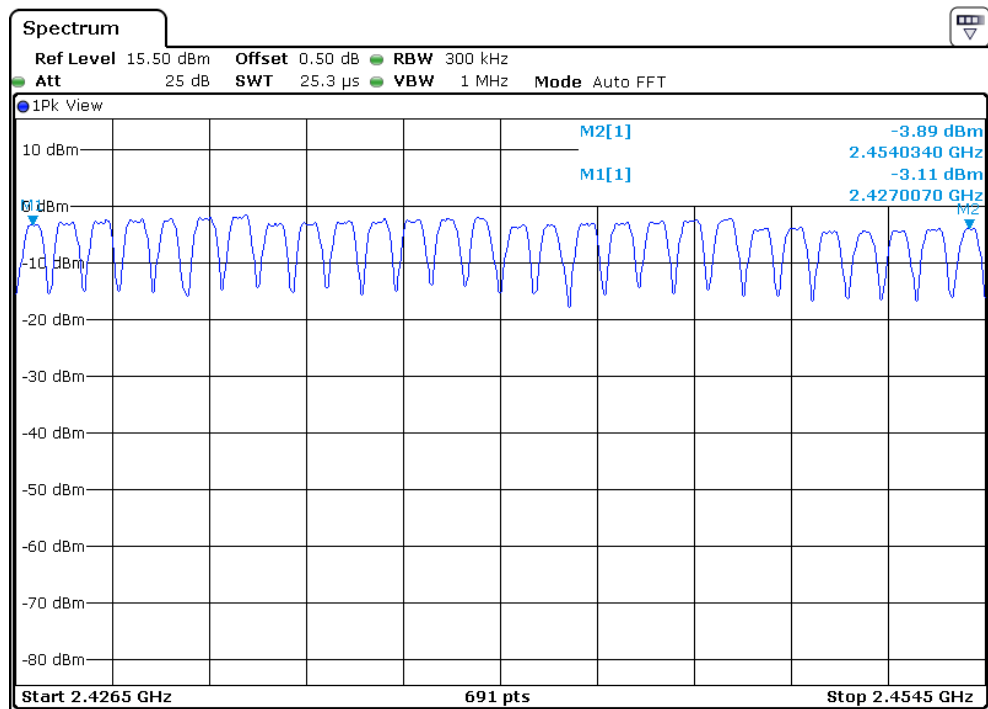


INTERTEK TESTING SERVICES

CH00-CH24



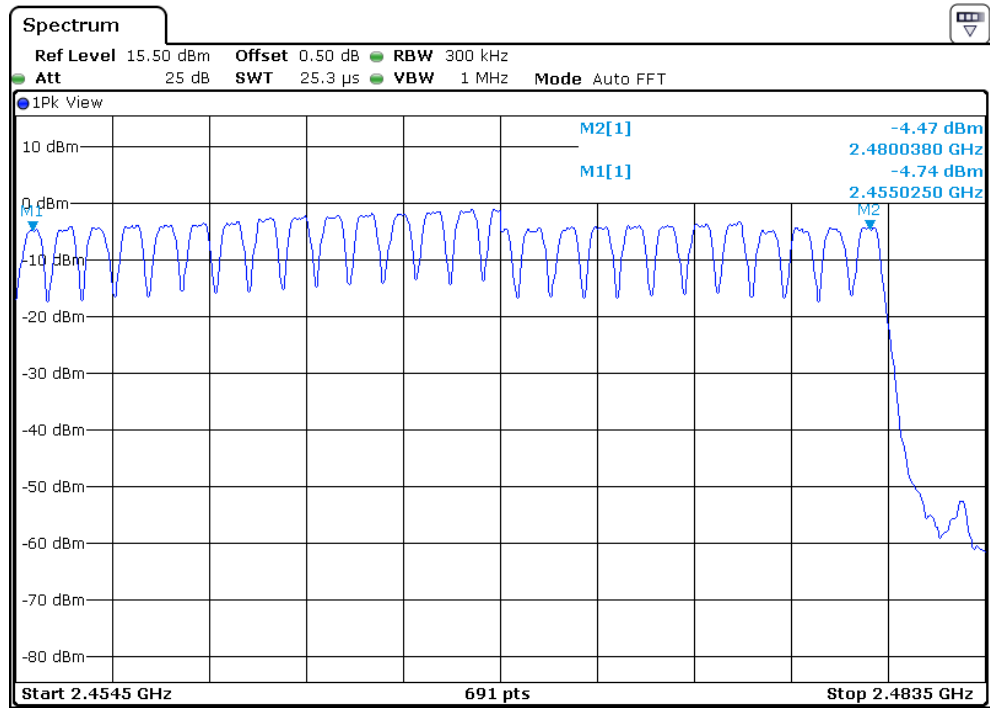
CH25-CH52



TRF No.: FCC 15C_TX_b
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CH53-CH78



TRF No.: FCC 15C_TX_b
FCC ID: A5MBT500
150212033SZN-001

INTERTEK TESTING SERVICES

3.6 Channel Separation (Carrier Frequency Separation)

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

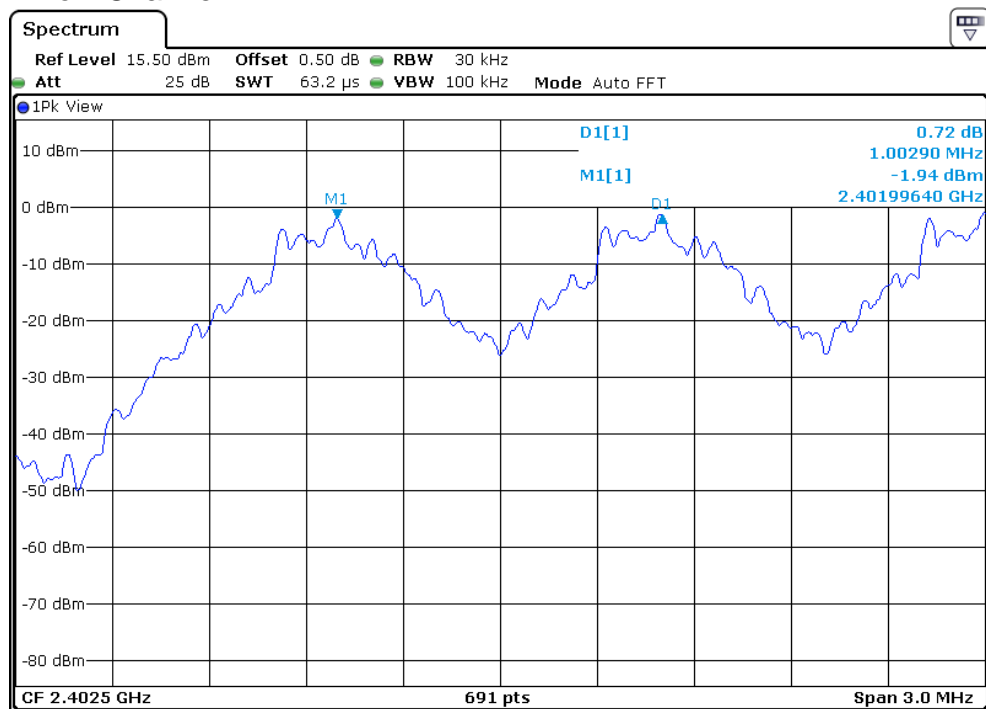
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: $1.385 \times 2/3 = 0.923\text{MHz}$

| | |
|--------------------|-----------|
| Channel Separation | 1.003 MHz |
|--------------------|-----------|

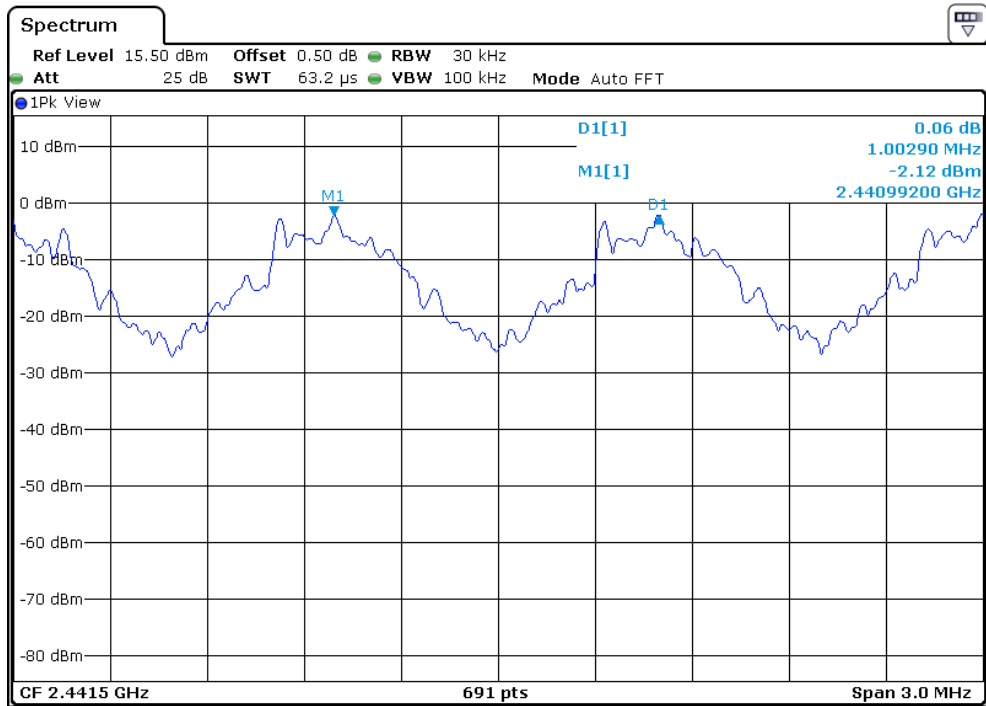
Modulation Type: GFSK

Low Channel

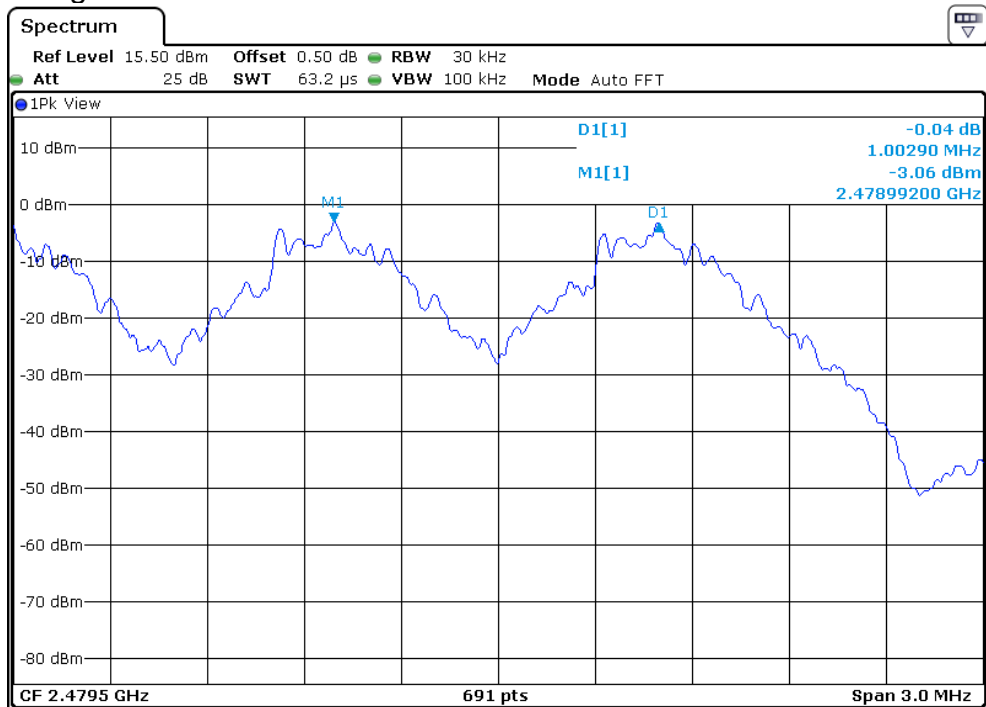


INTERTEK TESTING SERVICES

Middle Channel



High Channel



TRF No.: FCC 15C_TX_b
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INTERTEK TESTING SERVICES

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 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
 $= 1600 / 4 / 79 * 31.6 = 160$

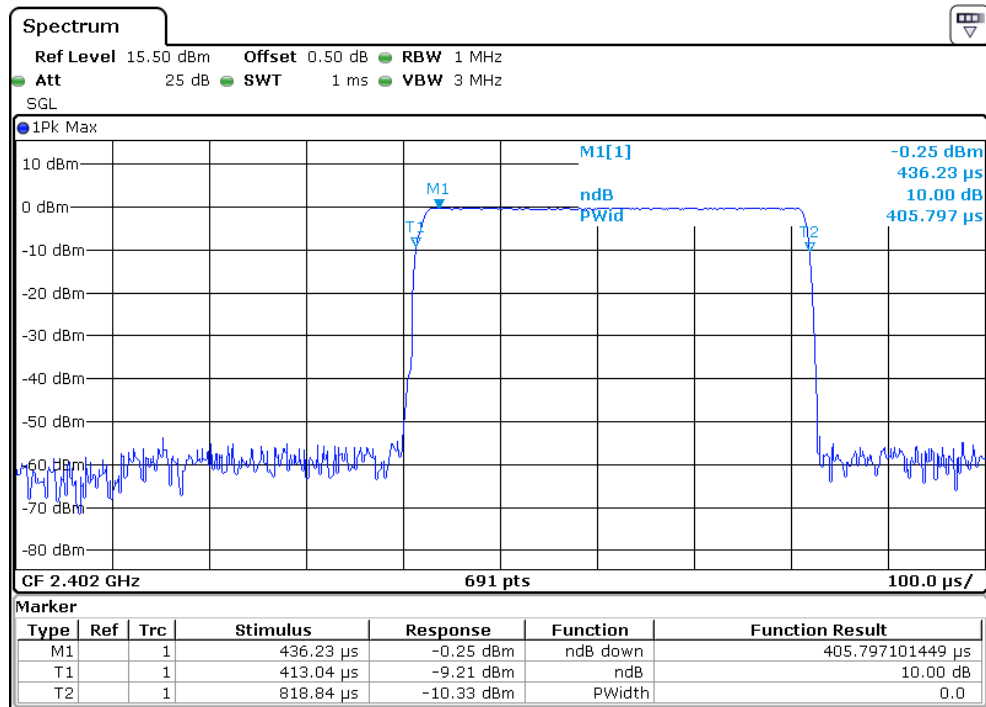
The maximum number of hopping channels in 31.6s for DH5
 $= 1600 / 6 / 79 * 31.6 = 107$

| 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 |

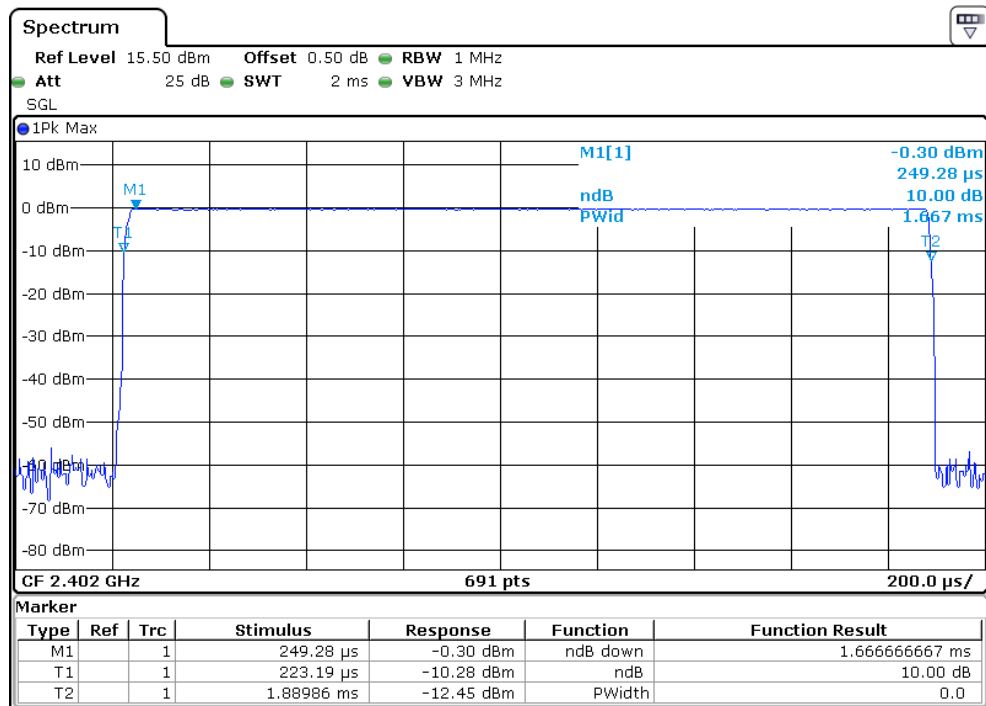
INTERTEK TESTING SERVICES

Modulation Type: GFSK

Packet: DH1



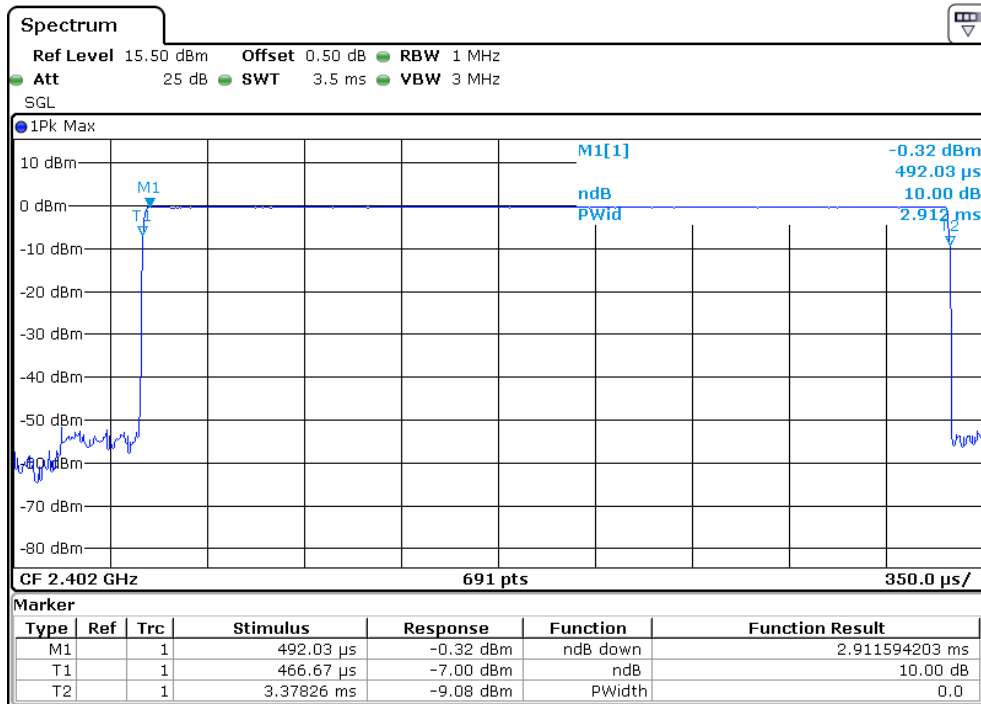
Packet: DH3



TRF No.: FCC 15C_TX_b
FCC ID: A5MBT500
150212033SZN-001

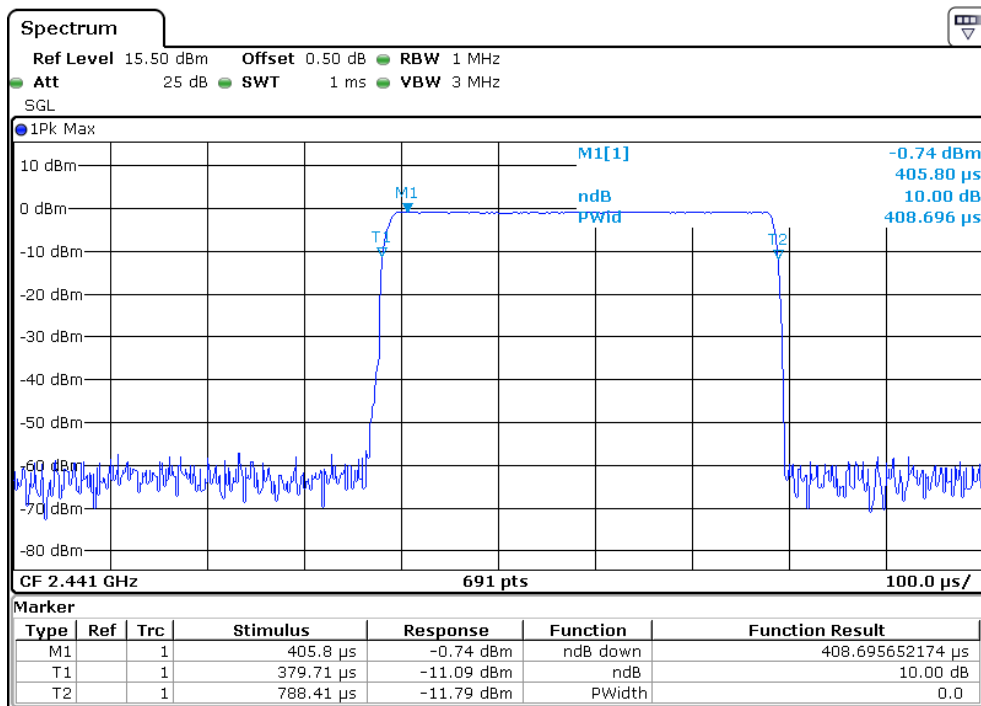
INTERTEK TESTING SERVICES

Packet: DH5



Modulation Type: $\pi/4$ -DQPSK

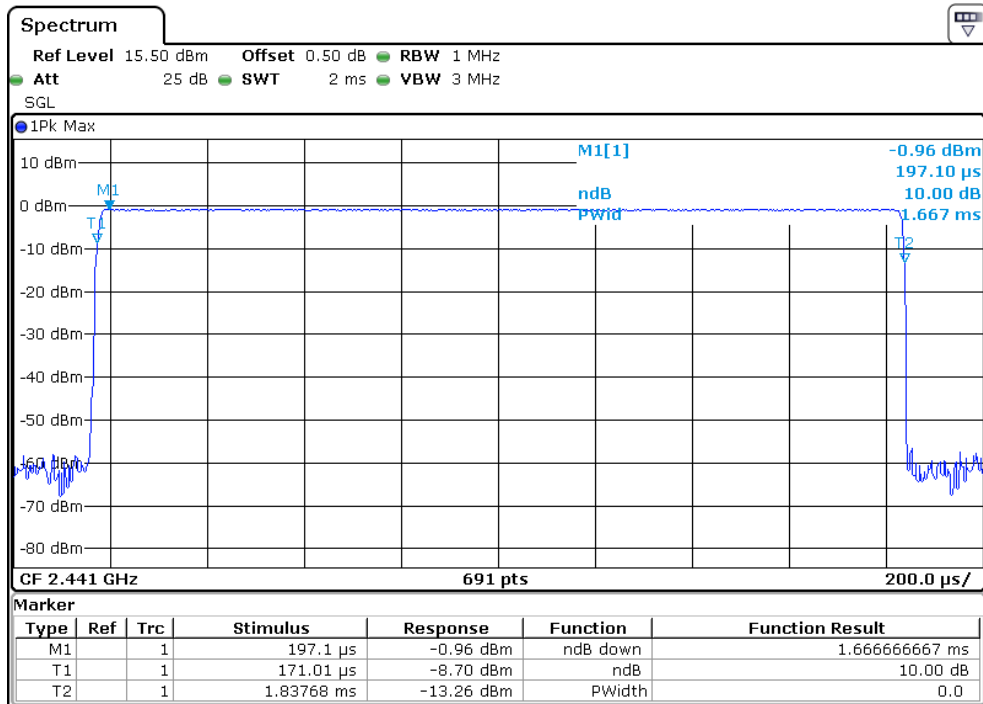
Packet: DH1



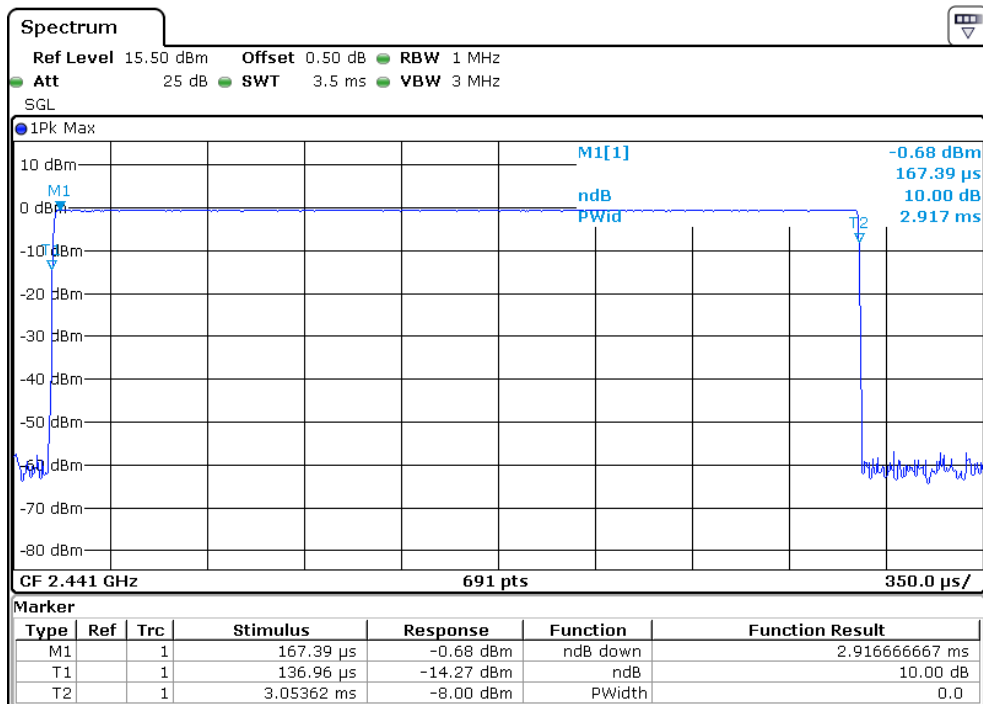
TRF No.: FCC 15C_TX_b
FCC ID: A5MBT500
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INTERTEK TESTING SERVICES

Packet: DH3



Packet: DH5

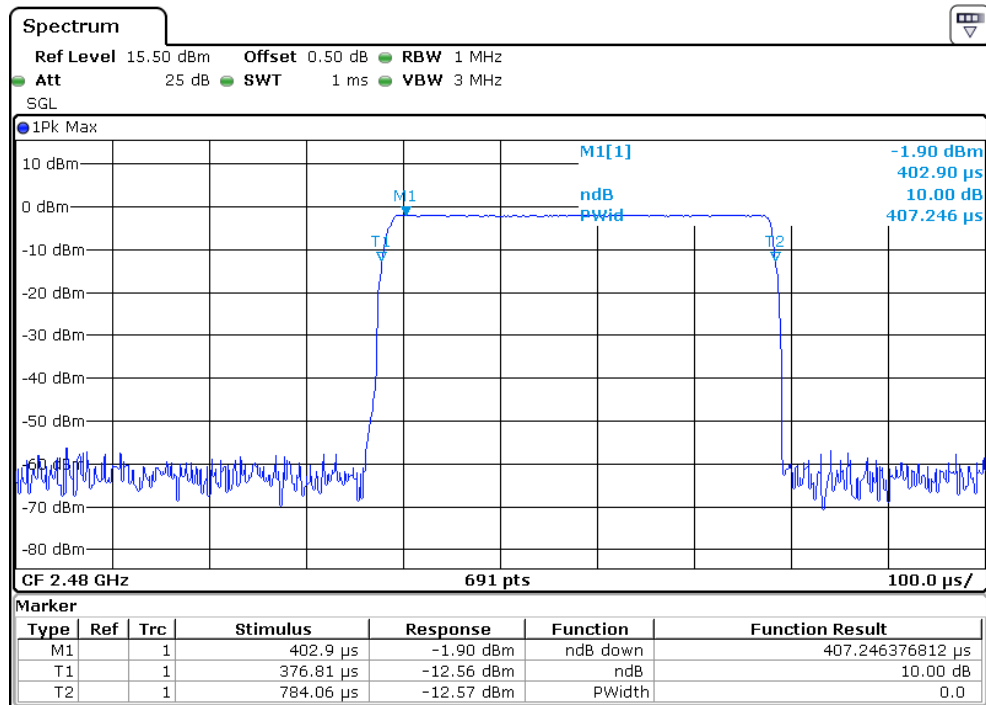


TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
 150212033SZN-001

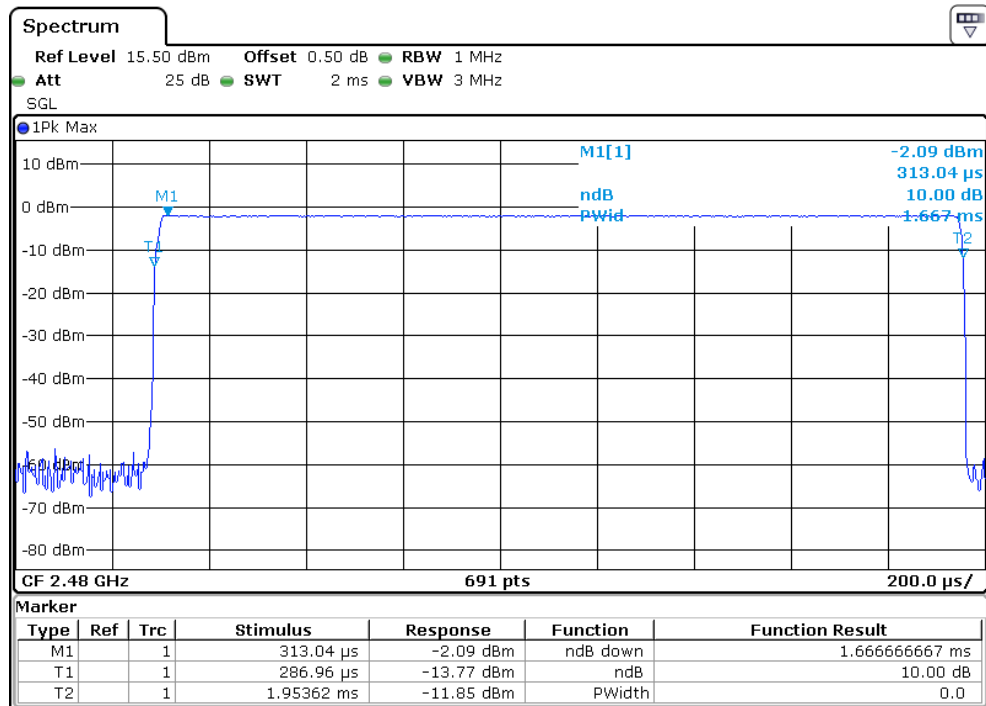
INTERTEK TESTING SERVICES

Modulation Type: 8DPSK

Packet: DH1



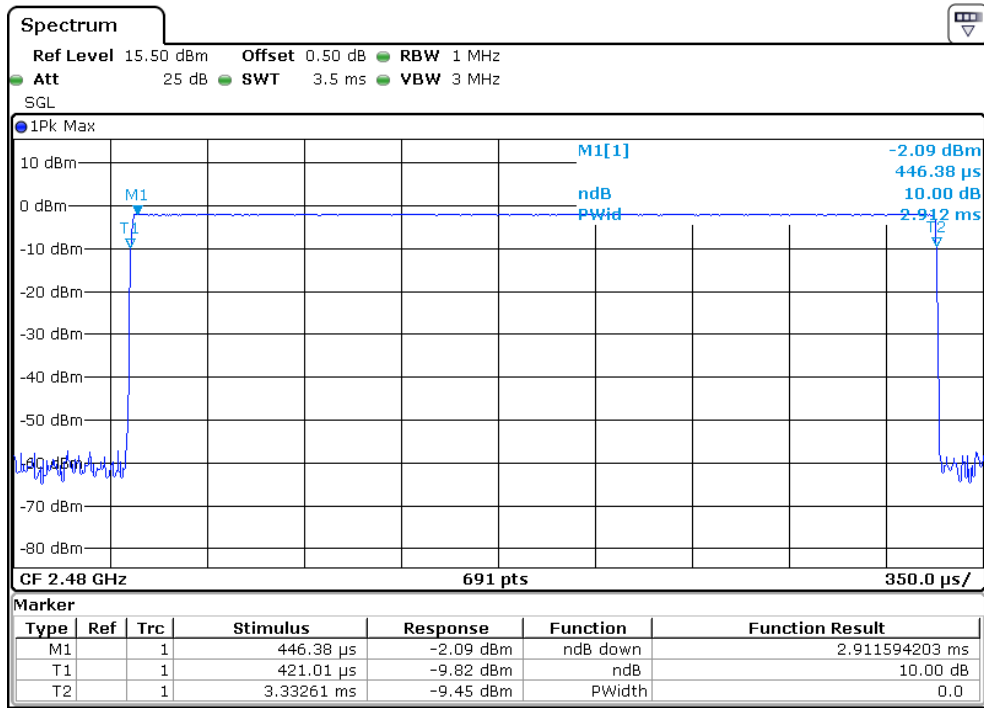
Packet: DH3



TRF No.: FCC 15C_TX_b
FCC ID: A5MBT500
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INTERTEK TESTING SERVICES

Packet: DH5



TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
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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

$$= 94.8\text{dB}\mu\text{v/m} - 50.7\text{dB}$$

$$= 44.1\text{dB}\mu\text{v/m}$$

(ii) Upper channel 2480MHz:

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

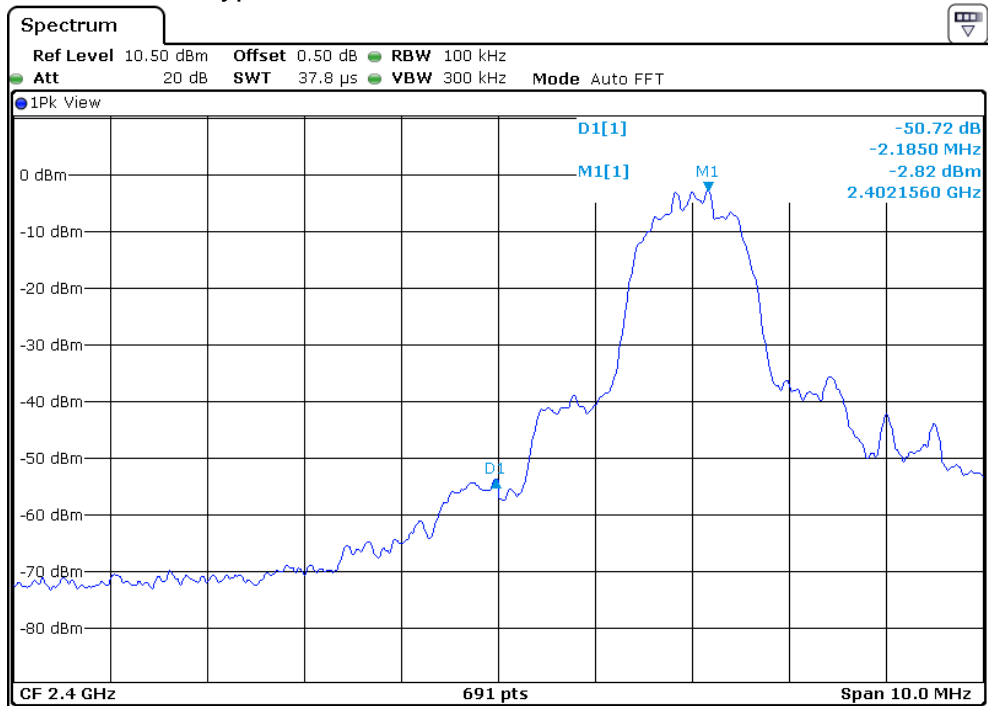
$$= 94.1\text{dB}\mu\text{v/m} - 61.3\text{dB}$$

$$= 32.8\text{dB}\mu\text{v/m}$$

The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 54dB μ v/m (Average Limit).

INTERTEK TESTING SERVICES

Modulation Type: 8DPSK



TRF No.: FCC 15C_TX_b
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INTERTEK TESTING SERVICES

3.9 Transmitter Spurious Emissions (Conducted)

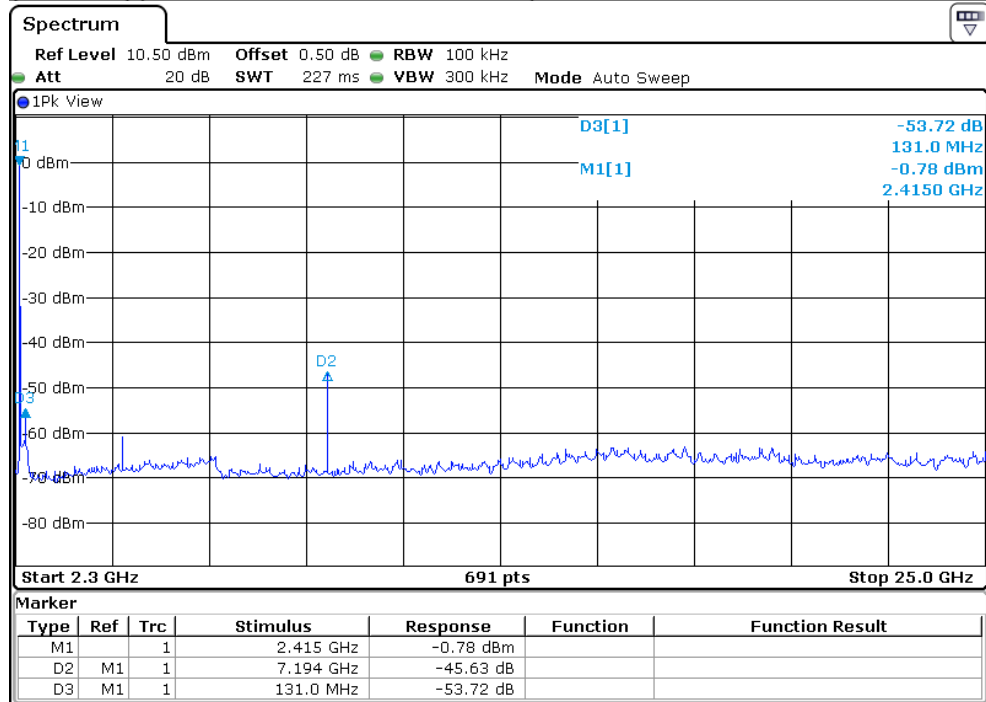
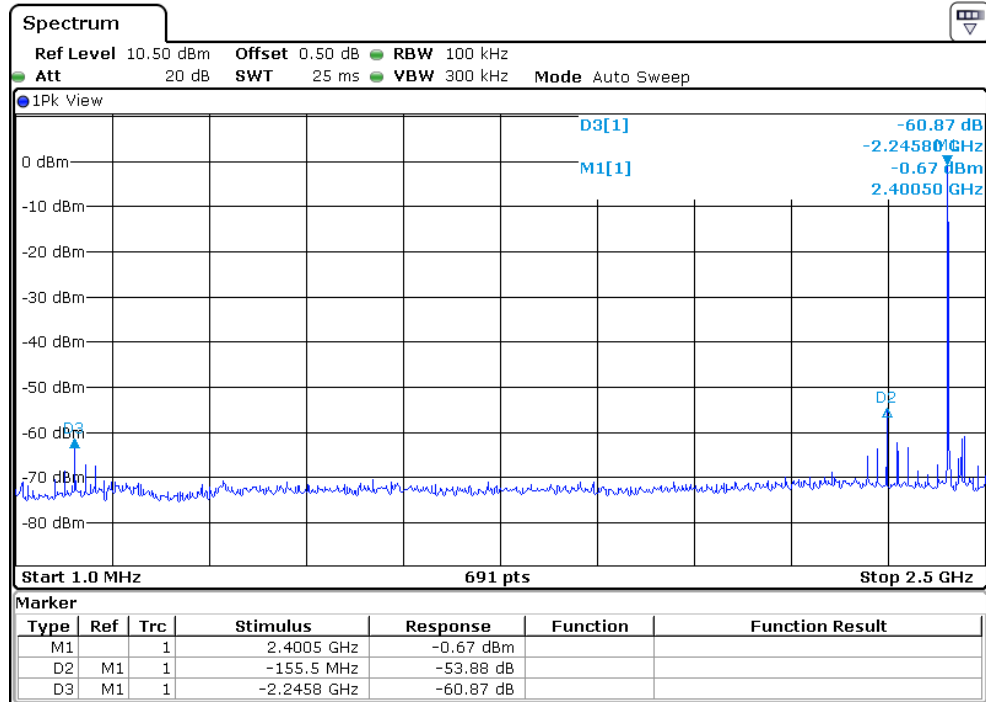
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

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.

INTERTEK TESTING SERVICES

Modulation Type: GFSK

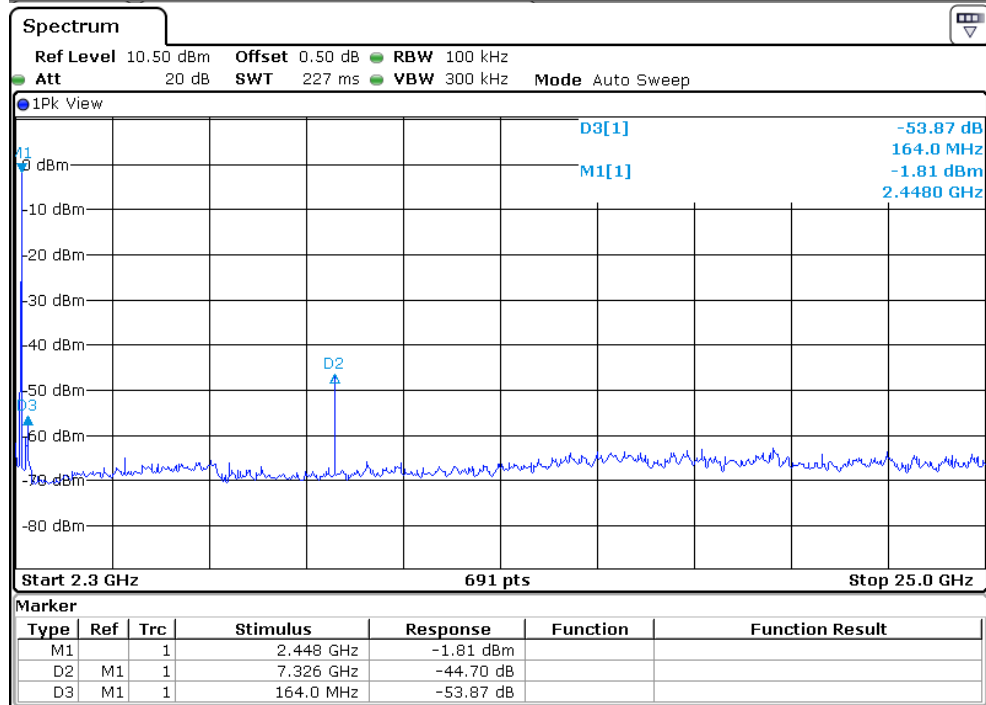
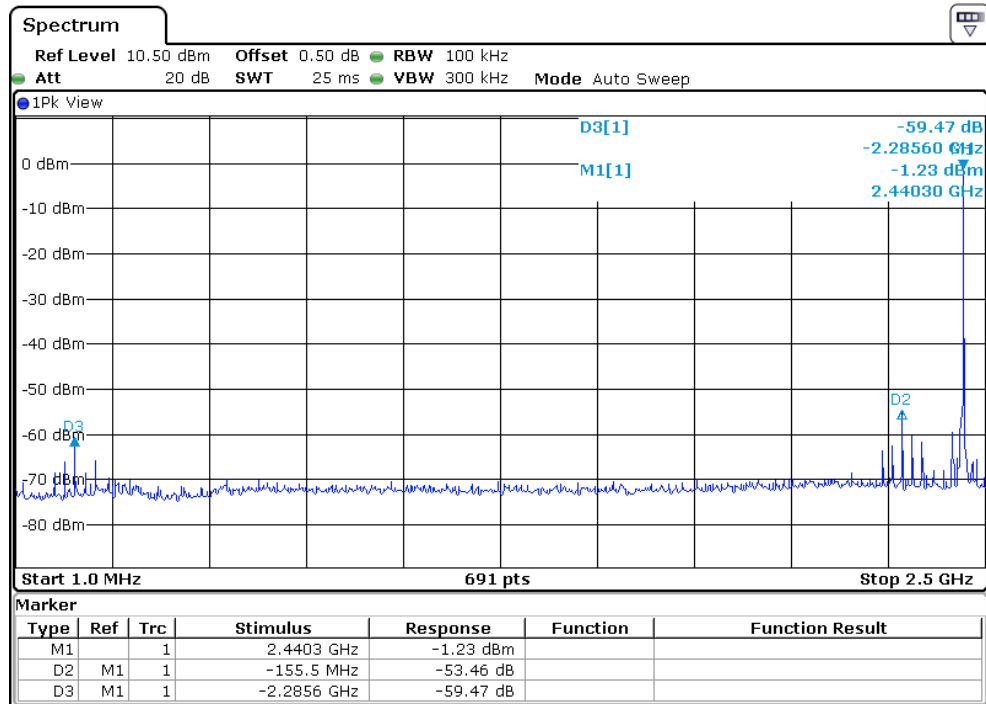
CH00



TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
 150212033SZN-001

INTERTEK TESTING SERVICES

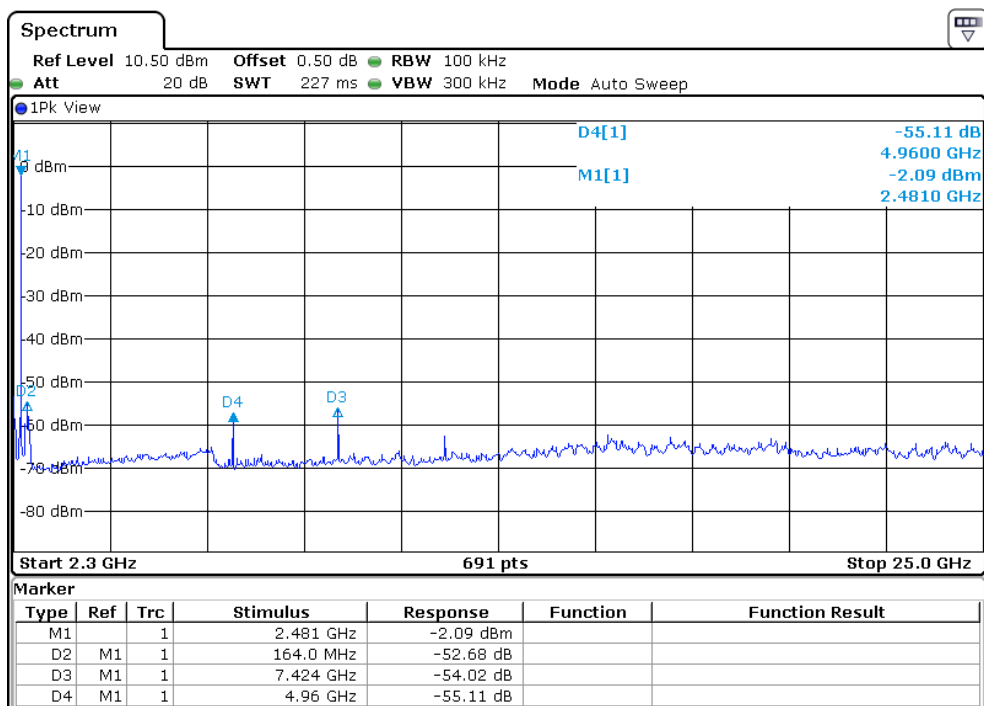
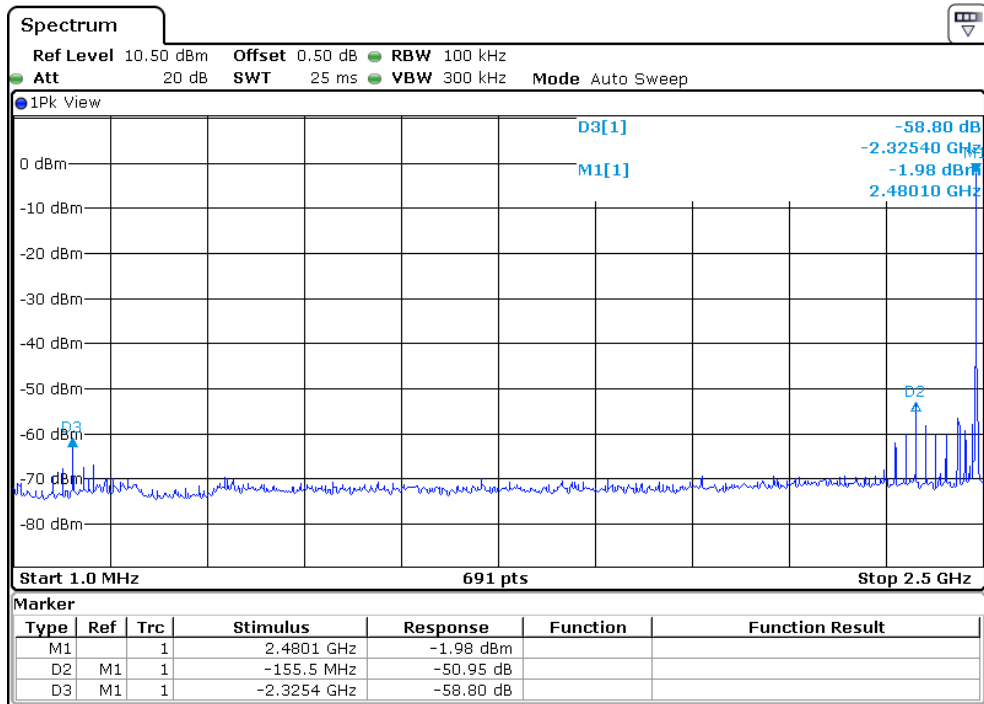
CH39



TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
 150212033SZN-001

INTERTEK TESTING SERVICES

CH78



TRF No.: FCC 15C_TX_b
 FCC ID: A5MBT500
 150212033SZN-001

EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

INTERTEK TESTING SERVICES

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

INTERTEK TESTING SERVICES

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

INTERTEK TESTING SERVICES

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

INTERTEK TESTING SERVICES

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 625 μ s for Bluetooth. With a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

INTERTEK TESTING SERVICES

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 = $1 / 133.33 \text{ hops/second} = 7.5 \text{ ms}$

Time to cycle through all channels = $7.5 \times 20 \text{ channels} = 150 \text{ ms}$

Number of times transmitter hits on one channel = $100 \text{ ms} / 150 \text{ ms} = 1 \text{ time(s)}$

Worst case dwell time = 7.5 ms

Duty cycle connection factor = $20\log_{10}(7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$

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 C63.4: 2009.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings.

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.

INTERTEK TESTING SERVICES

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 C63.4: 2009.

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

INTERTEK TESTING SERVICES

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 | 21-May-14 | 21-May-15 |
| SZ182-02-01 | Power Sensor | Anritsu | MA2411B | 1207429 | 21-May-14 | 21-May-15 |
| SZ061-12 | BiConiLog Antenna | ETS | 3142E | 00166158 | 28-Jun-14 | 28-Jun-15 |
| SZ185-01 | EMI Receiver | R&S | ESCI | 100547 | 7-Feb-15 | 7-Feb-16 |
| SZ061-09 | Horn Antenna | ETS | 3115 | 00092346 | 1-Nov-14 | 1-Nov-15 |
| SZ061-07 | Pyramidal Horn Antenna | ETS | 3160-09 | 00083067 | 3-Sep-14 | 3-Sep-15 |
| SZ061-06 | Active Loop Antenna | Electro-Metrics | EM-6876 | 217 | 29-Apr-14 | 29-Apr-15 |
| EM031-03 | EXA Spectrum Analyzer | R&S | FSV40 | 101506 | 09-Jun-14 | 09-Jun-15 |
| SZ181-04 | Preamplifier | Agilent | 8449B | 3008A02474 | 11-Oct-14 | 11-Apr-15 |
| SZ188-01 | Anechoic Chamber | ETS | RFD-F/A-100 | 4102 | 11-Oct-14 | 11-Apr-15 |
| SZ062-02 | RF Cable | RADIAL | RG 213U | -- | 19-Apr-14 | 19-Apr-15 |
| SZ062-05 | RF Cable | RADIAL | 0.04-26.5GHz | -- | 31-Dec-14 | 30-Jun-15 |
| SZ062-12 | RF Cable | RADIAL | 0.04-26.5GHz | -- | 9-Oct-14 | 9-Apr-15 |
| SZ067-04 | Notch Filter | Micro-Tronics | BRM5070 2-02 | -- | 9-Oct-14 | 9-Apr-15 |
| SZ185-02 | EMI Test Receiver | R&S | ESCI | 100692 | 21-May-14 | 21-May-15 |
| SZ187-01 | Two-Line V-Network | R&S | ENV216 | 100072 | 1-Nov-14 | 1-Nov-15 |
| SZ187-02 | Two-Line V-Network | R&S | ENV216 | 100073 | 1-Nov-14 | 1-Nov-15 |
| SZ188-03 | Shielding Room | ETS | RFD-100 | 4100 | 16-Jun-14 | 16-Jun-15 |