



Nokia Corporation

**Application
For
Certification**

(FCC ID: PYABH-110U)

Bluetooth headset

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

2.4GHz Transceiver

Report No.: 130313014SZN-001

Prepared and Checked by:

Approved by:

Sign on file

Leo Lai
Engineer

Billy Li
Supervisor
Date: April 20, 2013

- 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

Nokia Corporation

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

FCC ID: PYABH-110U

April 20, 2013

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 [10-1-12 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	Radiated Emission	radiated photos.pdf
Test Setup Photo	Conducted Emission	conducted photos.pdf
External Photos	External Photo	external photos.pdf
Internal Photos	Internal Photo	internal photos.pdf
ID Label/Location Info	Label Artwork and Location	label.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Users Manual	User Manual	manual.pdf
Cover Letter	Letter of Agency	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 Bluetooth headset model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0). It is powered by 3.7V from internal rechargeable battery and can be charged by AC/DC adapter with output voltage of DC 5V or PC USB port.

Antenna Type: Integral antenna

Modulation Type: FHSS.

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

1.2 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.

1.3 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 which was charged by AC/DC adapter or PC USB port through AC 120V/60Hz (AC 120V/60Hz is for AC/DC adapter and PC) during the test. Only the worst case data was reported.

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.

The EUT was centered laterally (left to right facing the tabletop) on the Tabletop, and its rear was flush with the rear of the table when powered by internal rechargeable battery and charged by adapter or PC.

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 Nokia Corporation 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.
Mobile Phone	Nokia	N8
AC/DC Adapter	Nokia	AC-50U (Input: AC 100-240V 50-60Hz, 0.2A; Output: DC 5V, 1.3A)
USB Cable	Nokia	CA-190CD, 120cm
PC	Lenovo	T420

EXHIBIT 3
TEST RESULTS

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

103.235 MHz

Judgement: Passed by 16.7 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, Engineer

Typed / Printed Name

March 28, 2013

Date

INTERTEK TESTING SERVICES

Applicant: Nokia Corporation

Date of Test: March 28, 2013

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

Worst Case Operating Mode: BT Link With Cell Phone and Charged by AC-50U

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	330.215	26.8	20.0	18.6	25.4	46.0	-20.6
Horizontal	392.780	34.6	20.0	13.0	27.6	46.0	-18.4
Horizontal	417.030	30.1	20.0	17.0	27.1	46.0	-18.9
Vertical	36.790	23.1	20.0	18.2	21.3	40.0	-18.7
Vertical	61.040	33.7	20.0	7.1	20.8	40.0	-19.2
Vertical	103.235	24.7	20.0	22.1	26.8	43.5	-16.7

- 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

INTERTEK TESTING SERVICES

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
4804.000 and 7323.000 MHz

Judgement: Passed by 19.7 dB

TEST PERSONNEL:

Sign on file

Leo Lai, Engineer
Typed/Printed Name

March 28, 2013
Date

INTERTEK TESTING SERVICES

Applicant: Nokia Corporation
 Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)
 Mode: TX-CH00 (2402MHz)

Date of Test: March 28, 2013

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)
Vertical	**2402.000	109.9	36.7	28.5	101.7	--	--
Vertical	*4804.000	57.3	36.1	33.1	54.3	74.0	-19.7

Polarization	Frequency (MHz)	Reading (dBμV)	Pre- Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Vertical	*4804.000	57.3	36.1	33.1	22.5	31.8	54.0	-22.2

- 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.
- ** 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: PYABH-110U

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Applicant: Nokia Corporation
 Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)
 Mode: TX-CH39 (2441MHz)

Date of Test: March 28, 2013

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)
Vertical	**2441.000	109.8	36.7	28.5	101.6	--	--
Vertical	*4882.000	56.3	36.1	33.3	53.5	74.0	-20.5
Vertical	*7323.000	52.6	36.2	37.9	54.3	74.0	-19.7

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Vertical	*4882.000	56.3	36.1	33.3	22.5	31.0	54.0	-23.0
Vertical	*7323.000	52.6	36.2	37.9	22.5	31.8	54.0	-22.2

- 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

INTERTEK TESTING SERVICES

Applicant: Nokia Corporation
 Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)
 Mode: TX-CH78 (2480MHz)

Date of Test: March 28, 2013

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	110.8	36.7	28.6	102.7	--	--
Vertical	*4960.000	55.2	36.1	33.4	52.5	74.0	-21.5
Vertical	*7440.000	49.4	36.2	38.2	51.4	74.0	-22.6

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)
Vertical	*4960.000	55.2	36.1	33.4	22.5	30.0	54.0	-24.0
Vertical	*7440.000	49.4	36.2	38.2	22.5	28.9	54.0	-25.1

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
 FCC ID: PYABH-110U

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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
0.418 MHz

Judgement: Passed by 7.3 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, Engineer

Typed/Printed Name

March 28, 2013

Date

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Company: Nokia Corporation

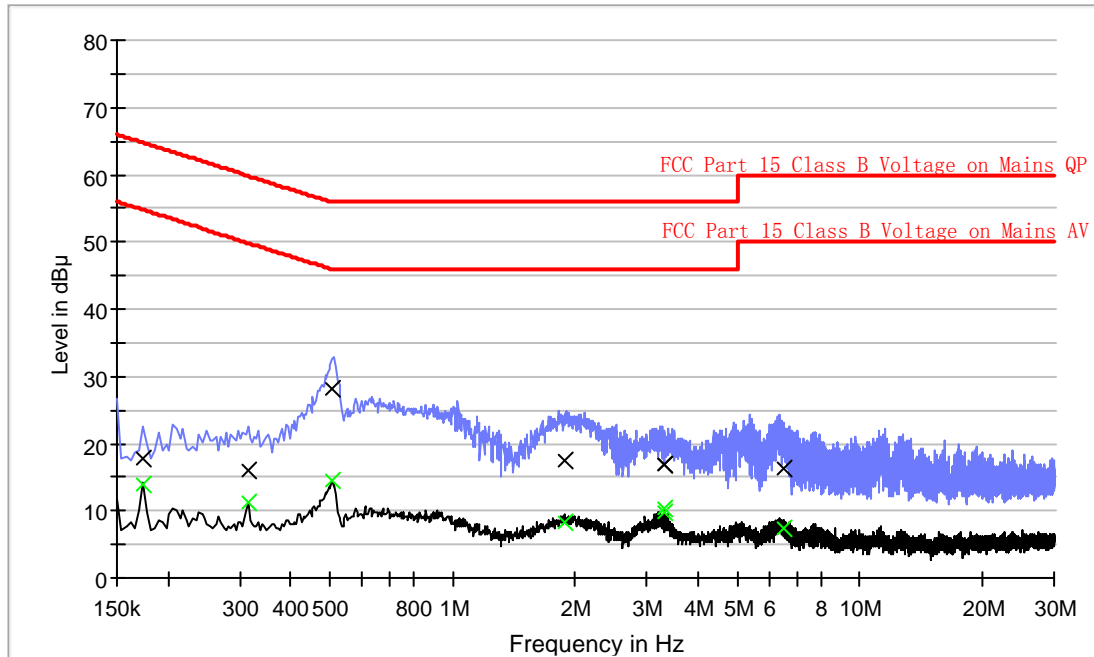
Date of Test: March 28, 2013

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

Worst Case Operating Mode: BT Link With Cell Phone and Charged by AC-50U

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.174000	17.8	L1	9.6	47.0	64.8
0.314000	16.1	L1	9.6	43.8	59.9
0.506000	28.0	L1	9.6	28.0	56.0
1.878000	17.4	L1	9.8	38.6	56.0
3.294000	16.9	L1	9.7	39.1	56.0
6.494000	16.2	L1	9.8	43.8	60.0

Result Table AV

Frequency (MHz)	Average (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.174000	14.0	L1	9.6	40.8	54.8
0.314000	11.1	L1	9.6	38.8	49.9
0.506000	14.4	L1	9.6	31.6	46.0
1.878000	8.4	L1	9.8	37.6	46.0
3.294000	10.4	L1	9.7	35.6	46.0
6.494000	7.4	L1	9.8	42.6	50.0

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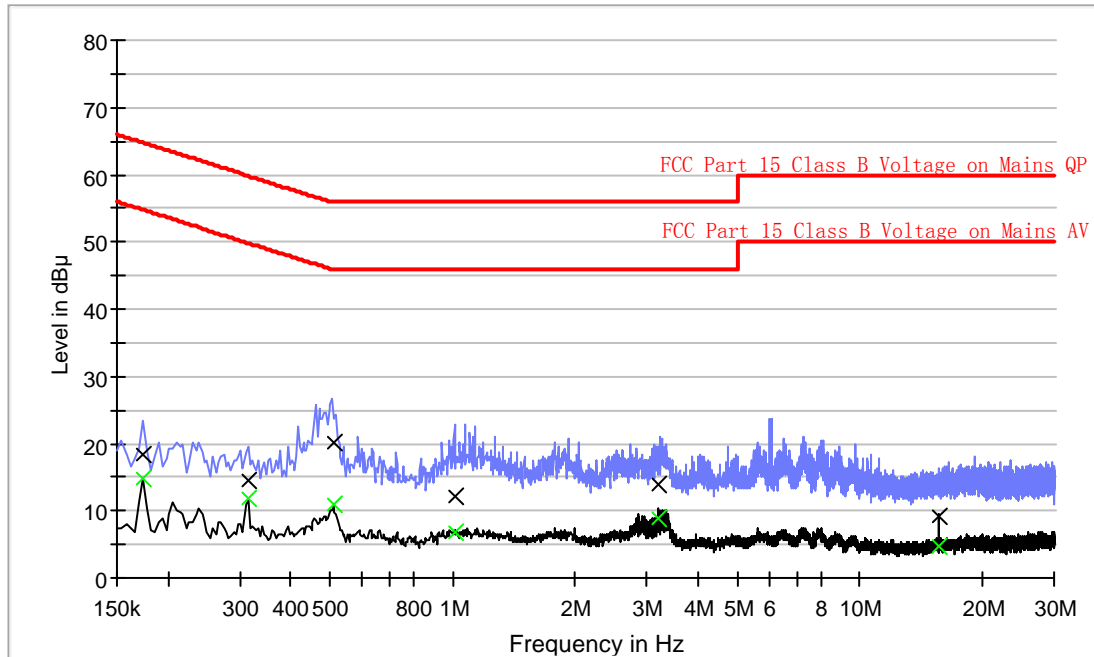
Date of Test: March 28, 2013

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

Worst Case Operating Mode: BT Link With Cell Phone and Charged by AC-50U

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.174000	18.3	N	9.7	46.5	64.8
0.314000	14.5	N	9.6	45.4	59.9
0.510000	20.2	N	9.6	35.8	56.0
1.010000	12.1	N	9.9	43.9	56.0
3.202000	13.8	N	9.7	42.2	56.0
15.674000	9.2	N	10.3	50.8	60.0

Result Table AV

Frequency (MHz)	Average (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.174000	14.9	N	9.7	39.9	54.8
0.314000	11.9	N	9.6	38.0	49.9
0.510000	11.0	N	9.6	35.0	46.0
1.010000	6.9	N	9.9	39.1	46.0
3.202000	8.8	N	9.7	37.2	46.0
15.674000	4.7	N	10.3	45.3	50.0

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Company: Nokia Corporation

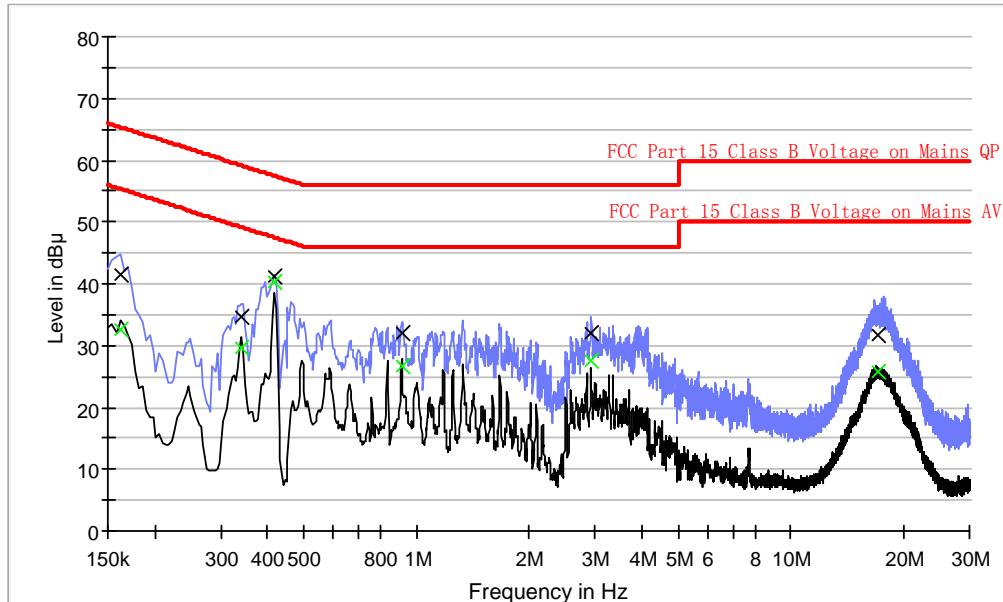
Date of Test: March 28, 2013

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

Worst Case Operating Mode: BT Link With Cell Phone and Charged by PC

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.162000	41.5	L1	9.6	23.9	65.4
0.342000	34.6	L1	9.6	24.6	59.2
0.418000	41.2	L1	9.6	16.3	57.5
0.914000	31.9	L1	9.7	24.1	56.0
2.930000	32.1	L1	9.7	23.9	56.0
17.038000	31.6	L1	10.4	28.4	60.0

Result Table AV

Frequency (MHz)	Average (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.162000	32.7	L1	9.6	22.7	55.4
0.342000	29.7	L1	9.6	19.5	49.2
0.418000	40.2	L1	9.6	7.3	47.5
0.914000	26.7	L1	9.7	19.3	46.0
2.930000	27.4	L1	9.7	18.6	46.0
17.038000	25.6	L1	10.4	24.4	50.0

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Company: Nokia Corporation

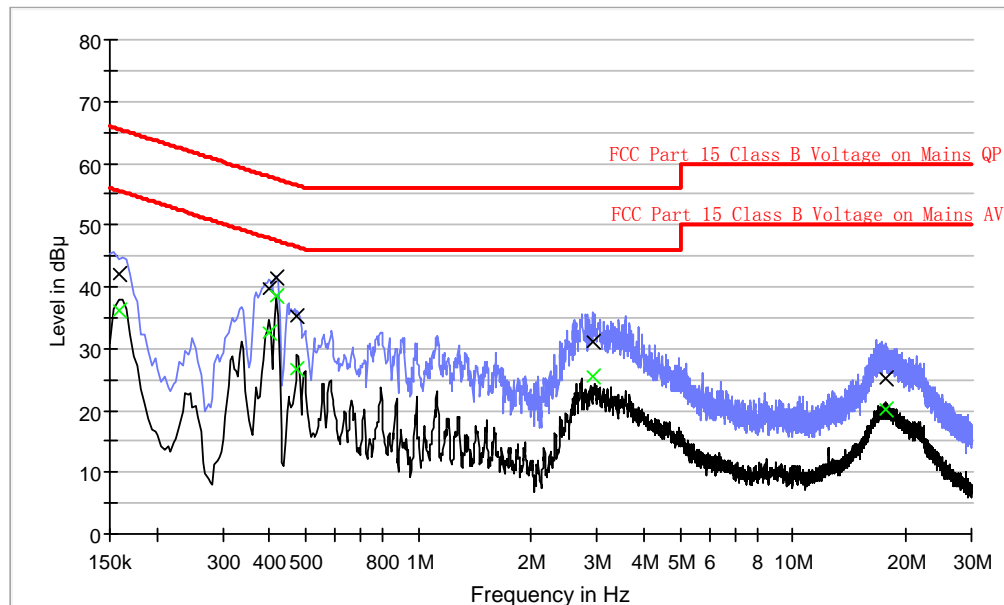
Date of Test: March 28, 2013

Model: BH-110U (HW: 1.0; SW: B4.0.0.1; MV: 1.0)

Worst Case Operating Mode: BT Link With Cell Phone and Charged by PC

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.158000	42.2	N	9.7	23.4	65.6
0.398000	39.6	N	9.6	18.3	57.9
0.418000	41.3	N	9.6	16.2	57.5
0.474000	35.3	N	9.6	21.1	56.4
2.918000	31.2	N	9.7	24.8	56.0
17.582000	25.3	N	10.5	34.7	60.0

Result Table AV

Frequency (MHz)	Average (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.158000	36.1	N	9.7	19.5	55.6
0.398000	32.5	N	9.6	15.4	47.9
0.418000	38.4	N	9.6	9.1	47.5
0.474000	26.8	N	9.6	19.6	46.4
2.918000	25.4	N	9.7	20.6	46.0
17.582000	20.1	N	10.5	29.9	50.0

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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 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, maximum allowed transmitter output power as below:

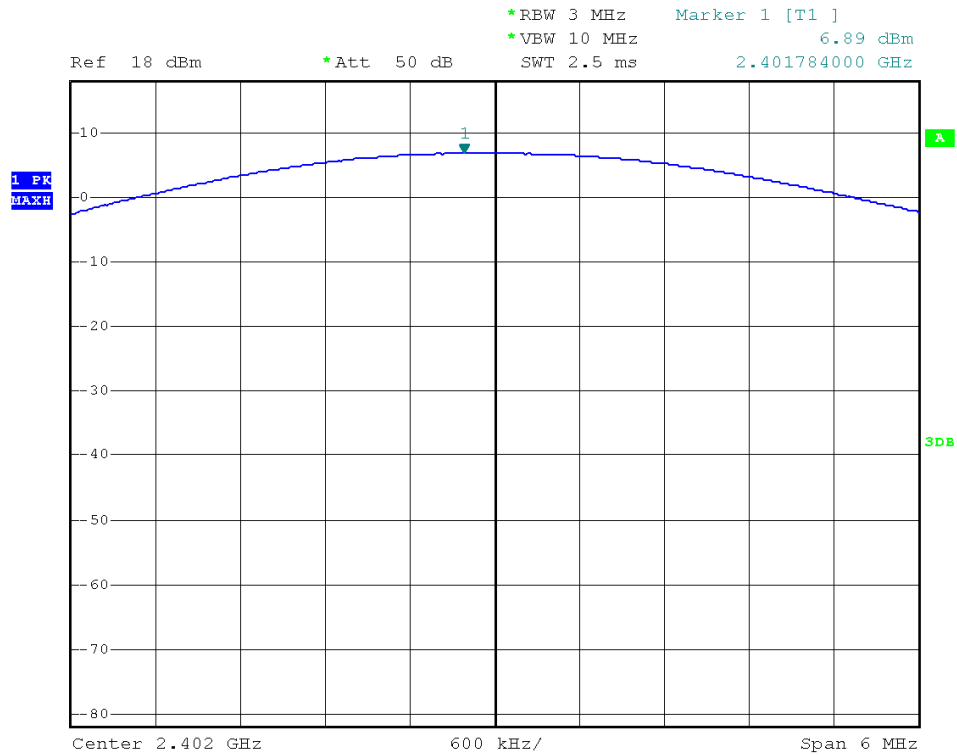
For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt. For all other frequency hopping systems (eg: Bluetooth AFH Mode) in the 2400–2483.5 MHz band: 0.125 watts.

Antenna Gain = -2dBi			
Modulation Type	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
GFSK	2402	6.89	4.89
	2441	7.01	5.02
	2480	7.07	5.09
$\pi/4$ -DQPSK	2402	6.94	4.94
	2441	6.88	4.88
	2480	6.79	4.78
8DPSK	2402	7.16	5.20
	2441	7.28	5.35
	2480	7.13	5.16

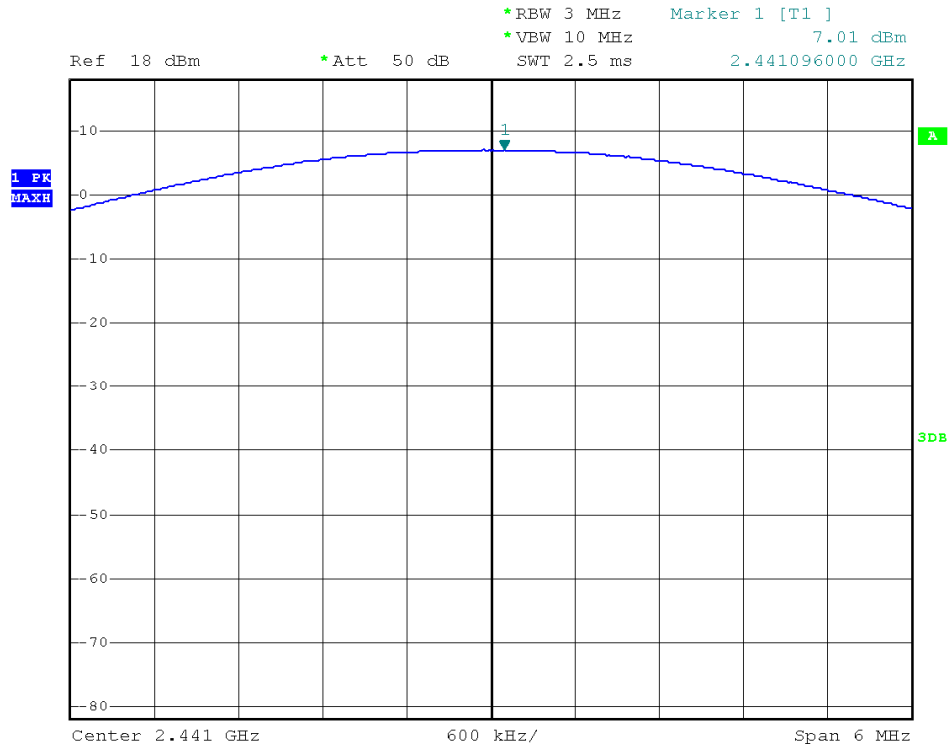
INTERTEK TESTING SERVICES

Modulation Type: GFSK

CH00

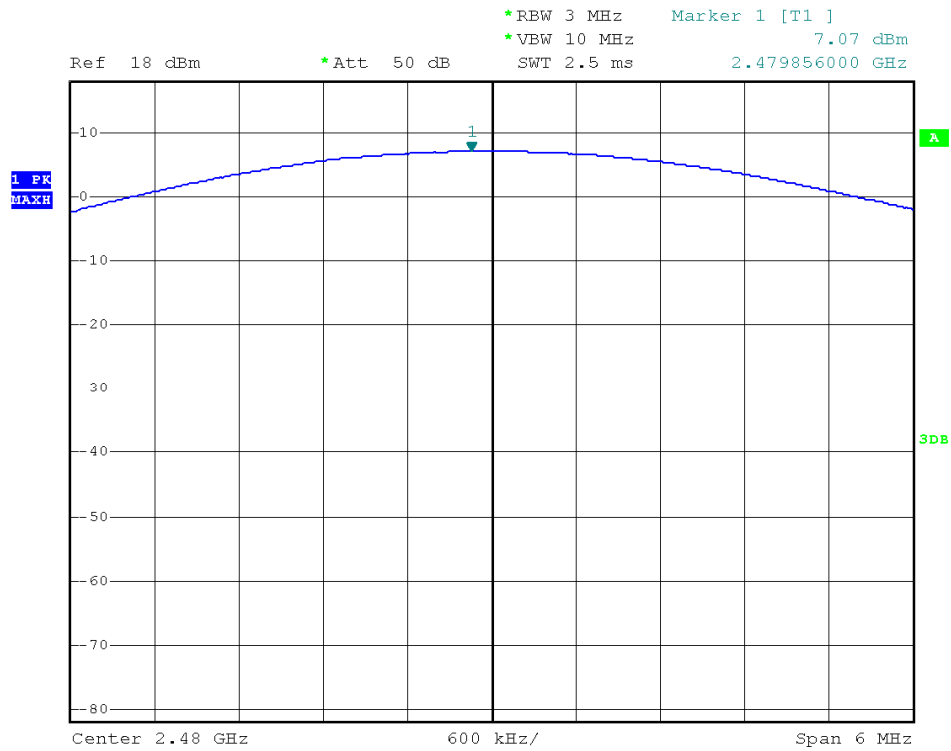


CH39



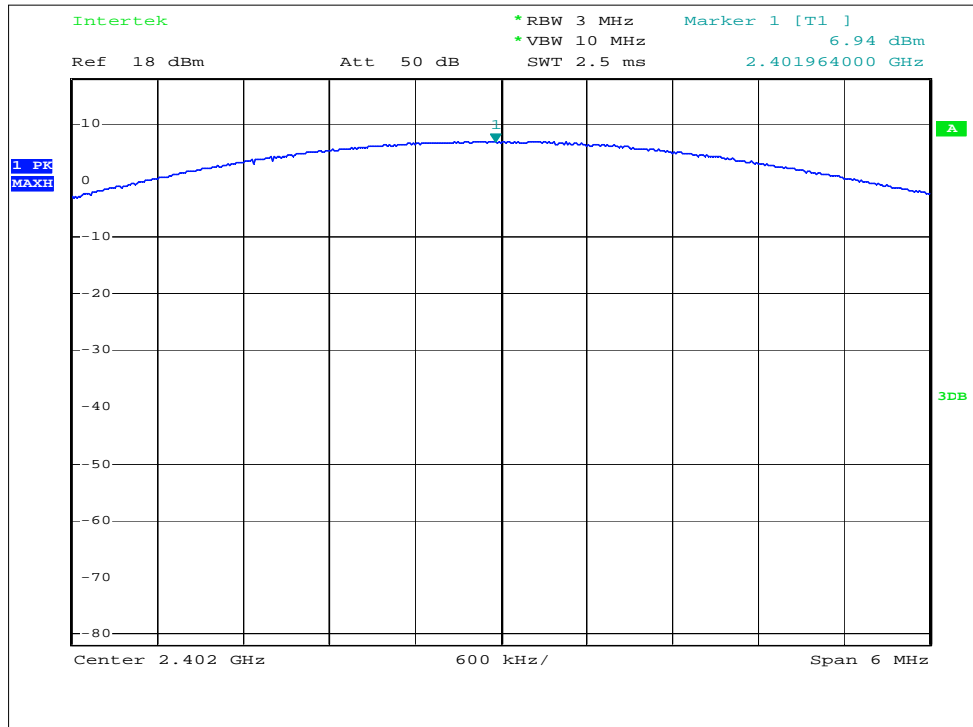
INTERTEK TESTING SERVICES

CH78



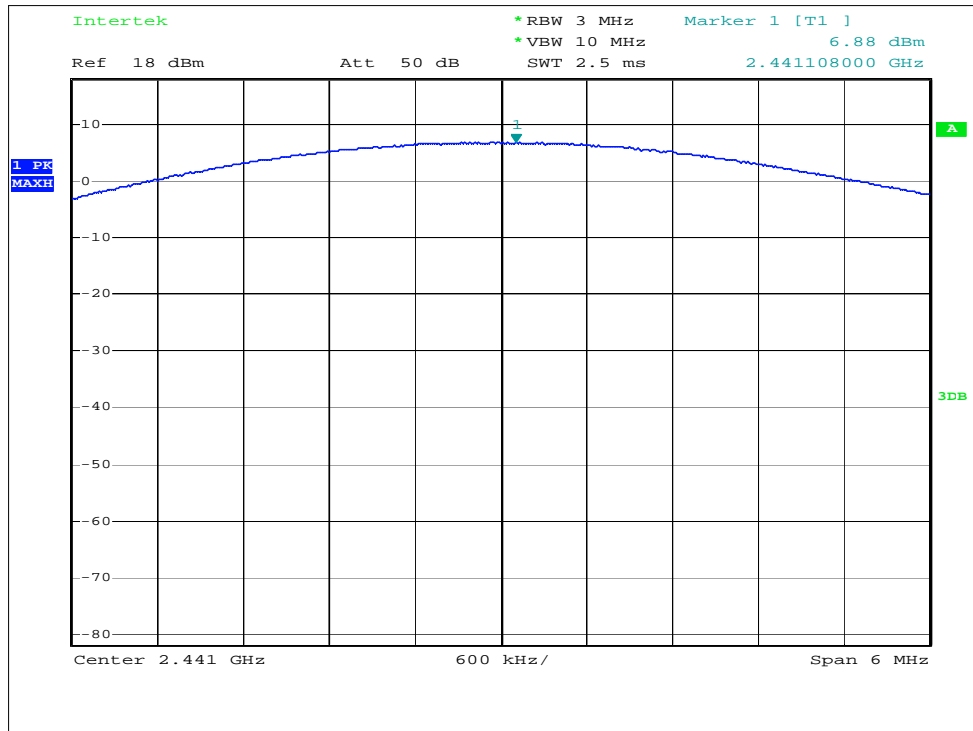
Modulation Type: $\pi/4$ -DQPSK

CH00

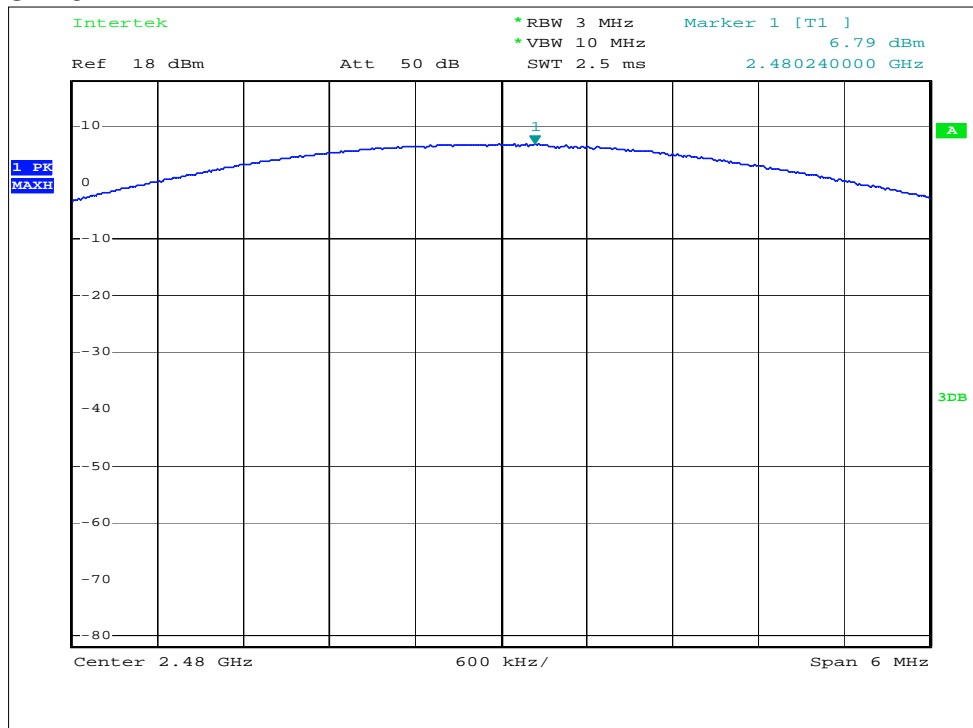


INTERTEK TESTING SERVICES

CH39



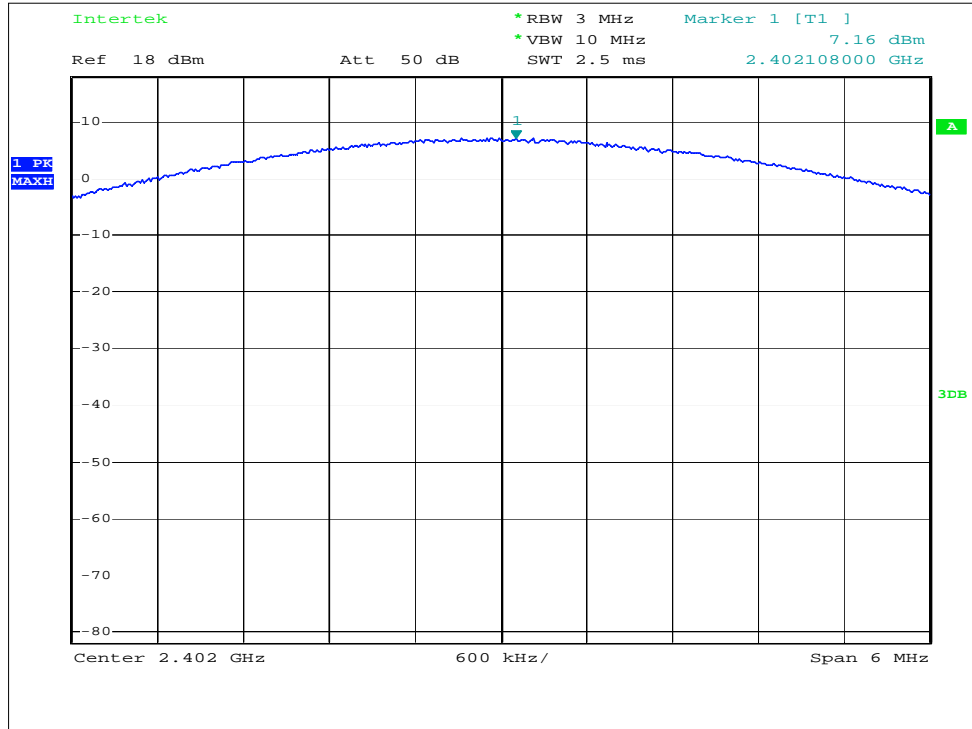
CH78



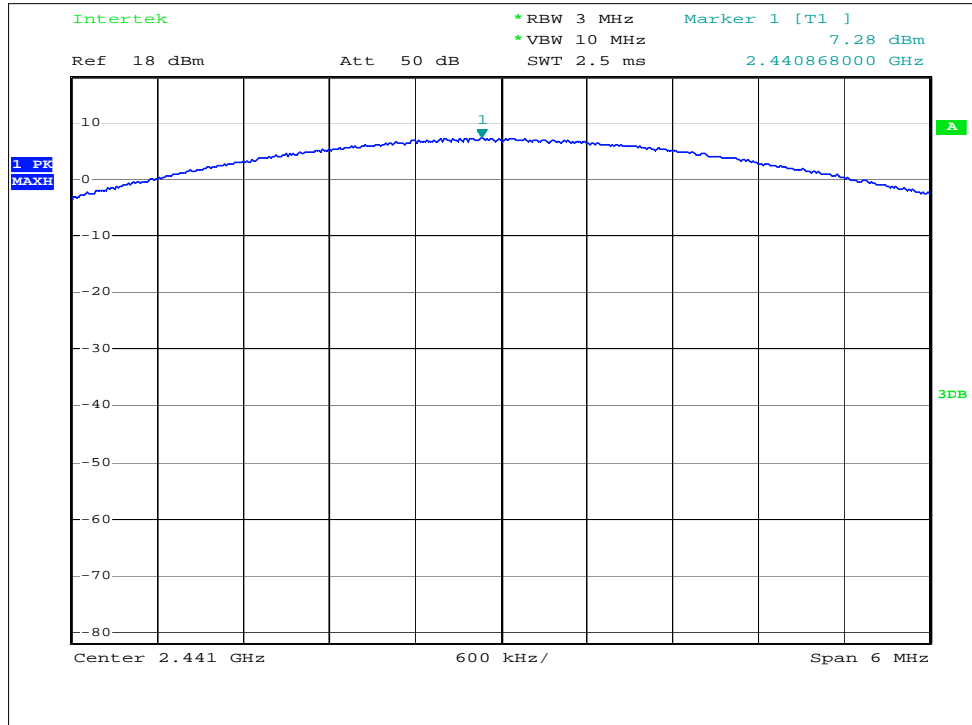
INTERTEK TESTING SERVICES

Modulation Type: 8DPSK

CH00



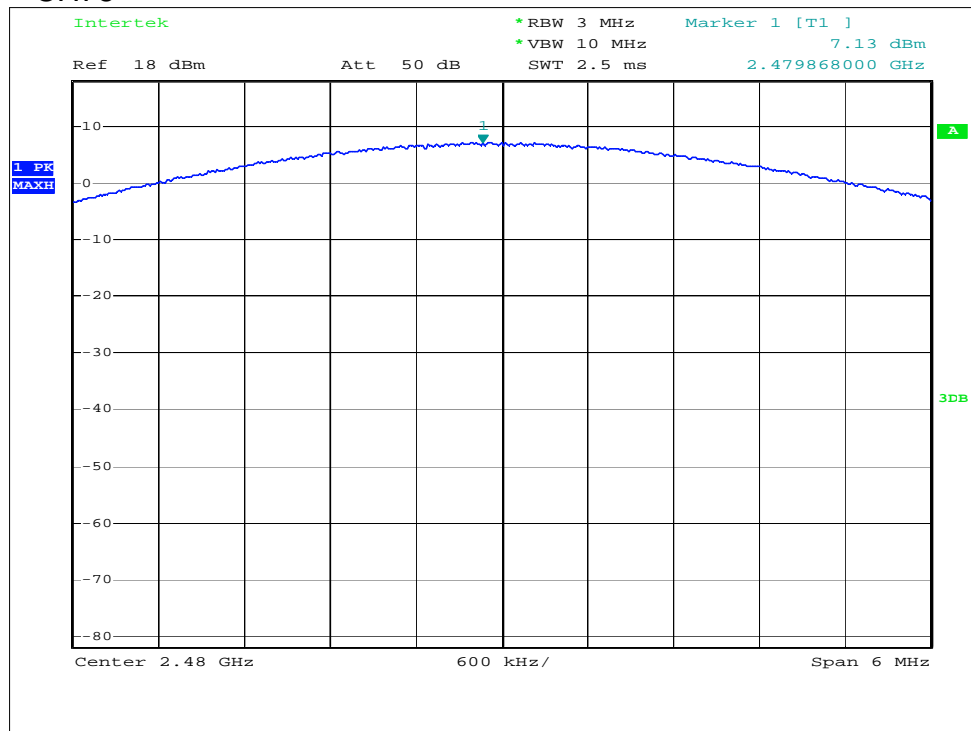
CH39



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INTERTEK TESTING SERVICES

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INTERTEK TESTING SERVICES

3.3 20dB Bandwidth

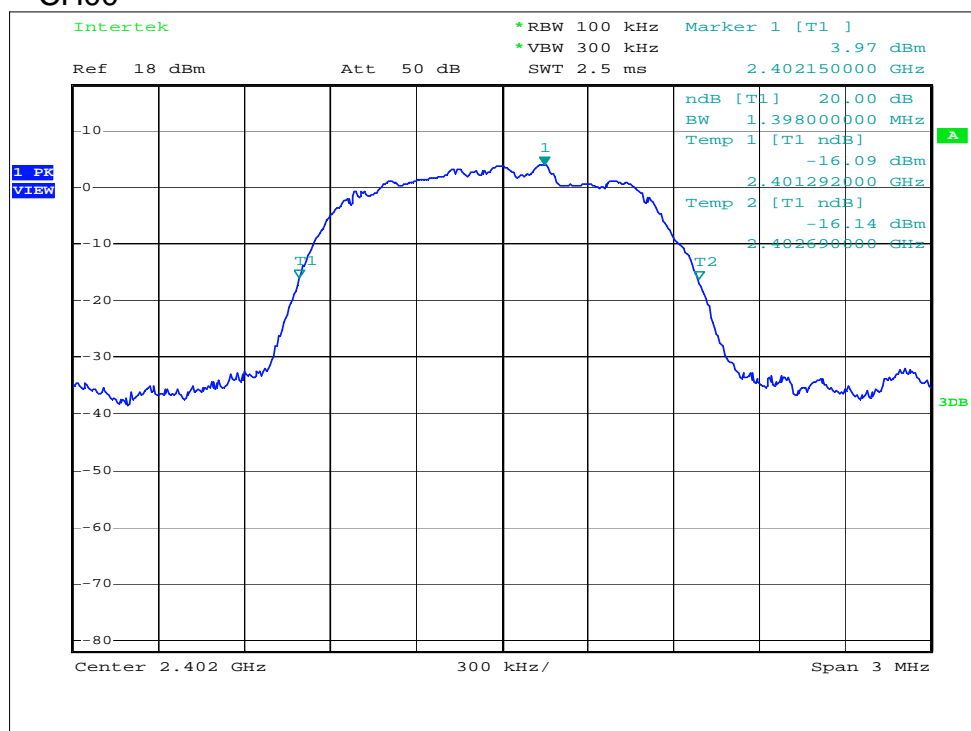
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

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	1.398
2441	1.392
2480	1.392

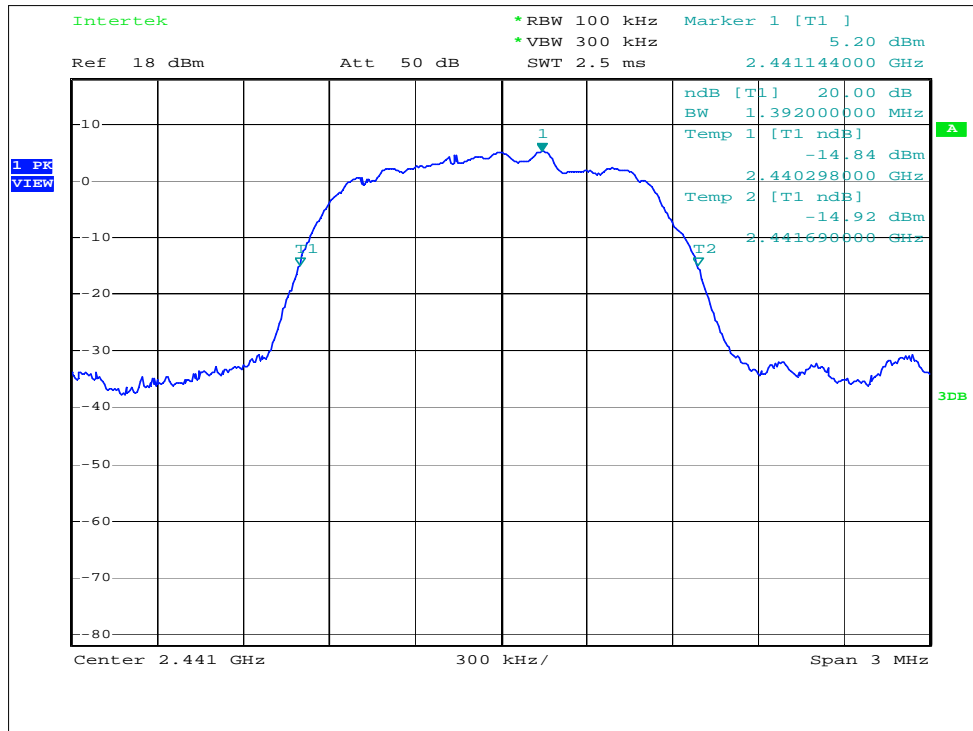
Modulation Type: 8DPSK

CH00

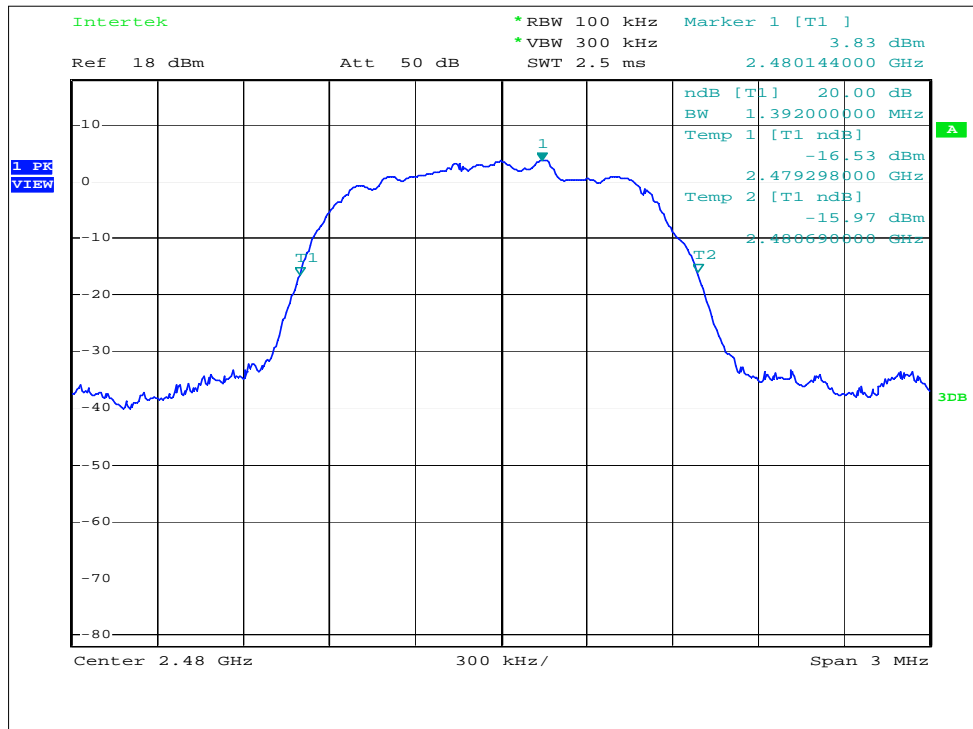


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3.5 Channel Number (Number of Hopping Frequencies)

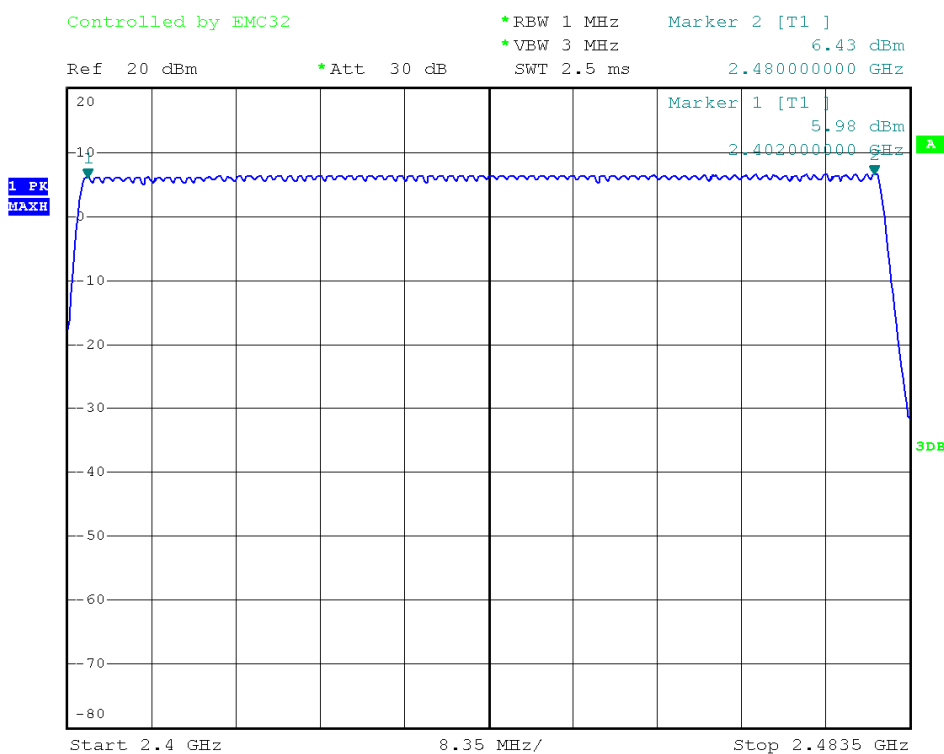
Minimum Number of Hopping Frequencies, FCC Rule 15.247(a) (1) (iii):

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
Number of AFH hopping channels=	20

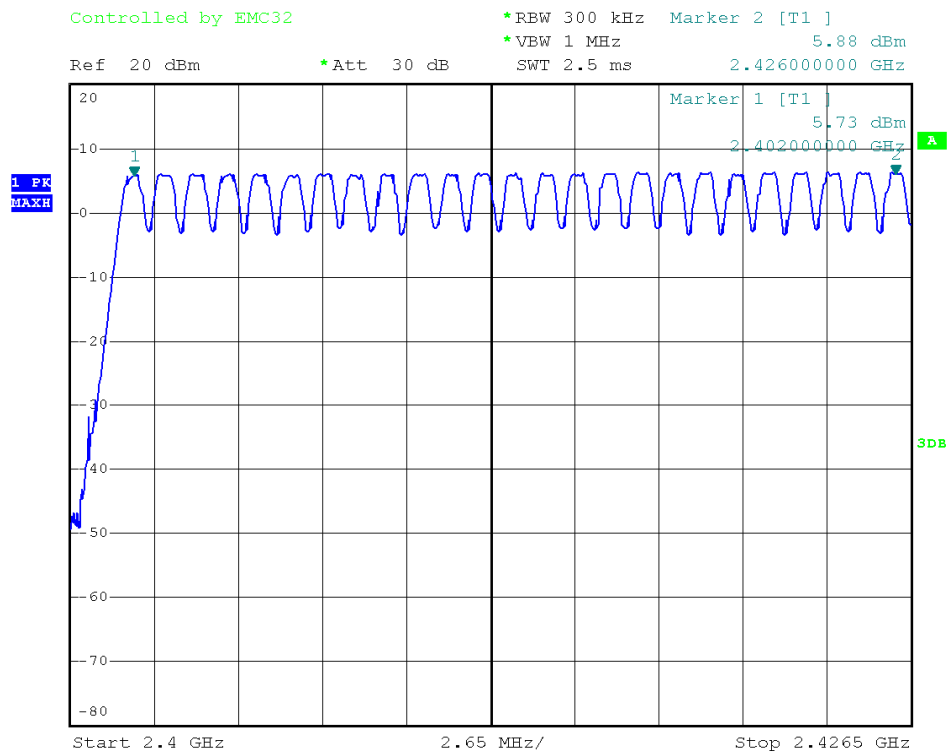
Modulation Type: GFSK

CH00-CH78

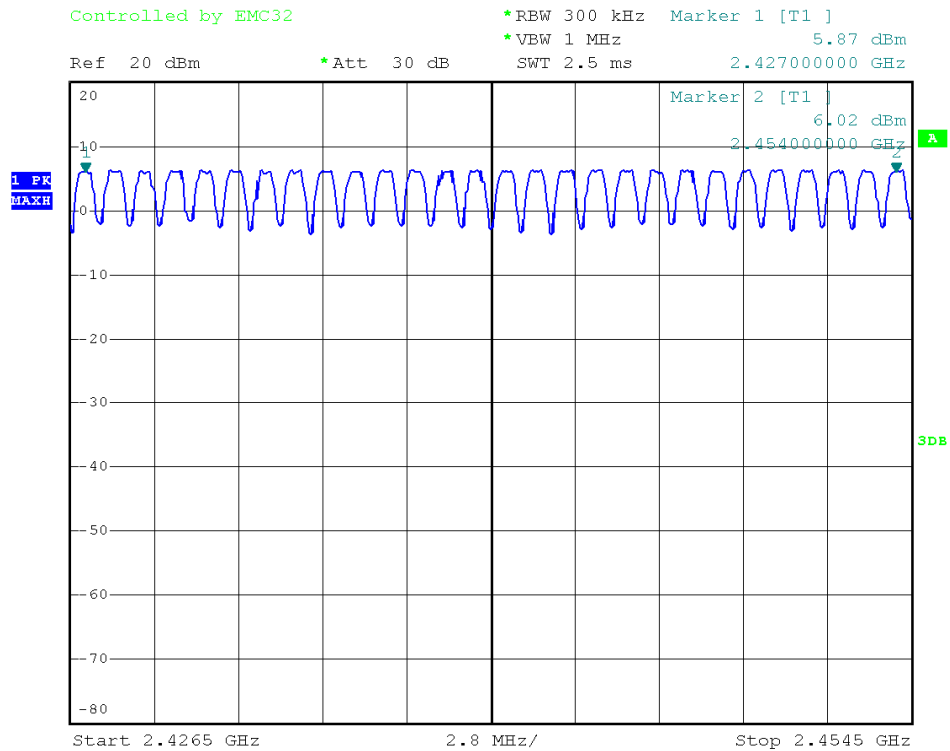


INTERTEK TESTING SERVICES

CH00-CH24

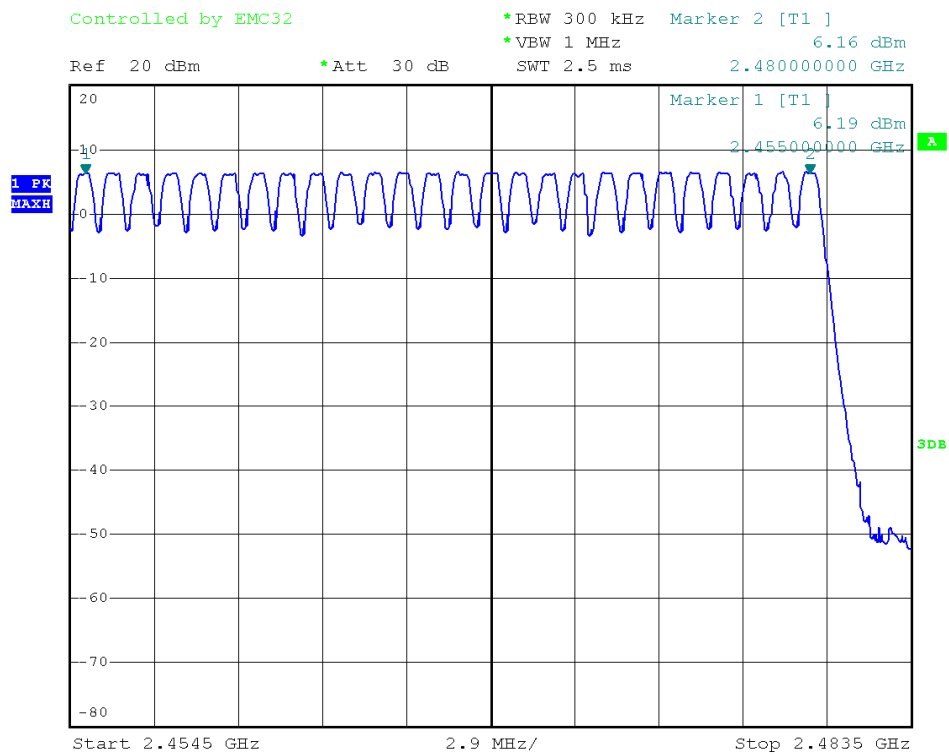


CH25-CH52



INTERTEK TESTING SERVICES

CH53-CH78



INTERTEK TESTING SERVICES

3.6 Channel Separation (Carrier Frequency Separation)

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

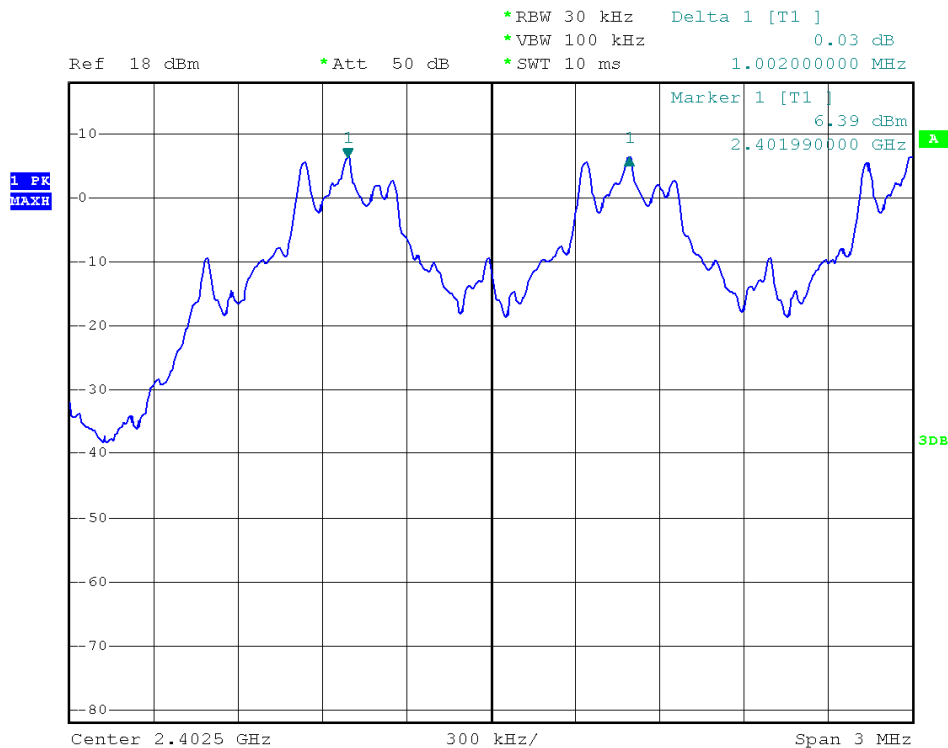
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: $1.398 \times 2/3 = 0.932$ MHz

Channel Separation	1.002 MHz
--------------------	-----------

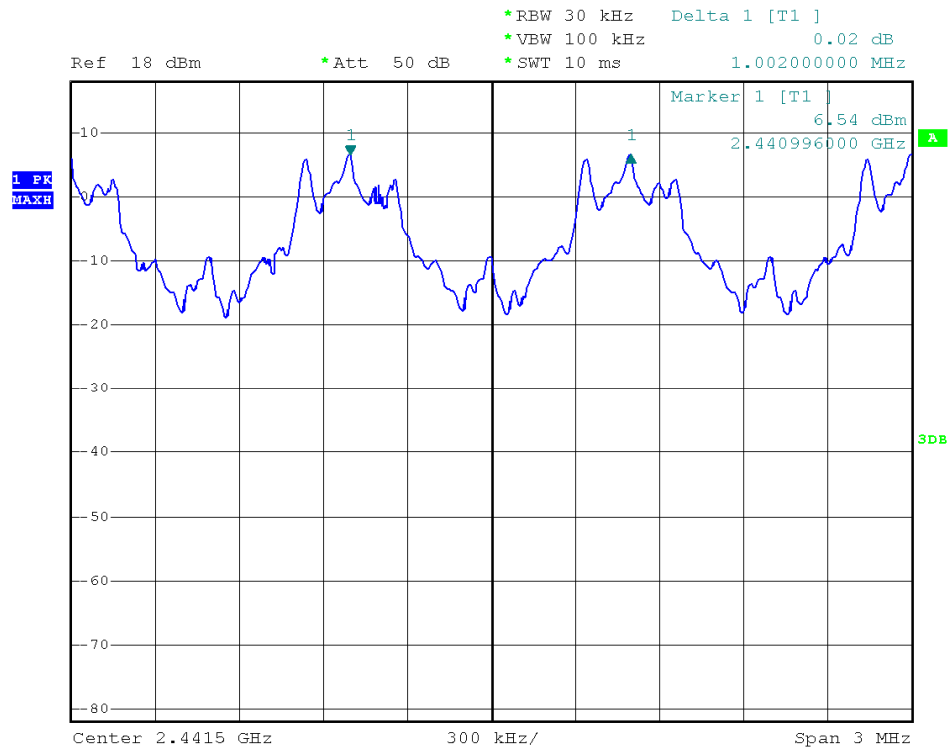
Modulation Type: GFSK

Low Channel

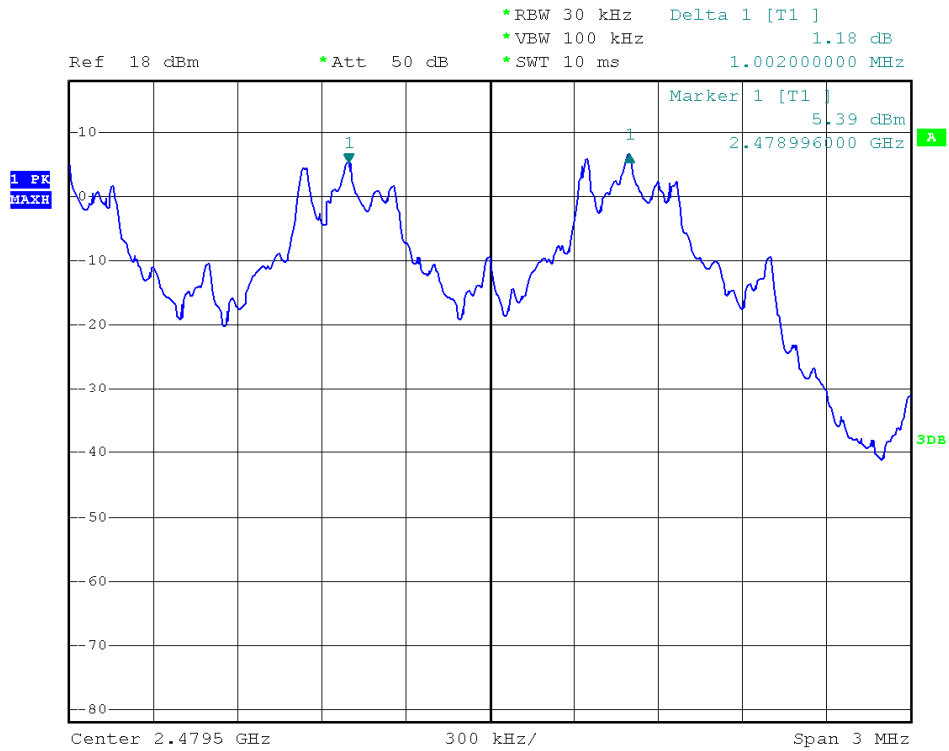


INTERTEK TESTING SERVICES

Middle Channel



High Channel



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 SWEEP was then set to the time required by the regulation (0.4s x number of hopping channels employed for 2400-2483.5 MHz). The analyzer was set to SINGLE SWEEP, the total ON time was added and compared against the limit (0.4s)

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

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

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

The maximum number of hopping channels in 8s (AFH mode) for DH3
 $=800 / 4 / 20 * 8 = 80$

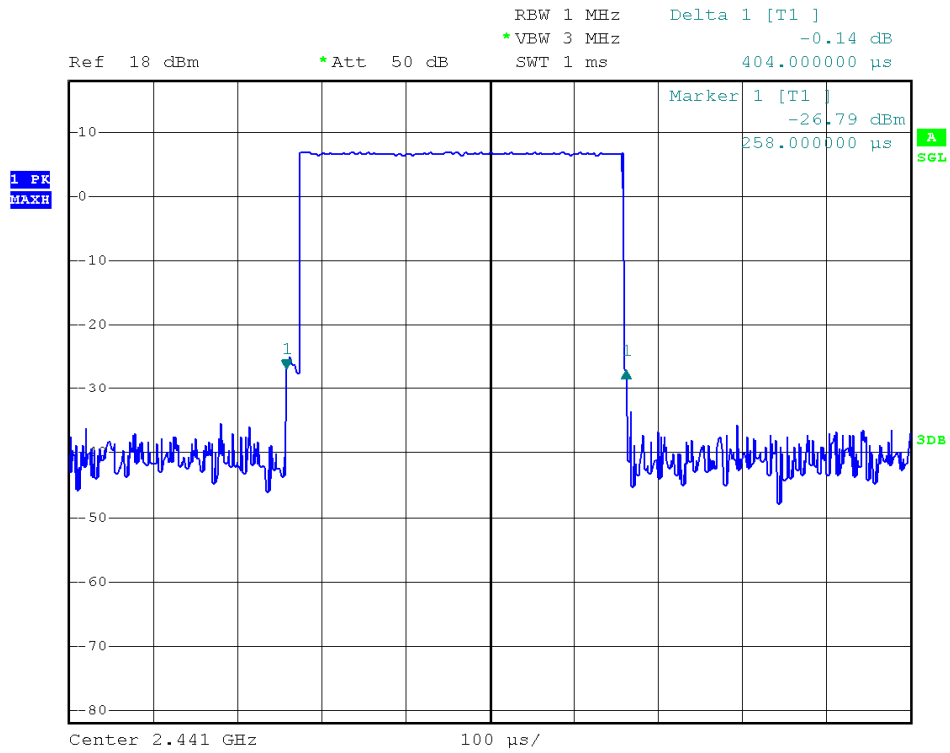
The maximum number of hopping channels in 31.6s for DH5
 $=1600 / 6 / 79 * 31.6 = 107$

The maximum number of hopping channels in 8s (AFH mode) for DH5
 $=800 / 6 / 20 * 8 = 53$

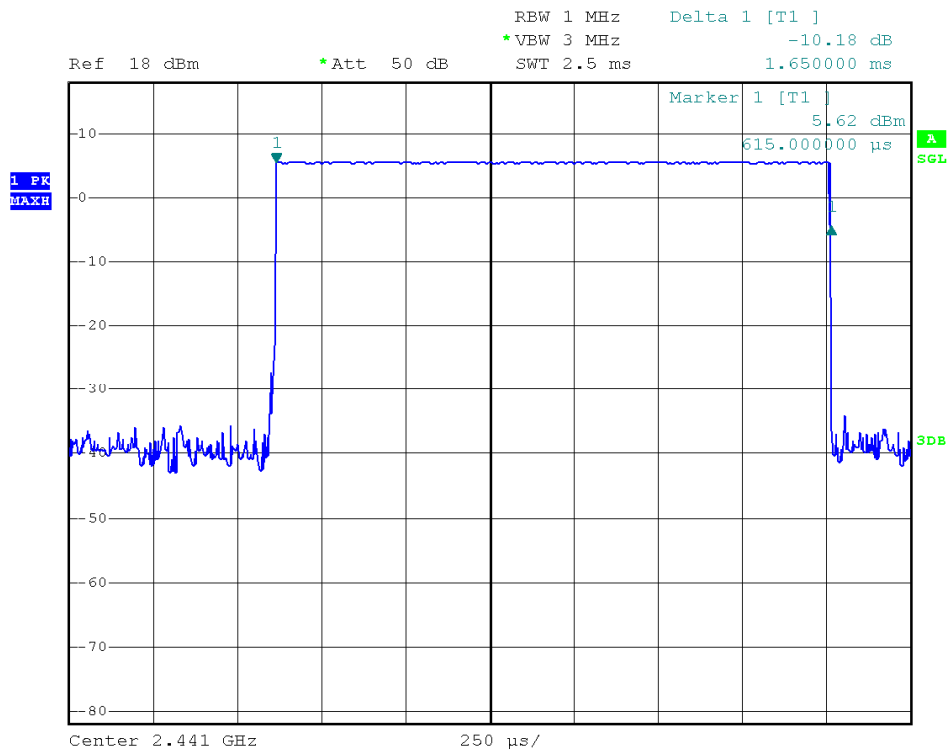
Modulation Type	Packet	Worst Case Max Dwell Time				Limit (s)	Result	
GFSK	DH1	0.404	ms	* 320=	129.28	ms	0.4	Pass
	DH3	1.650	ms	* 160=	264.00	ms	0.4	Pass
	DH5	2.919	ms	* 107=	312.33	ms	0.4	Pass
π/4-DQPSK	DH1	0.392	ms	* 320=	125.44	ms	0.4	Pass
	DH3	1.655	ms	* 160=	264.80	ms	0.4	Pass
	DH5	2.898	ms	* 107=	310.09	ms	0.4	Pass
8DPSK	DH1	0.392	ms	* 320=	125.44	ms	0.4	Pass
	DH3	1.650	ms	* 160=	264.00	ms	0.4	Pass
	DH5	2.905	ms	* 107=	310.84	ms	0.4	Pass

INTERTEK TESTING SERVICES

Modulation Type: GFSK
Packet: DH1



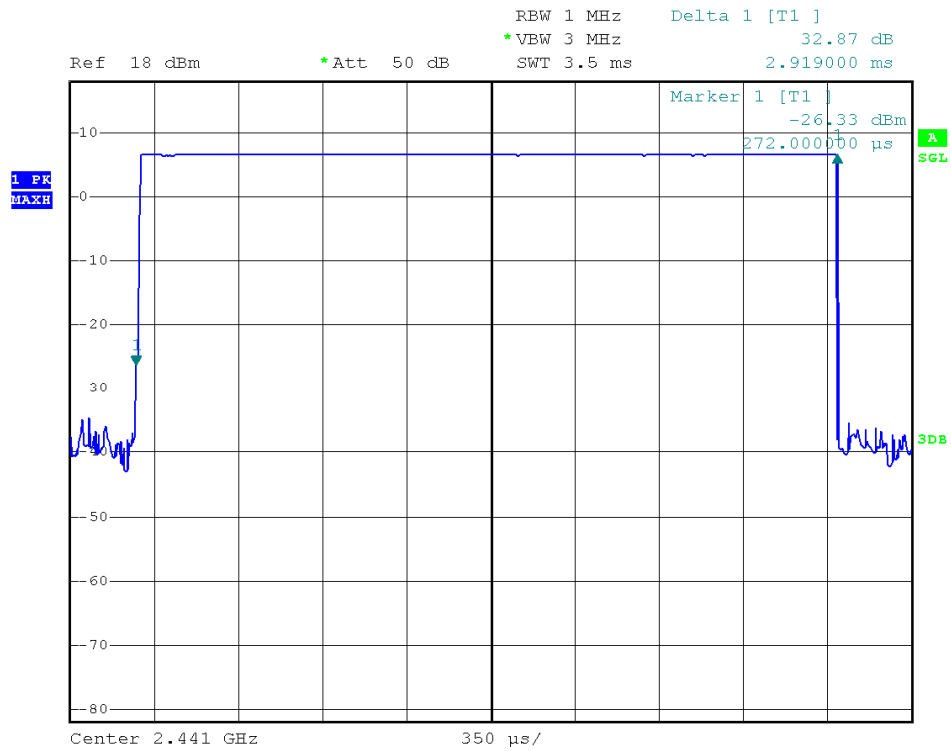
Packet: DH3



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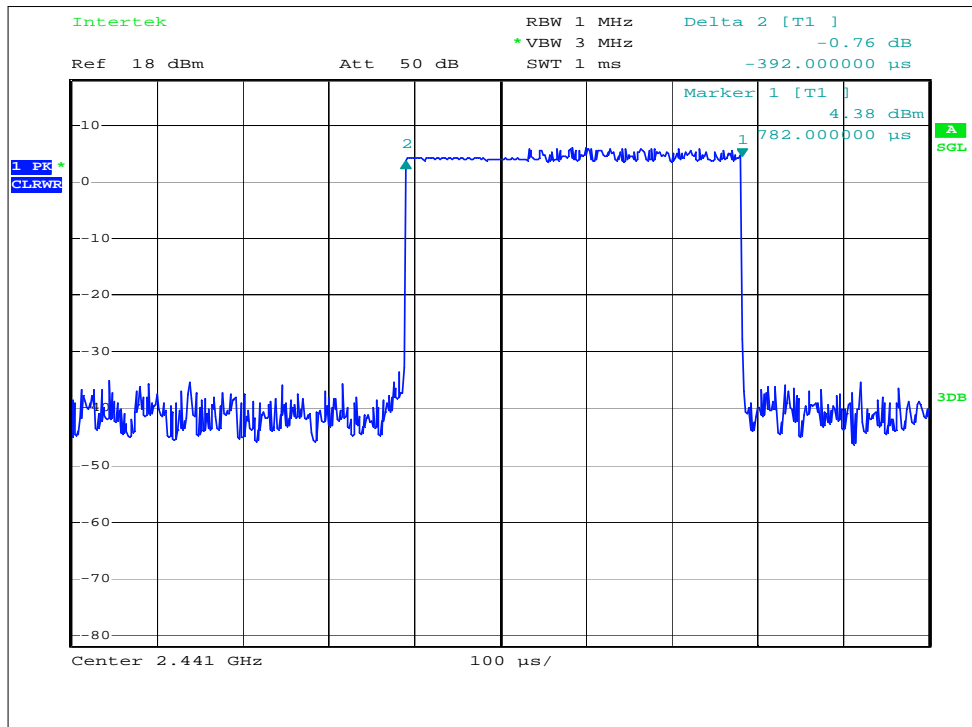
INTERTEK TESTING SERVICES

Packet: DH5



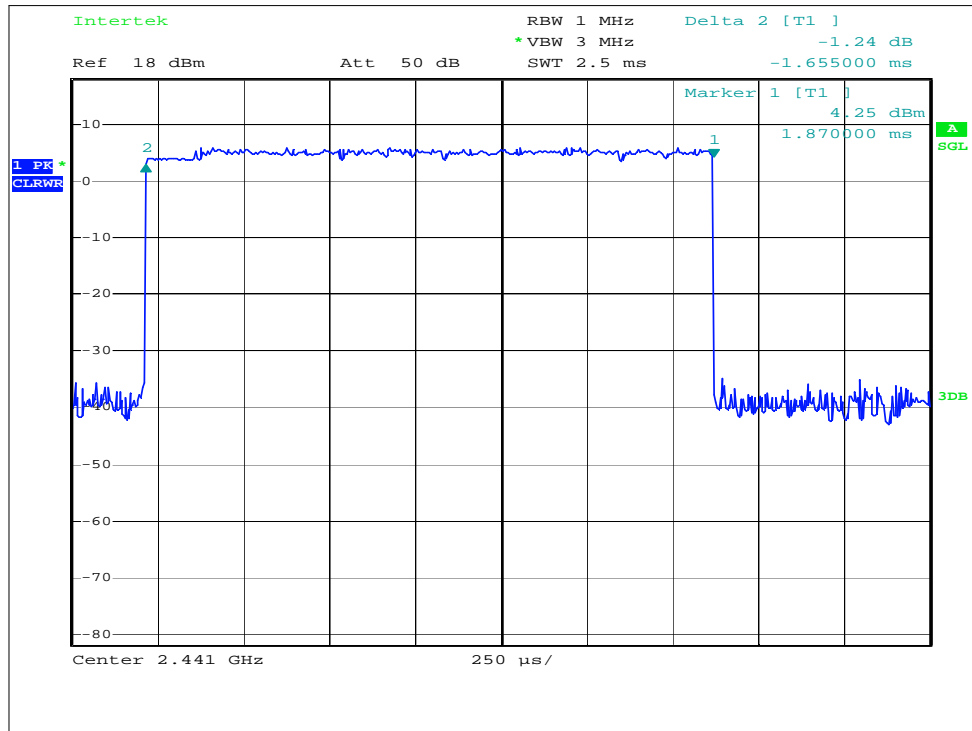
Modulation Type: $\pi/4$ -DQPSK

Packet: DH1

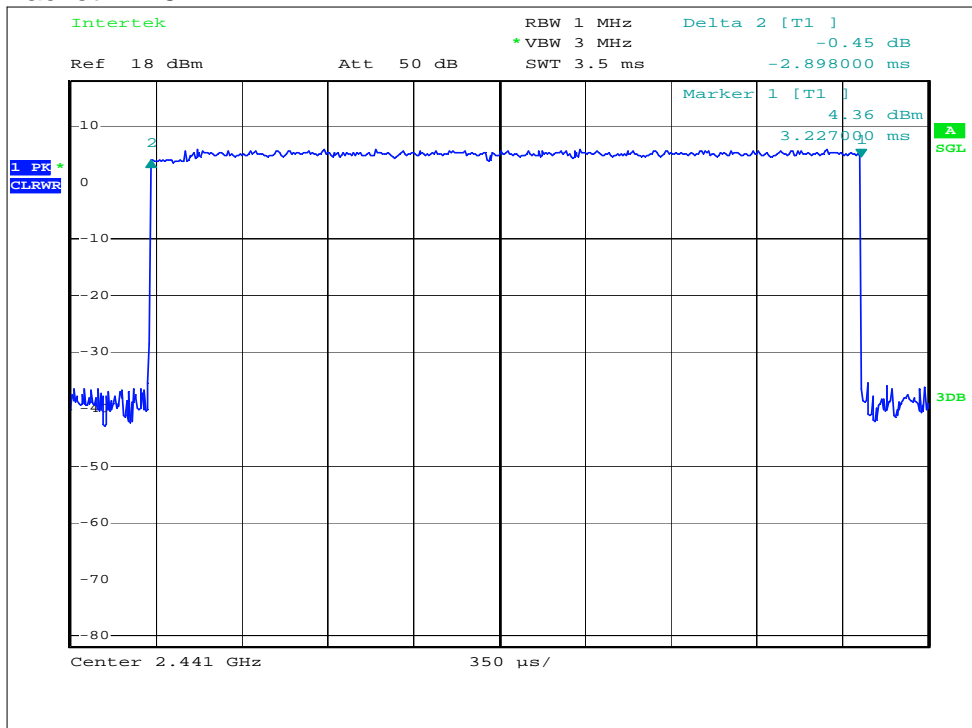


INTERTEK TESTING SERVICES

Packet: DH3



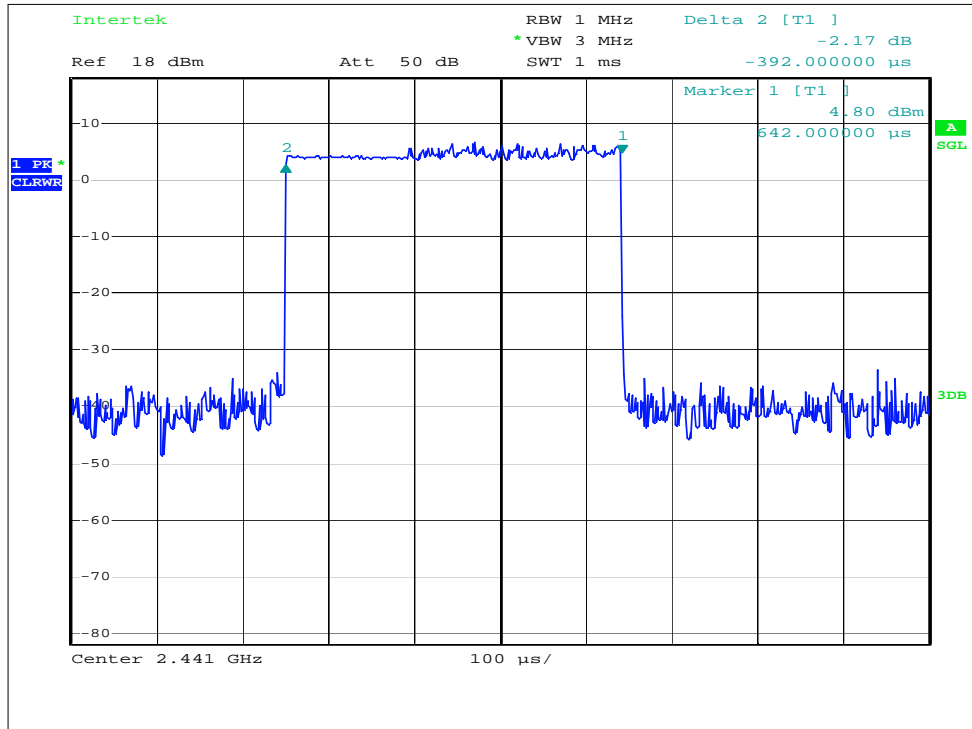
Packet: DH5



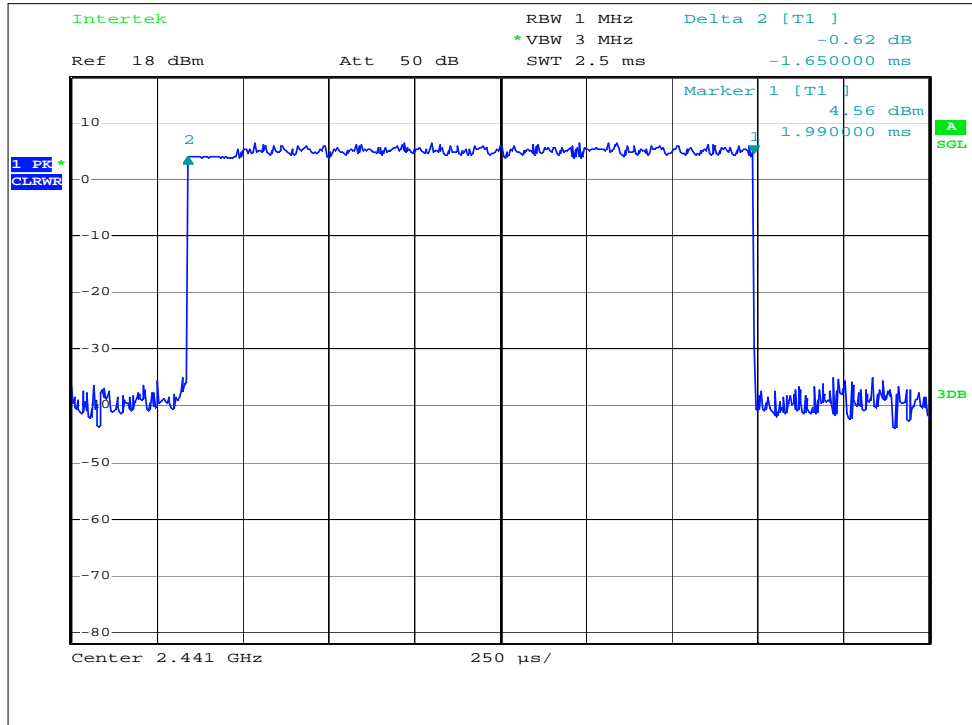
INTERTEK TESTING SERVICES

Modulation Type: 8DPSK

Packet: DH1

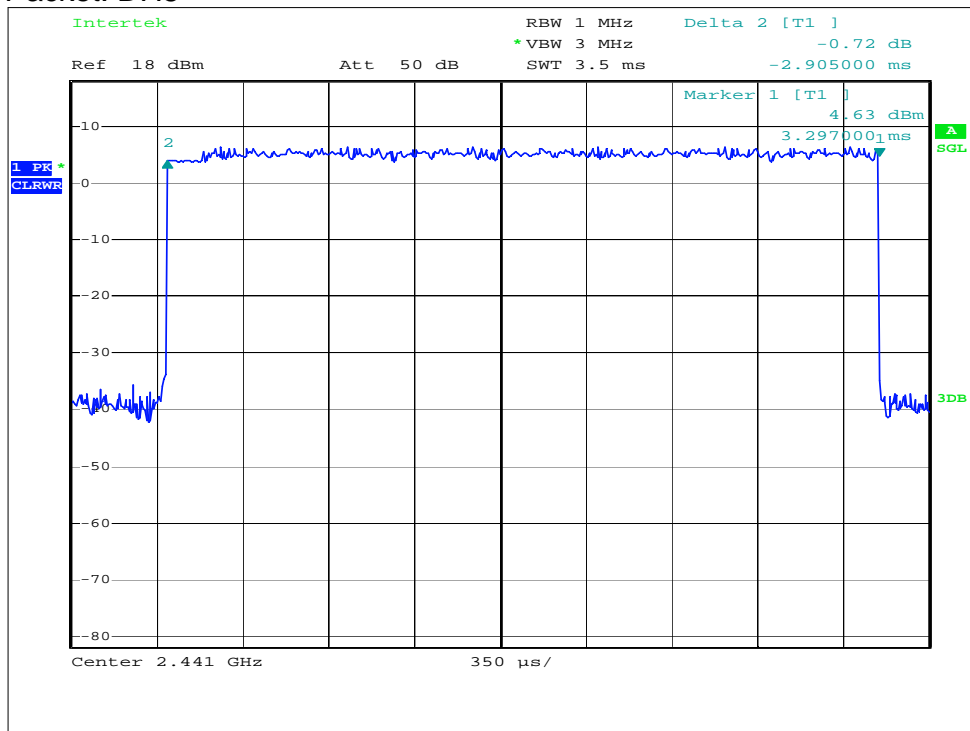


Packet: DH3



INTERTEK TESTING SERVICES

Packet: DH5



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

$$\begin{aligned} &= 101.7\text{dB}\mu\text{v/m}-45.05\text{dB} \\ &= 56.65\text{dB}\mu\text{v/m} \end{aligned}$$

$$\begin{aligned} \text{Average Resultant field strength} &= 56.65\text{dB}\mu\text{v/m}-22.5\text{dB} \\ &= 34.15\text{dB}\mu\text{v/m} \end{aligned}$$

(ii) Upper channel 2480MHz:

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

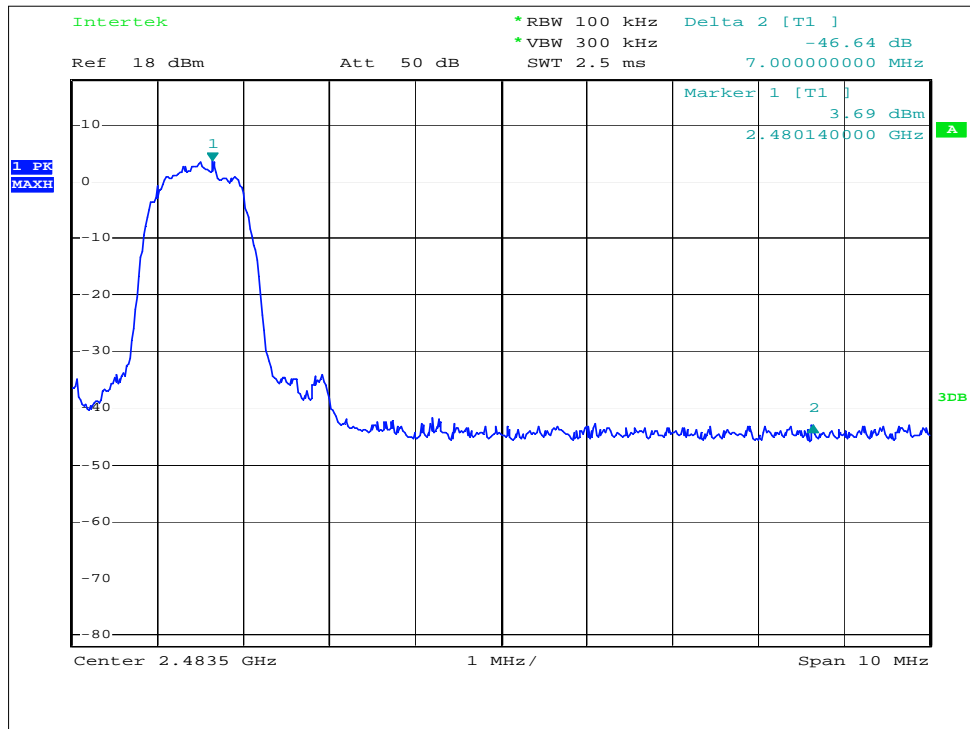
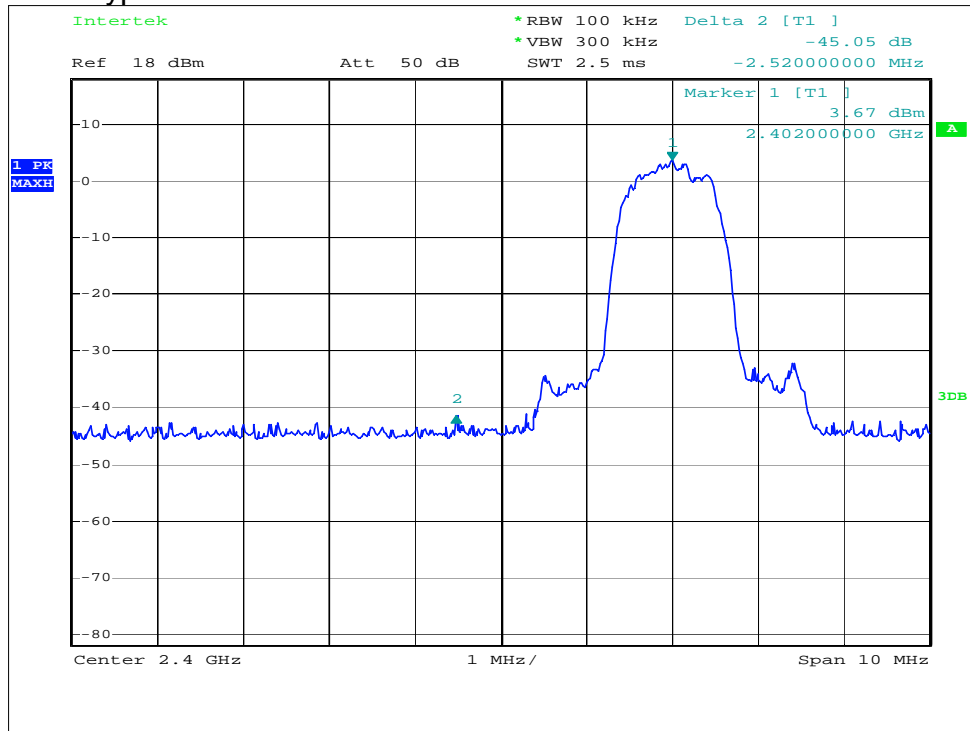
$$\begin{aligned} &= 102.7\text{dB}\mu\text{v/m}-46.64\text{dB} \\ &= 56.06\text{dB}\mu\text{v/m} \end{aligned}$$

$$\begin{aligned} \text{Average Resultant field strength} &= 56.06\text{dB}\mu\text{v/m}-22.5\text{dB} \\ &= 33.56\text{dB}\mu\text{v/m} \end{aligned}$$

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

INTERTEK TESTING SERVICES

Modulation Type: 8DPSK



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3.9 **Transmitter Spurious Emissions (Conducted)**

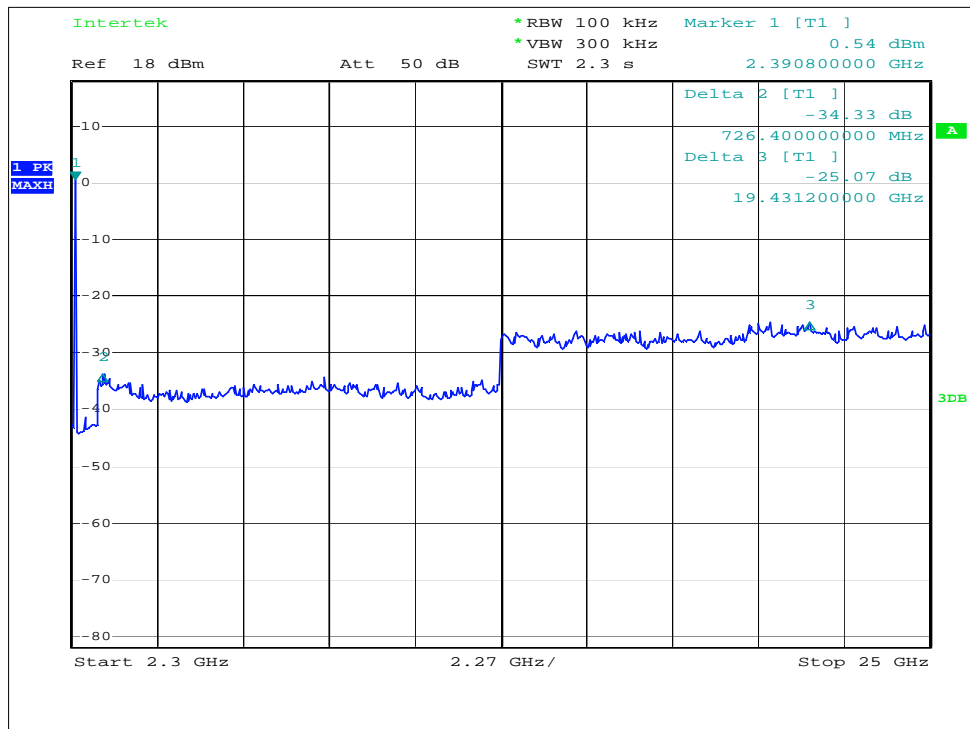
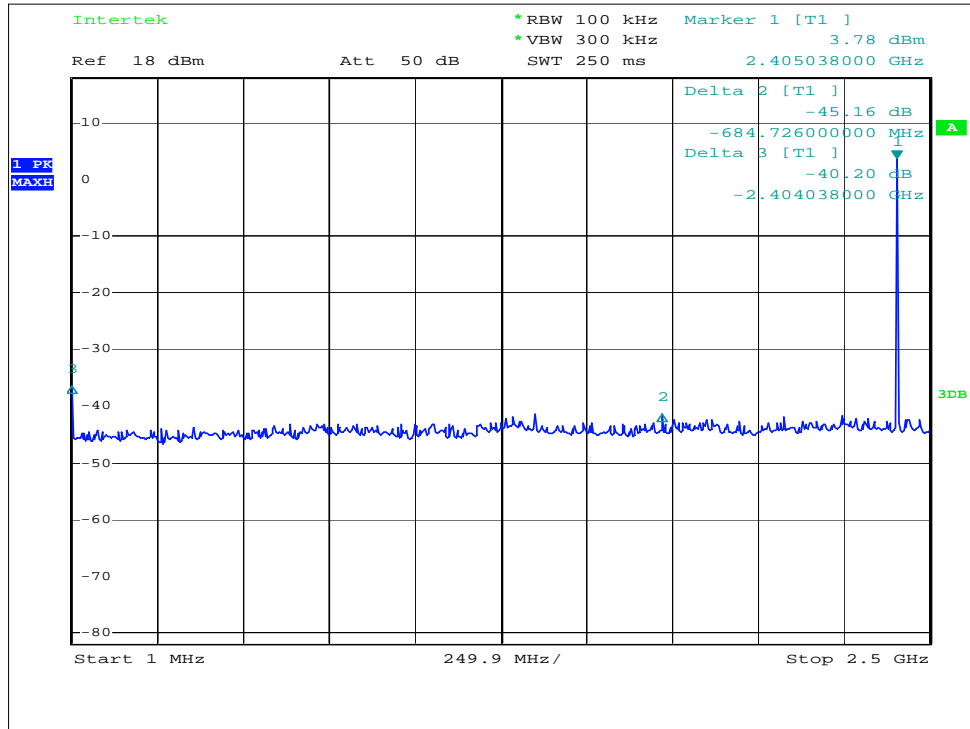
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

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

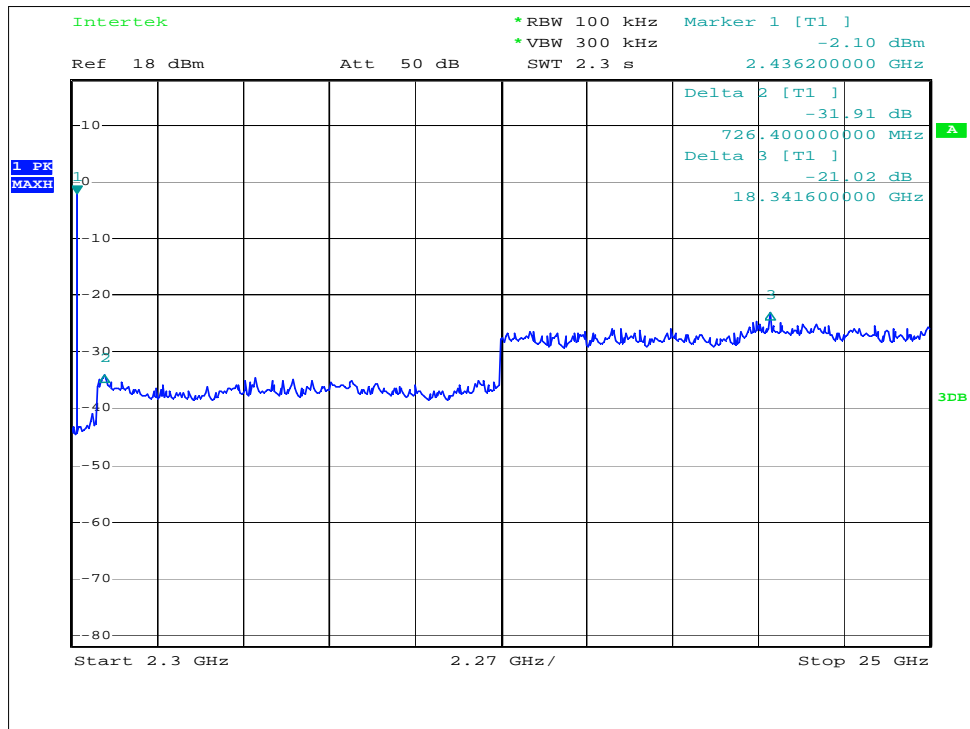
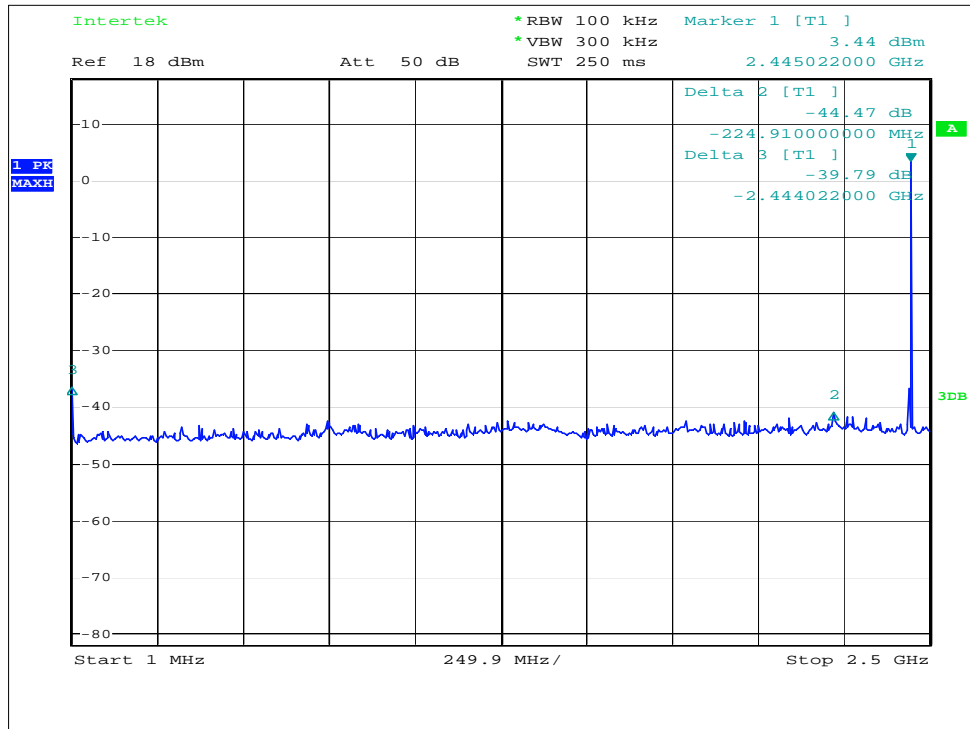
CH00



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FCC ID: PYABH-110U

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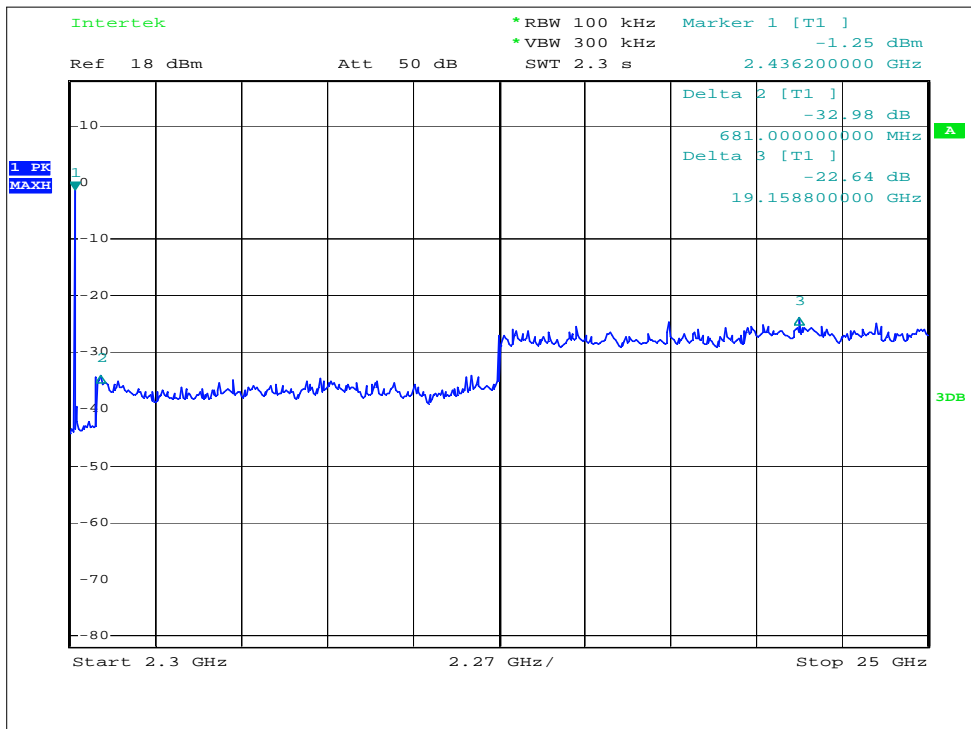
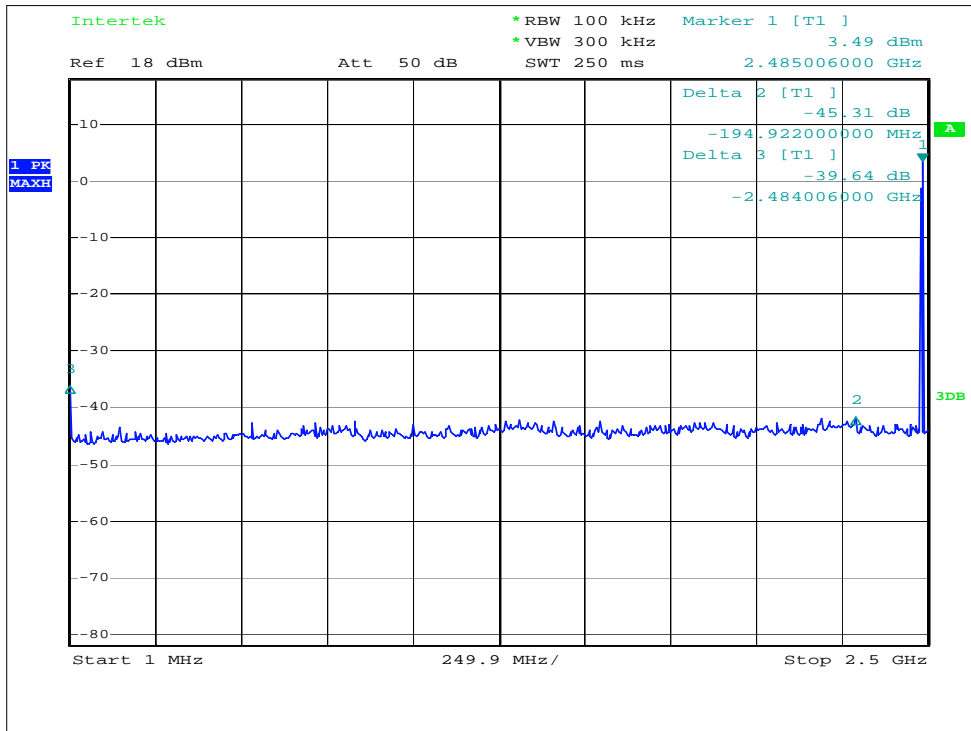
CH39



TRF No.: FCC 15C_TX_b
FCC ID: PYABH-110U

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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.

INTERTEK TESTING SERVICES

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.

INTERTEK TESTING SERVICES

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.

INTERTEK TESTING SERVICES

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.

INTERTEK TESTING SERVICES

EXHIBIT 8

MISCELLANEOUS INFORMATION

INTERTEK TESTING SERVICES

8.0 **Miscellaneous Information**

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

INTERTEK TESTING SERVICES

8.1 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (T_{eff}) is approximately 392 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, 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 = $20\log_{10}(7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$

INTERTEK TESTING SERVICES

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.

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.

INTERTEK TESTING SERVICES

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
SZ061-03	BiConiLog Antenna	ETS	3142C	00066460	30-Jun-12	30-Jun-13
SZ185-01	EMI Receiver	R&S	ESCI	100547	12-Mar-13	12-Mar-14
SZ061-08	Horn Antenna	ETS	3115	00092346	3-Nov-12	3-Nov-13
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	12-Mar-13	12-Mar-14
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	21-May-12	21-May-13
SZ061-07	Pyramidal Horn Antenna	ETS	3160-09	00083067	26-Feb-13	26-Aug-13
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	12-Mar-13	12-Mar-14
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	2-Mar-13	2-Mar-14
SZ062-02	RF Cable	RADIALL	RG 213U	--	26-Feb-13	26-Aug-13
SZ062-12	RF Cable	RADIALL	R288531262	--	26-Feb-13	26-Aug-13
SZ062-19	RF Cable	HUBER+SUHNER	SF104	--	26-Feb-13	26-Aug-13
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	11-Jun-12	11-Jun-13
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	5-Nov-12	5-Nov-13
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	5-Nov-12	5-Nov-13
SZ187-02	Two-Line V-Network	R&S	ENV216	100073	5-Nov-12	5-Nov-13
SZ188-03	Shielding Room	ETS	RFD-100	4100	10-Sep-12	10-Sep-13
SZ065-03	Bluetooth Tester	R&S	CBT32	--	22-Mar-13	22-Mar-14

INTERTEK TESTING SERVICES

10.0 Annex

Document History

Report No.	Issue Date	Change
SZ11090192-1	September 14, 2011	Original Report
130313014SZN-001	April 20, 2013	<ol style="list-style-type: none">1. Changing the version from (HW: V4.0; SW: B4.0.0.1; MV: V2.0) to (HW: 1.0; SW: B4.0.0.1; MV: 1.0);2. Charging port has been change from 2mm circle port to Micro USB port;3. Updated RE, CE test.