

Thermos LLC

Application
For
Certification
FCC ID: 2ABDJ-BRCM1078

Smart Hydration Bottle

Model: SP400

2.4GHz Transceiver

Report No.: 150204012SZN-001

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-13]

Prepared and Checked by:

Approved by:

Sign on file
Leo Lai
Project Engineer

Andy Yan
Senior Project Engineer
Date: February 04, 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
FCC ID: 2ABDJ-BRCM1078
Report No.: 150204012SZN-001

INTERTEK TESTING SERVICES

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List of attached file

Exhibit type	File Description	Filename
Test Report	Test Report	report.pdf
Test Setup Photo	Conducted Emission	conducted photos.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
Test Report	Bandedge Plot	bandedge.pdf
Test Report	20dB BW Plot	bw.pdf
External Photo	External Photo	external photos.pdf
Internal Photo	Internal Photo	internal photos.pdf
Internal Photo	Internal Photo	internal photos.pdf

EXHIBIT 1

GENERAL DESCRIPTION

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1.0 General Description

1.1 Product Description

The equipment under test (EUT) is a Smart Hydration Bottle with Bluetooth function. The EUT is operated by DC 3.7V (1 x 3.7V rechargeable battery). For more information, please refer to user manual.

Antenna Type: Integral antenna

Modulation Type: GFSK

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 a transceiver for the Smart Hydration Bottle, SP400 uses iDevice Module BCM20736S (FCC ID: 2ABDJ-BRCM1078 and IC: 11569A-BRCM1078), and there is no corresponding unit for certification.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2009). 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. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

1.4 Test Facility

The Semi-anechoic chamber and shielding room used to collect the radiated data and conducted data are **Intertek Testing Services Shenzhen Ltd. Kejiyuan Branch** and located at 6F, D Block, 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 DC 3.7V (1 x 3.7V rechargeable battery) during the test.

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 unit was operated standalone and placed in the centre of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

The EUT exercise program (provided by client) used during testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

N/A.

2.4 Equipment Modification

Any modifications installed previous to testing by 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

Description	Manufacturer	Model No.
iPod	Apple	A1421
AC Adapter	TP Link	T050100-2AS
Shielded USB cable	Motorola	100cm

EXHIBIT 3
EMISSION RESULTS

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3.0 **Emission Results**

Data is included worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

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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.

$$\begin{aligned} RA &= 62.0 \text{ dB}\mu\text{V} \\ AF &= 7.4 \text{ dB} \\ CF &= 1.6 \text{ dB} \\ AG &= 29.0 \text{ dB} \\ PD &= 0 \text{ dB} \\ AV &= -10 \text{ dB} \\ FS &= 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 \text{ dB}\mu\text{V/m} \end{aligned}$$

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

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3.1.2 Radiated Emission Configuration Photograph

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

3.1.3 Radiated Emissions

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
927.720 MHz

Judgement: Passed by 16.2 dB

TEST PERSONNEL:

Sign on file

Leo Lai Project Engineer

Typed/Printed Name

January 27, 2015

Date

INTERTEK TESTING SERVICES

Applicant: Thermos LLC

Date of Test: January 27, 2015

Model: SP400

Sample: 1/1

Worst Case Operating Mode: Transmit

Table 1

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	30.240	32.8	20.0	8.1	20.9	40.0	-19.1
Horizontal	148.320	21.7	20.0	15.4	17.1	43.5	-26.4
Horizontal	960.720	34.6	20.0	16.4	31.0	54.0	-23.0
Vertical	31.160	35.1	20.0	8.1	23.2	40.0	-16.8
Vertical	54.720	25.6	20.0	15.5	21.1	40.0	-18.9
Vertical	927.720	32.9	20.0	16.9	29.8	46.0	-16.2

- 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.

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3.1.4 Transmitter Spurious Emissions (Radiated)

Worst Case Radiated Emission
at
9608.0 MHz

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

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.

Judgement: Passed by 8.7 dB

TEST PERSONNEL:

Sign on file

Leo Lai Project Engineer
Typed/Printed Name

January 27, 2015
Date

INTERTEK TESTING SERVICES

Applicant: Thermos LLC
Model: SP400
Sample: 1/1
Worst Case Operating Mode: Transmit

Date of Test: January 27, 2015

Table 2

Radiated Emissions

(2402MHz)

Polarization	Frequency (MHz)	Reading Peak (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2402.000	98.4	36.7	28.5	90.2	114.0	-23.8
Horizontal	4804.000	59.7	36.7	28.5	51.5	74.0	-22.5
Horizontal	7206.000	61.9	36.1	33.1	58.9	74.0	-15.1
Horizontal	9608.000	59.0	36.2	37.8	60.6	74.0	-13.4

Polarization	Frequency (MHz)	Reading Average (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2402.000	84.9	36.7	28.5	76.7	94.0	-17.3
Horizontal	4804.000	46.9	36.7	28.5	38.7	54.0	-15.3
Horizontal	7206.000	47.5	36.1	33.1	44.5	54.0	-9.5
Horizontal	9608.000	43.7	36.2	37.8	45.3	54.0	-8.7

Notes: 1. Peak detector Data unless otherwise stated. Above 1000 MHz, RBW=1MHz, VBW=3MHz is used for Peak measurement, RBW=1MHz, VBW=10Hz is used for Average measurement.

2. All measurements were made at 3 meter. Harmonic 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 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. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Leo Lai

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Applicant: Thermos LLC
Model: SP400
Sample: 1/1
Worst Case Operating Mode: Transmit

Date of Test: January 27, 2015

Table 3

Radiated Emissions

(2440MHz)

Polarization	Frequency (MHz)	Reading Peak (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2440.000	97.7	36.7	28.5	89.5	114.0	-24.5
Horizontal	4880.000	58.2	36.7	28.5	50.0	74.0	-24.0
Horizontal	7320.000	59.3	36.1	33.1	56.3	74.0	-17.7
Horizontal	9760.000	58.8	36.2	37.8	60.4	74.0	-13.6

Polarization	Frequency (MHz)	Reading Average (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2440.000	84.2	36.7	28.5	76.0	94.0	-18.0
Horizontal	4880.000	43.7	36.7	28.5	35.5	54.0	-18.5
Horizontal	7320.000	45.2	36.1	33.1	42.2	54.0	-11.8
Horizontal	9760.000	43.6	36.2	37.8	45.2	54.0	-8.8

- Notes:
1. Peak detector Data unless otherwise stated. Above 1000 MHz, RBW=1MHz, VBW=3MHz is used for Peak measurement, RBW=1MHz, VBW=10Hz is used for Average measurement.
 2. All measurements were made at 3 meter. Harmonic 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 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. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Leo Lai

INTERTEK TESTING SERVICES

Applicant: Thermos LLC
Model: SP400
Sample: 1/1
Worst Case Operating Mode: Transmit

Date of Test: January 27, 2015

Table 4

Radiated Emissions

(2480MHz)

Polarization	Frequency (MHz)	Reading Peak (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2480.000	97.8	36.7	28.5	89.6	114.0	-24.4
Horizontal	4960.000	58.7	36.7	28.5	50.5	74.0	-23.5
Horizontal	7440.000	59.6	36.1	33.1	56.6	74.0	-17.4
Horizontal	9920.000	58.9	36.2	37.8	60.5	74.0	-13.5

Polarization	Frequency (MHz)	Reading Average (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2480.000	84.3	36.7	28.5	76.1	94.0	-17.9
Horizontal	4960.000	43.8	36.7	28.5	35.6	54.0	-18.4
Horizontal	7440.000	45.1	36.1	33.1	42.1	54.0	-11.9
Horizontal	9920.000	43.6	36.2	37.8	45.2	54.0	-8.8

- Notes: 1. Peak detector Data unless otherwise stated. Above 1000 MHz, RBW=1MHz, VBW=3MHz is used for Peak measurement, RBW=1MHz, VBW=10Hz is used for Average measurement.
2. All measurements were made at 3 meter. Harmonic 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 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. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Leo Lai

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3.2 Conducted Emission at Mains Terminal

3.2.1 Conducted Emissions Configuration Photograph

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

3.2.2 Conducted Emissions

Worst Case Neutral-Conducted Configuration
At

0.178 MHz

Judgement: Passed by 23.1 dB margin

TEST PERSONNEL:

Sign on file

Leo Lai, Project Engineer
Typed/Printed Name

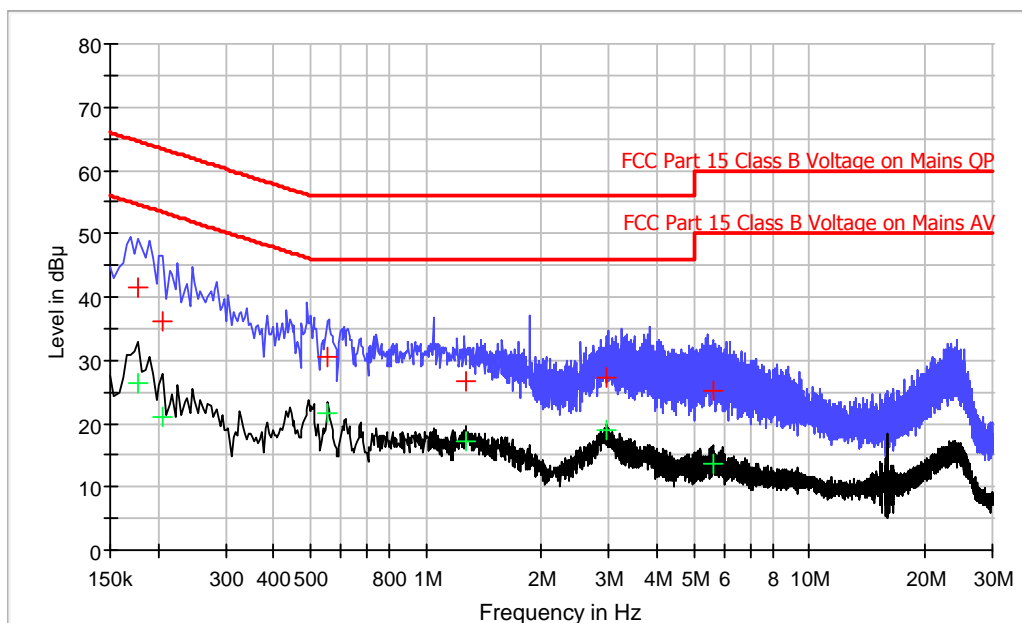
January 27, 2015
Date

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Applicant: Thermos LLC
Model: SP400
Sample: 1/1
Worst Case Operating Mode: Transmit
Phase: Live

Date of Test: January 27, 2015

Conducted Emission Test - FCC



Result Table QP

Frequency (MHz)	QuasiPeak (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.178000	41.5	L1	9.9	23.1	64.6
0.206000	36.1	L1	9.8	27.3	63.4
0.554000	30.4	L1	9.6	25.6	56.0
1.274000	26.6	L1	9.8	29.4	56.0
2.970000	27.1	L1	9.8	28.9	56.0
5.582000	25.2	L1	9.9	34.8	60.0

Result Table AV

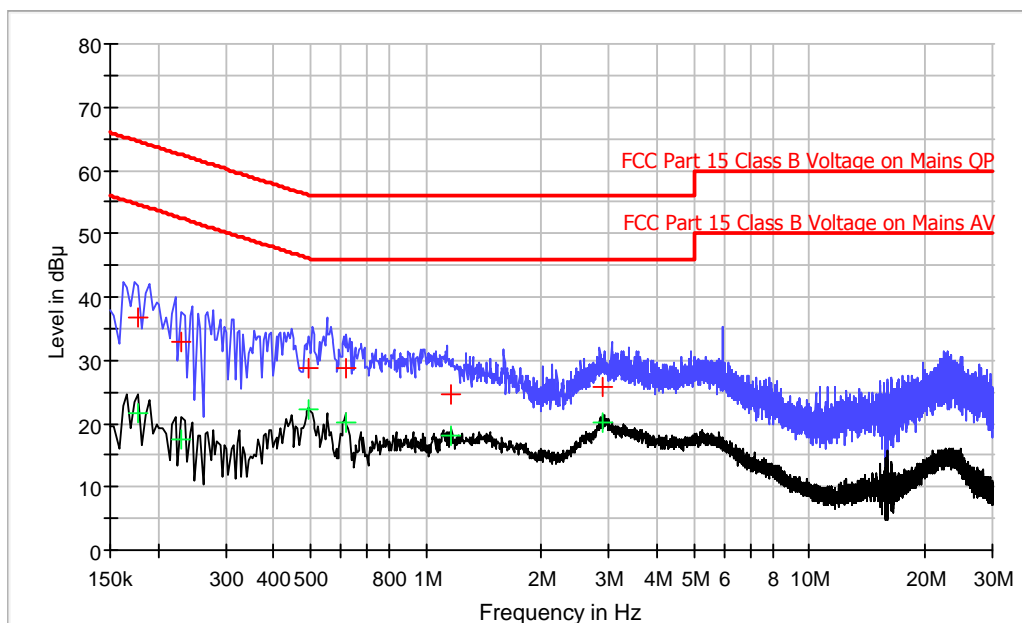
Frequency (MHz)	Average (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.178000	26.4	L1	9.9	28.2	54.6
0.206000	21.0	L1	9.8	32.4	53.4
0.554000	21.7	L1	9.6	24.3	46.0
1.274000	17.3	L1	9.8	28.7	46.0
2.970000	19.1	L1	9.8	26.9	46.0
5.582000	13.5	L1	9.9	36.5	50.0

INTERTEK TESTING SERVICES

Applicant: Thermos LLC
Model: SP400
Sample: 1/1
Worst Case Operating Mode: Transmit
Phase: Neutral

Date of Test: January 27, 2015

Conducted Emission Test - FCC



Result Table QP

Frequency (MHz)	QuasiPeak (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.178000	36.7	N	9.9	27.9	64.6
0.230000	32.8	N	9.8	29.6	62.4
0.494000	28.7	N	9.5	27.4	56.1
0.618000	28.7	N	9.5	27.3	56.0
1.166000	24.6	N	9.8	31.4	56.0
2.906000	25.7	N	9.8	30.3	56.0

Result Table AV

Frequency (MHz)	Average (dB μ V)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.178000	21.5	N	9.9	33.1	54.6
0.230000	17.5	N	9.8	34.9	52.4
0.494000	22.2	N	9.5	23.9	46.1
0.618000	20.3	N	9.5	25.7	46.0
1.166000	18.0	N	9.8	28.0	46.0
2.906000	20.1	N	9.8	25.9	46.0

EXHIBIT 4
EQUIPMENT PHOTOGRAPHS

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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

MISCELLANEOUS INFORMATION

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5.0 **Miscellaneous Information**

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

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5.1 Bandedge Plot

For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: bandedge.pdf. From the plot, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfils the requirement of 15.249(d).

Peak Measurement

Bandedge compliance is determined by applying marker-delta method, i.e (Bandedge Plot).

(i) Lower channel 2402MHz:

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

$$\begin{aligned} &= 90.2 \text{ dB}\mu\text{v/m} - 47.7 \text{ dB} \\ &= 42.5 \text{ dB}\mu\text{v/m} \end{aligned}$$

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

$$\begin{aligned} &= 76.7 \text{ dB}\mu\text{v/m} - 47.7 \text{ dB} \\ &= 29.0 \text{ dB}\mu\text{v/m} \end{aligned}$$

(ii) Upper channel 2480MHz:

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

$$\begin{aligned} &= 89.6 \text{ dB}\mu\text{v/m} - 60.4 \text{ dB} \\ &= 29.2 \text{ dB}\mu\text{v/m} \end{aligned}$$

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

$$\begin{aligned} &= 76.1 \text{ dB}\mu\text{v/m} - 60.4 \text{ dB} \\ &= 15.7 \text{ dB}\mu\text{v/m} \end{aligned}$$

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

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5.1 Bandedge Plot (cont'd)

Pursuant to FCC part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

Figure 8.1 Bandwidth

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5.2 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. Above 1000 MHz, RBW=1MHz, VBW=3MHz is used for Peak measurement, RBW=1MHz, VBW=10Hz is used for Average measurement.

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.

Detector function for conducted emissions is in QP & AV mode and IFBW setting is 9 kHz from the frequency band 150 kHz to 30MHz.

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5.2 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 6
TEST EQUIPMENT LIST

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6.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-03	BiConiLog Antenna	ETS	3142C	00066460	28-Jun-14	28-Jun-15
SZ185-01	EMI Receiver	R&S	ESCI	100547	10-Mar-14	10-Mar-15
SZ061-08	Horn Antenna	ETS	3115	00092346	19-Oct-14	19-Oct-15
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	29-Apr-14	29-Apr-15
SZ061-07	Pyramidal Horn Antenna	ETS	3160-09	00083067	3-Sep-14	3-Sep-15
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	10-Mar-14	10-Mar-15
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	10-Mar-14	10-Mar-15
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	19-Apr-14	19-Apr-15
SZ062-02	RF Cable	RADIAL	RG 213U	--	3-Jul-14	3-Jun-15
SZ062-12	RF Cable	RADIAL	R288531262	--	9-Oct-14	9-Apr-15
SZ062-19	RF Cable	HUBER+SUHNER	SF104	--	3-Jul-14	3-Jun-15
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	21-May-14	21-May-15
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	1-Nov-14	1-Nov-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	16-Jun-14	16-Jun-15
SZ188-03	Shielding Room	ETS	RFD-100	4100	23-Aug-14	23-Aug-15