# Huawei Technologies Co., Ltd

Application
For
Certification
**FCC ID: QISY520-U33**

**WCDMA Digital Mobile Phone**

**Model: HUAWEI Y520-U33**

## Report No.: 140710014SZN-001

## 2.4GHz Transceiver

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 | Digitally signed by Andy Yan<br>Location: Intertek Testing Services |
| Jenner Liu<br>Assitant Engineer | Andy Yan<br>Senior Project Engineer<br>Date: 15 August 2014 |



TRF No.: FCC 15C_TX_b


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# LIST OF EXHIBITS

# MEASUREMENT/TECHNICAL REPORT

## Huawei Technologies Co.,Ltd
## Model: WCDMA Digital Mobile Phone

## FCC ID: QISY520-U33

This report concerns (check one:) Original Grant ___X___ Class II Change _____

Equipment Type: DSS - Part 15 Spread Spectrum Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No __X__

If yes, defer until: _____
date

Company Name agrees to notify the Commission by: _____
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes _____ No __X__

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

Report prepared by:

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## Table of Contents

List of attached file

| Exhibit type | File Description | filename |
|---|---|---|
| Test Report | Test Report | report.pdf |
| Operational Description | Technical Description | descri.pdf |
| Test Setup Photo | 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/safety info.pdf |
| Cover Letter | Letter of Agency | agency.pdf |
| Cover Letter | Confidentiality Letter | request.pdf |

# EXHIBIT 1

# GENERAL DESCRIPTION

## 1.0 General Description

### 1.1 Product Description

The equipment under test (EUT) is a WCDMA Digital Mobile Phone, Model: HUAWEI Y520-U33 with Bluetooth FHSS technology. The EUT was powered by AC/DC Adapter (input: 100-240Vac, 50/60Hz, Output: 5Vdc, 550mA).

Antenna Type: Integral antenna
Antenna Gain: 0.5 dBi
Modulation Type: GFSK, π/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 portions are subject to the following procedures:
1. Bluetooth LE 4.0(2.4G band): 140710014SZN-002
2. WiFi Transceiver (2.4G band): 140710014SZN-003
3. WCDMA Digital Mobile Phone (2G&3G): 140710014SZN-004
4. PC download (Class B personal computer and peripherals): 140710014SZN-005
5. Other function: 140710014SZN-006

### 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, 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

## 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 AC/DC Adapter (Input: 120Vac, 60Hz, Output: 5Vdc, 550mA), and only the worst case data was recorded in this report.

The simultaneous transmission spurious was tested, only the worst case data was recorded in this report.

All packets mode in modulation type GFSK, π/4 –DQPSK and 8-DPSK with different accessories listed in next page were tested, and only the worst data was reported in this report.

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

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

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

### 2.2 EUT Exercising Software

The EUT exercise program (provided by client) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The worst case configuration is used in all specified testing.

The parameters of test software setting:
During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the application and is going to be fixed on the firmware of the end product.

### 2.3 Special Accessories

One shielded USB cable attached.

2.4 Equipment Modification

Any modifications installed previous to testing by Huawei Technologies Co.,Ltd will be incorporated in each production model sold / leased in the United States.

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

2.5 Measurement Uncertainty

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

2.6 Support Equipment List and Description

| Description | Manufacturer | Model No. |
|---|---|---|
| Earphone (Black) | Goertek | HA1-3 |
| | Quancheng | 1293#+3283# 3.5MM-150 |
| | Lianchuang | MEMD1532B528000 |
| Earphone (White) | Merry | EMC323-011-01 |
| | Goertek | HG-04A |
| USB Cable | / | Data Cable USB A Male to Micro USB, shielded, 100cm |
| Battery | BYD | HB5V1 (1730mAh) |
| | LISHEN | |
| | SUNWODA | HB5V1HV (1950mAh) |
| | SCUD | |
| AC/DC Adapter (Huawei) | BYD / HuntKey | HW-050055U1W Input: 100-240Vac, 50/60Hz, 0.2A; Output: 5Vdc, 550mA |
| | BYD / HuntKey | HW-050055E1W Input: 100-240Vac, 50/60Hz, 0.2A; Output: 5Vdc, 550mA |
| | BYD / HuntKey | HW-050055B1W Input: 100-240Vac, 50/60Hz, 0.2A; Output: 5Vdc, 550mA |
| | BYD /UE | HW-050055A1W Input: 100-240Vac, 50/60Hz, 0.2A; Output: 5Vdc, 550mA |
| | BYD /UE | HW-050055R1W Input: 100-240Vac, 50/60Hz, 0.2A; Output: 5Vdc, 550mA |

Note: The Model: HUAWEI Y520-U33 have five different AC/DC Adapter power suppliers, which have already arranged the test accordingly, and the worst case data was recorded in this report.

# EXHIBIT 3

# TEST RESULTS

## 3.0 **Test Results**

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

3.1 **Radiated Test Results**

A sample calculation, configuration photographs and data tables of the emissions are included.

3.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

Where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

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

AV = -10 dB

FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 dBµV/m

Level in µV/m = Common Antilogarithm [(32 dBµV/m)/20] = 39.8 µV/m

3.1.2 Radiated Emission Configuration Photograph

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

3.1.3 Radiated Emissions- FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission
at
57.660 MHz

Judgement: Passed by 12.4 dB

***TEST PERSONNEL:***

*Sign on file*

Jenner Liu Assitant Engineer
*Typed/Printed Name*

25 July 2014
*Date*

Applicant: Huawei Technologies Co.,Ltd Date of Test: 25 July 2014
Model: HUAWEI Y520-U33
Sample: 1/1
Worst-case operating Mode: BT Link
Modulation type: GFSK
AC/DC Adapter: HuntKey (HW-050055U1W)

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 | 202.200 | 34.8 | 20.0 | 10.6 | 25.4 | 43.5 | -18.1 |
| Horizontal | 243.900 | 38.3 | 20.0 | 12.0 | 30.3 | 46.0 | -15.7 |
| Horizontal | 310.800 | 32.5 | 20.0 | 14.7 | 27.2 | 46.0 | -18.8 |
| Vertical | 30.480 | 27.8 | 20.0 | 18.9 | 26.7 | 40.0 | -13.3 |
| Vertical | 51.360 | 37.7 | 20.0 | 9.2 | 26.9 | 40.0 | -13.1 |
| Vertical | 57.660 | 39.8 | 20.0 | 7.8 | 27.6 | 40.0 | -12.4 |

NOTES: 1. Quasi-Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. All emissions are below the QP limit.

3.1.4 Transmitter Spurious Emissions (Radiated) - FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission
at
4960 MHz

Judgement: Passed by 22.8 dB

***TEST PERSONNEL:***

*Sign on file*

Jenner Liu Assitant Engineer
*Typed/Printed Name*

25 July 2014
*Date*

Applicant: Huawei Technologies Co.,Ltd Date of Test: 25 July 2014
Model: HUAWEI Y520-U33
Sample: 1/1
Worst-case operating Mode: Transmit-CH00 (2402MHz)
Modulation type: GFSK

Table 2

**Radiated Emissions**

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Horizontal | **2402.000 | 114.1 | 36.7 | 28.1 | 105.5 | -- | -- |
| Horizontal | *4804.000 | 50.9 | 36.1 | 35.5 | 50.3 | 74.0 | -23.7 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| Horizontal | *4804.000 | 50.9 | 36.1 | 35.5 | 22.5 | 27.8 | 54.0 | -26.2 |

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.

Applicant: Huawei Technologies Co.,Ltd Date of Test: 25 July 2014
Model: HUAWEI Y520-U33
Sample: 1/1
Worst-case operating Mode: Transmit-CH39 (2441MHz)
Modulation type: GFSK

Table 3

**Radiated Emissions**

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Horizontal | 2441.000 | 113.5 | 36.7 | 28.1 | 104.9 | -- | -- |
| Horizontal | *4882.000 | 51.4 | 36.1 | 35.5 | 50.8 | 74.0 | -23.2 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| Horizontal | *4882.000 | 51.4 | 36.1 | 35.5 | 22.5 | 28.3 | 54.0 | -25.7 |

NOTES: 1. Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Applicant: Huawei Technologies Co.,Ltd Date of Test: 25 July 2014
Model: HUAWEI Y520-U33
Sample: 1/1
Worst-case operating Mode: Transmit-CH78 (2480MHz)
Modulation type: GFSK

Table 4

**Radiated Emissions**

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Net at 3m (dBµV/m) | Peak Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Horizontal | **2480.000 | 113.5 | 36.7 | 28.1 | 104.9 | -- | -- |
| Horizontal | *4960.000 | 51.8 | 36.1 | 35.5 | 51.2 | 74.0 | -22.8 |

| Polarization | Frequency (MHz) | Reading (dBµV) | Pre-Amp Gain (dB) | Antenna Factor (dB) | Average Factor (-dB) | Net at 3m (dBµV/m) | Average Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| Horizontal | *4960.000 | 51.8 | 36.1 | 35.5 | 22.5 | 28.7 | 54.0 | -25.3 |

NOTES: 1. Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

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

## 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 Conducted Configuration
at
2.634 MHz

Judgement: Passed by 10.1 dB margin

***TEST PERSONNEL:***

*Sign on file*

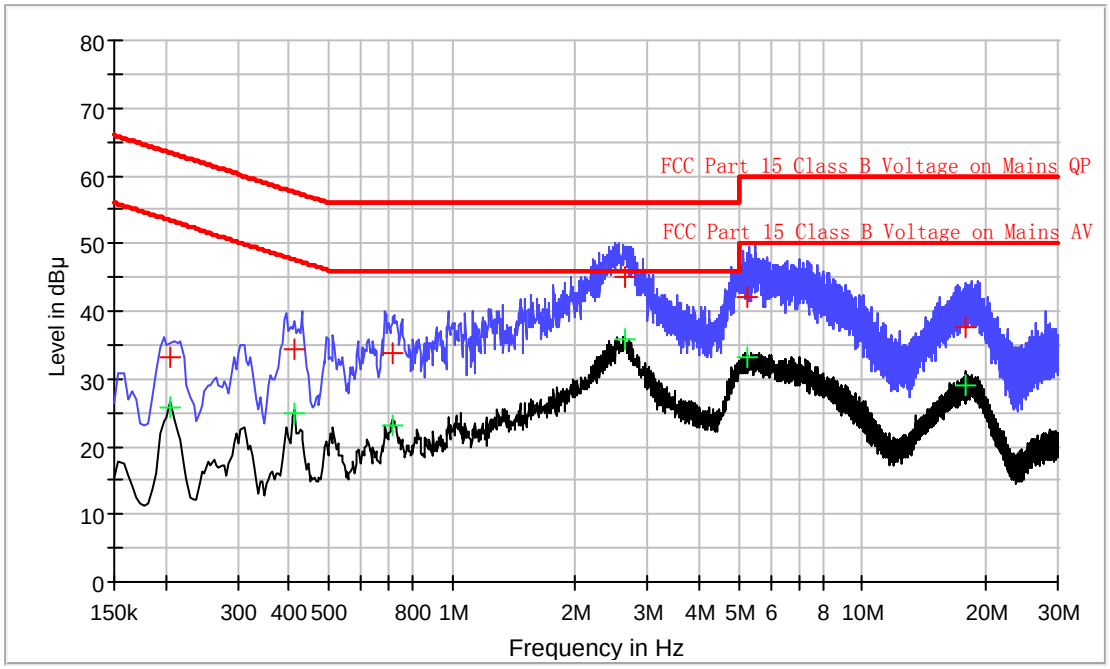
Jenner Liu Assitant Engineer
*Typed/Printed Name*

25 July 2014
*Date*

Applicant: Huawei Technologies Co.,Ltd
Model: HUAWEI Y520-U33
Sample: 1/1
Worst-case operating Mode: BT Link
Modulation type: GFSK
AC/DC Adapter: HuntKey (HW-050055U1W)

Date of Test: 25 July 2014

**Conducted Emission Test - FCC**




## Result Table QP

| Frequency (MHz) | Average (dB µ V) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|---|---|---|---|---|---|
| 0.206 | 25.9 | L1 | 9.8 | 30.1 | 63.4 |
| 0.414 | 24.8 | L1 | 9.8 | 23.1 | 57.6 |
| 0.714 | 23.3 | L1 | 10.0 | 22.3 | 56.0 |
| 2.634 | 35.9 | L1 | 10.0 | 10.9 | 56.0 |
| 5.238 | 33.2 | L1 | 10.0 | 17.9 | 60.0 |
| 17.946 | 29.1 | L1 | 10.4 | 22.2 | 60.0 |

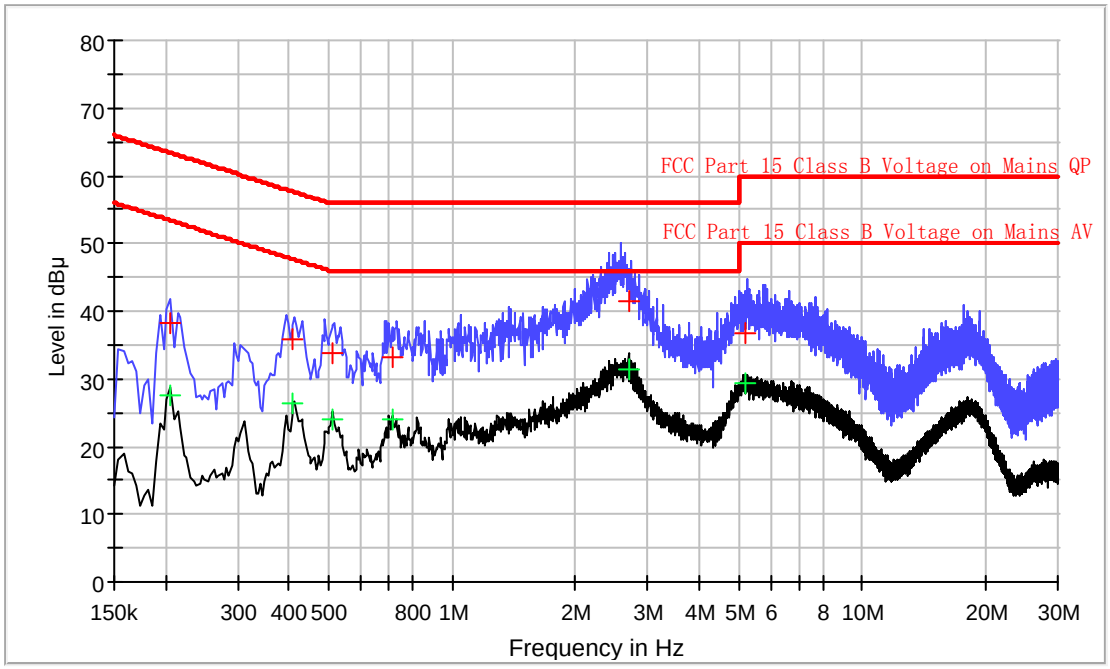
## Result Table AV

| Frequency (MHz) | QuasiPeak (dB µ V) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|---|---|---|---|---|---|
| 0.206 | 33.3 | L1 | 9.8 | 27.5 | 53.4 |
| 0.414 | 34.5 | L1 | 9.8 | 22.8 | 47.6 |
| 0.714 | 33.7 | L1 | 10.0 | 22.7 | 46.0 |
| 2.634 | 45.1 | L1 | 10.0 | 10.1 | 46.0 |
| 5.238 | 42.1 | L1 | 10.0 | 16.8 | 50.0 |
| 17.946 | 37.8 | L1 | 10.4 | 20.9 | 50.0 |

Applicant: Huawei Technologies Co.,Ltd
Model: HUAWEI Y520-U33
Sample: 1/1
Worst-case operating Mode: BT Link
Modulation type: GFSK
AC/DC Adapter: HuntKey (HW-050055U1W)

Date of Test: 25 July 2014

**Conducted Emission Test - FCC**




## Result Table QP

| Frequency (MHz) | QuasiPeak (dB µ V) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|---|---|---|---|---|---|
| 0.206 | 38.3 | N | 10.1 | 25.1 | 63.4 |
| 0.410 | 36.0 | N | 10.1 | 21.6 | 57.6 |
| 0.510 | 33.9 | N | 10.2 | 22.1 | 56.0 |
| 0.714 | 33.2 | N | 10.2 | 22.8 | 56.0 |
| 2.690 | 41.4 | N | 10.3 | 14.6 | 56.0 |
| 5.202 | 36.7 | N | 10.4 | 23.3 | 60.0 |

## Result Table AV

| Frequency (MHz) | Average (dB µ V) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|---|---|---|---|---|---|
| 0.206 | 27.6 | N | 10.1 | 25.8 | 53.4 |
| 0.410 | 26.5 | N | 10.1 | 21.1 | 47.6 |
| 0.510 | 23.9 | N | 10.2 | 22.1 | 46.0 |
| 0.714 | 23.9 | N | 10.2 | 22.1 | 46.0 |
| 2.690 | 31.4 | N | 10.3 | 14.6 | 46.0 |
| 5.202 | 29.3 | N | 10.4 | 20.7 | 50.0 |

## 3.3 **Peak Power**

Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(1)

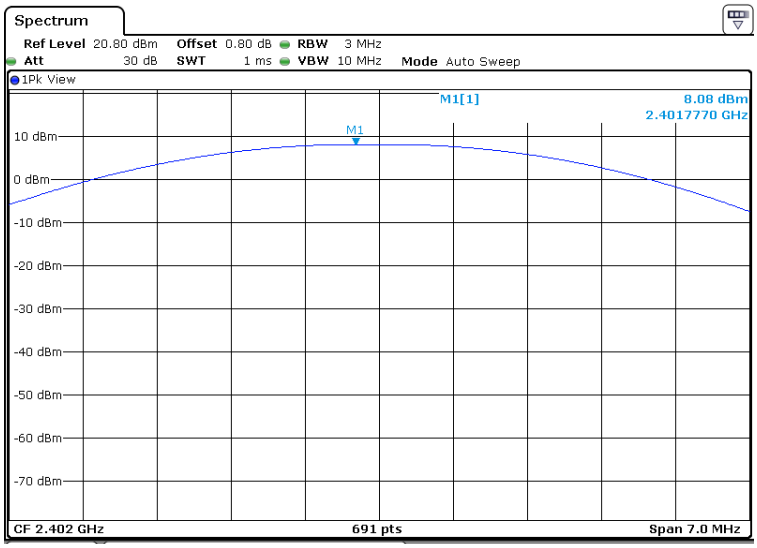
The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for RBW > 20dB bandwidth and power was read directly in dBm.

For antenna with gains of 6dBi or less, and frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, the systems operate with an output power no greater than 125 mW.

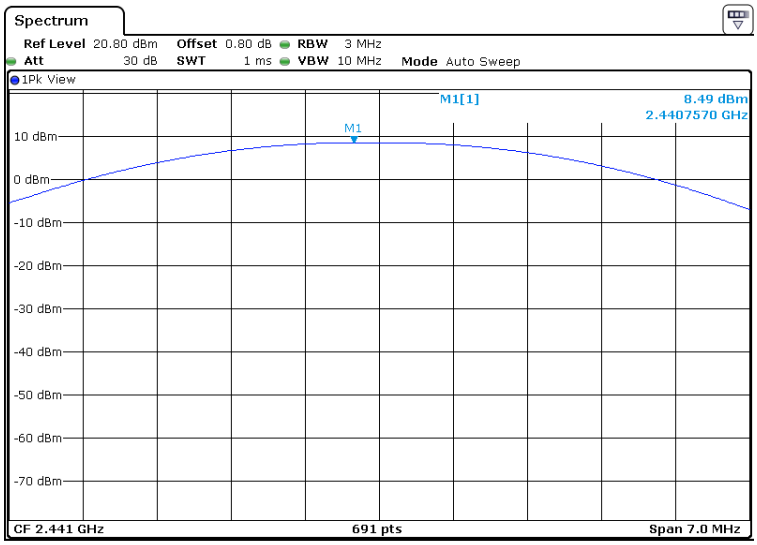
| Antenna Gain = 0.5dBi | | | |
|---|---|---|---|
| Modulation Type | Frequency (MHz) | Output Power (dBm) | Output Power (mW) |
| GFSK | 2402 | 8.08 | 6.43 |
| | 2441 | 8.49 | 7.06 |
| | 2480 | 8.56 | 7.18 |

Cable loss: 0.8 dB External Attenuation: 0 dB

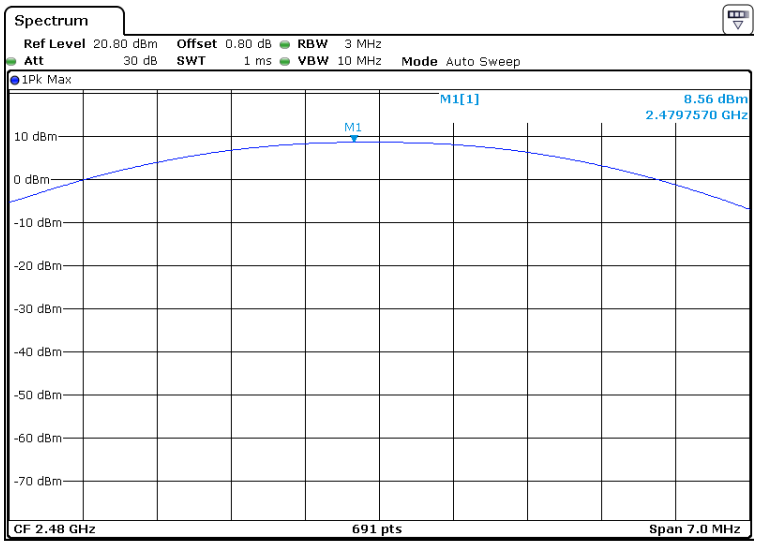
Modulation Type: GFSK
CH00




CH39



CH78


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 3 MHz
Att 30 dB SWT 1 ms VBW 10 MHz Mode Auto Sweep
1Pk Max
M1[1]
8.56 dBm
2.4797570 GHz
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
691 pts
Span 7.0 MHz

## 3.4 **20dB Bandwidth**

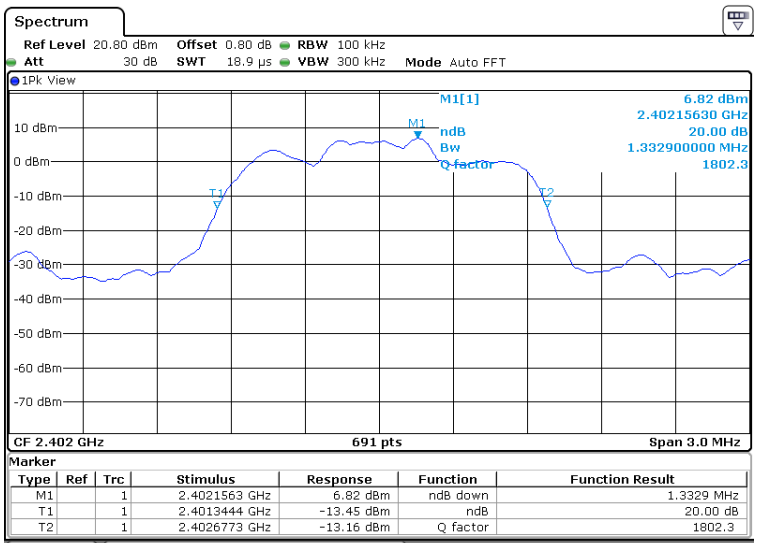
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

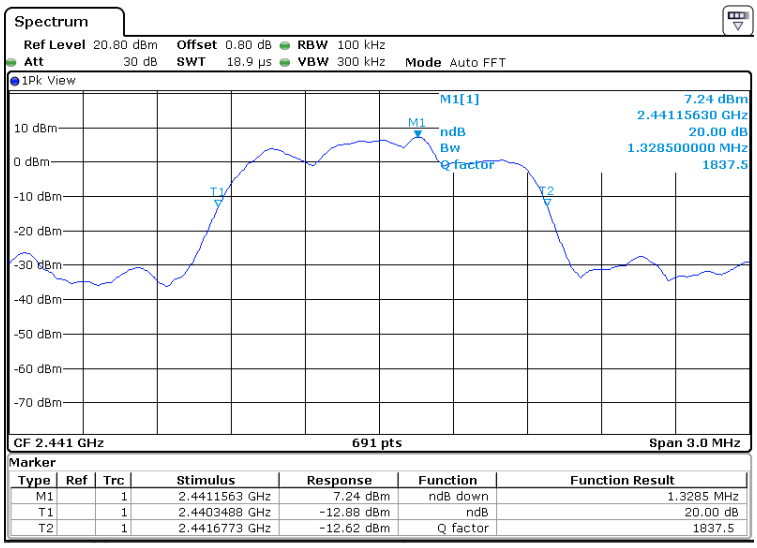
| Frequency (MHz) | 20 dB Bandwidth (MHz) |
|---|---|
| 2402 | 1.33 |
| 2441 | 1.33 |
| 2480 | 1.33 |

Modulation Type: 8DPSK

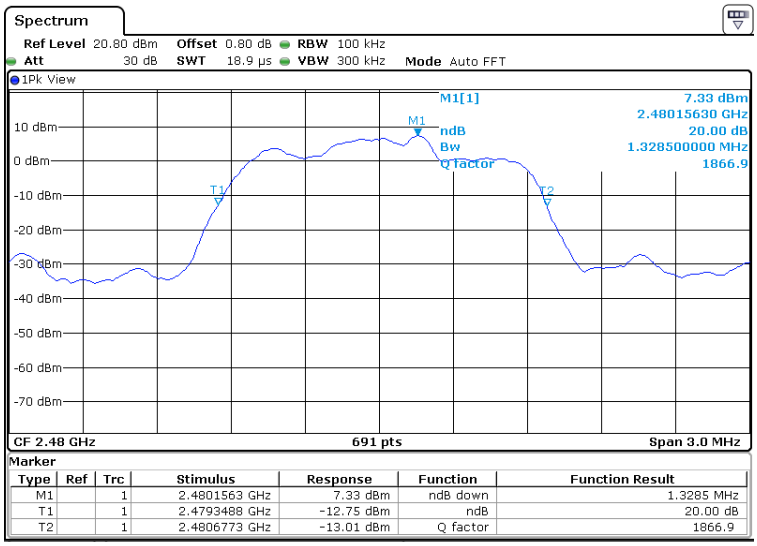
CH00



CH39


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 100 kHz
Att 30 dB SWT 18.9 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 7.24 dBm
2.44115630 GHz
ndB 20.00 dB
Bw 1.328500000 MHz
Q factor 1837.5
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 2.4411563 GHz 7.24 dBm ndB down 1.3285 MHz
T1 1 2.4403488 GHz -12.88 dBm ndB 20.00 dB
T2 1 2.4416773 GHz -12.62 dBm Q factor 1837.5

CH78


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 100 kHz
Att 30 dB SWT 18.9 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 7.33 dBm
2.48015630 GHz
ndB 20.00 dB
Bw 1.328500000 MHz
Q factor 1866.9
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 2.4801563 GHz 7.33 dBm ndB down 1.3285 MHz
T1 1 2.4793488 GHz -12.75 dBm ndB 20.00 dB
T2 1 2.4806773 GHz -13.01 dBm Q factor 1866.9

## 3.5 Channel Number (Number of Hopping Frequencies)

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

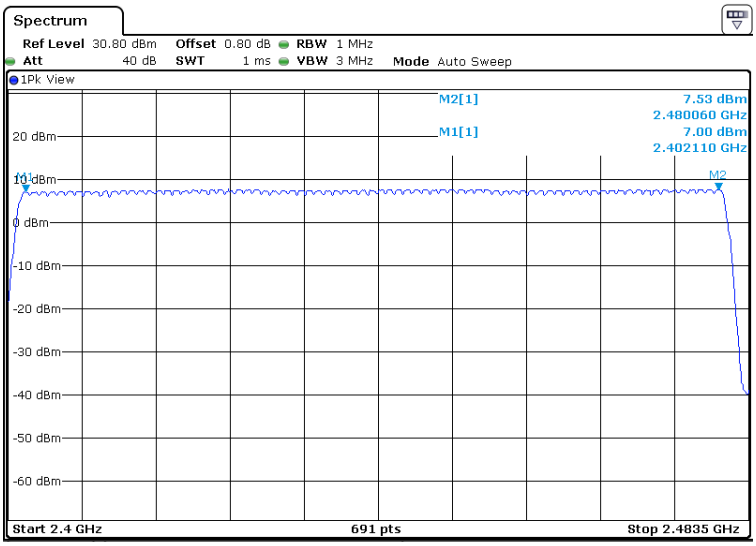
The RF passband of the EUT was divided into 3 approximately equal bands. With the analyzer set to MAX HOLD readings were taken for 2-3 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

| | |
|---|---|
| Number of hopping channels = | 79 |

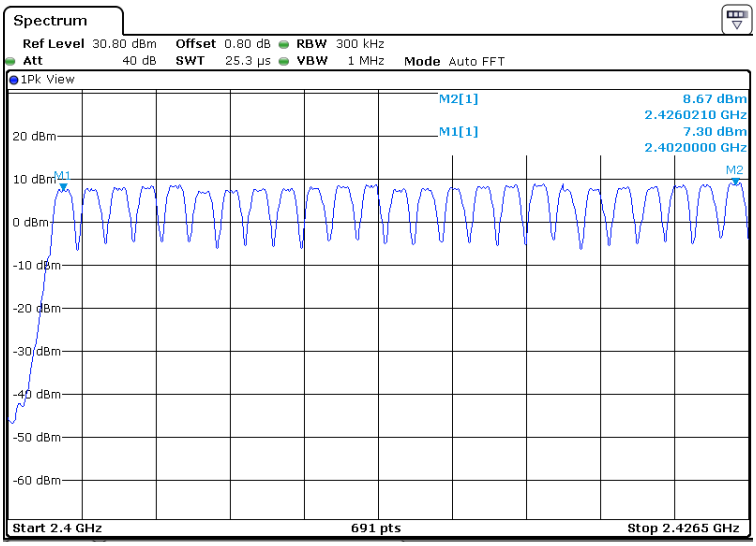
Note: In AFH mode, this device operates using 20 channels and it's satisfied the requirement of limit of minimum of 15 hopping channels.

Modulation Type: GFSK

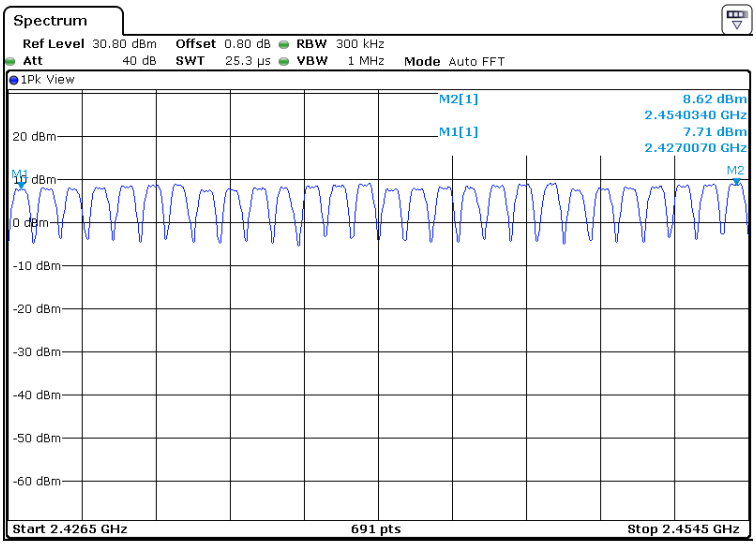
CH00-CH78



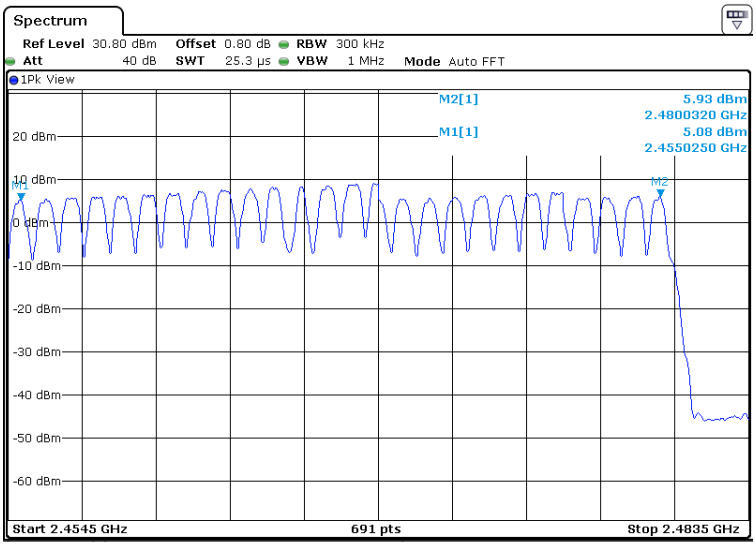
CH00-CH25




CH26-CH53



CH54-CH78


Spectrum
Ref Level 30.80 dBm Offset 0.80 dB RBW 300 kHz
Att 40 dB SWT 25.3 µs VBW 1 MHz Mode Auto FFT
1Pk View
M2[1] 5.93 dBm
2.4800320 GHz
M1[1] 5.08 dBm
2.4550250 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
M2
Start 2.4545 GHz
691 pts
Stop 2.4835 GHz

## 3.6 Channel Separation (Carrier Frequency Separation)

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

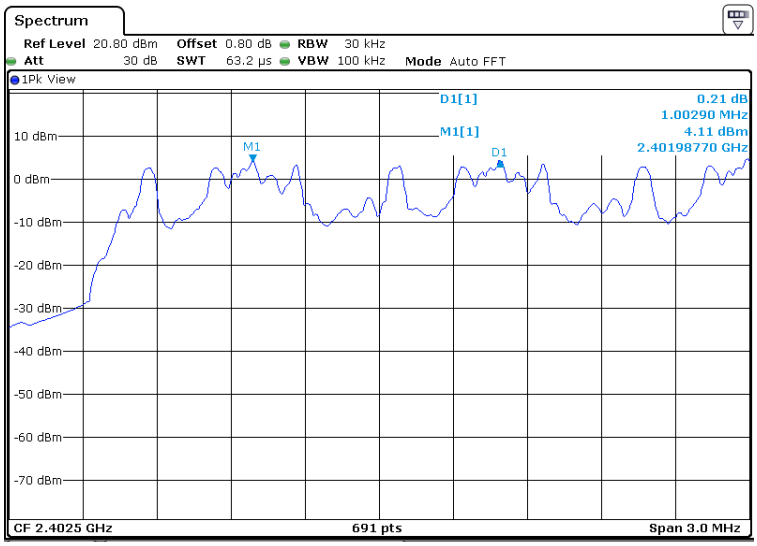
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: 1.33 x 2/3 = 0.887 MHz

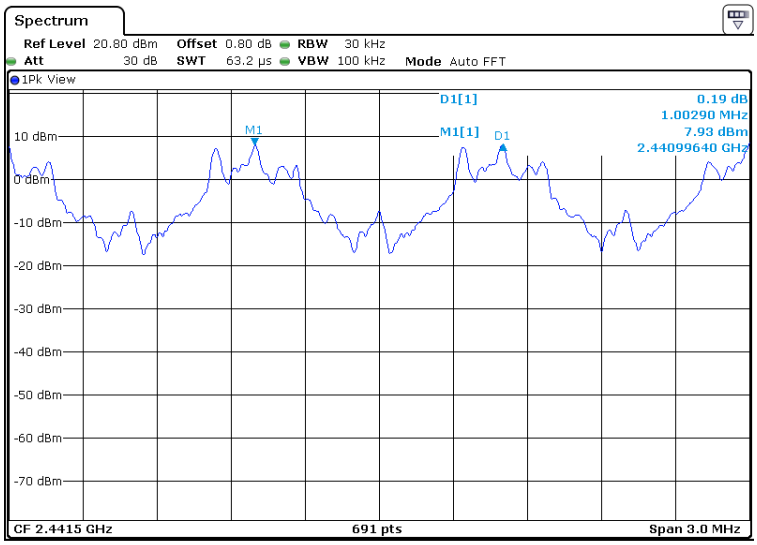
| | |
|---|---|
| Channel Separation | 1.000 MHz |

Modulation Type: GFSK

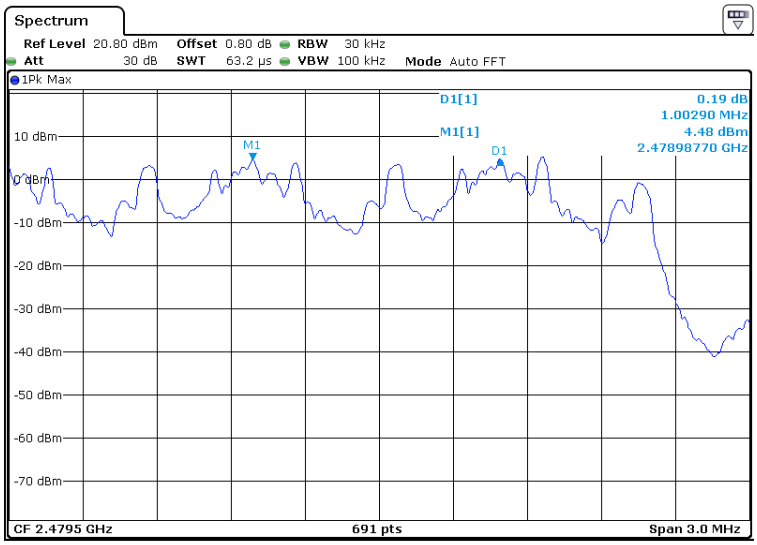
Low Channel



Middle Channel




High Channel



## 3.7 Dwell Time (Time of Occupancy)

Average Channel Occupancy Time, FCC Ref: 15.247(a)(1)(iii):

The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 10ms, the SPAN was set to ZERO SPAN, and the TRIGGER was set to VIDEO. The time duration of the transmissions so captured was measured with the MARKER DELTA function.

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

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

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

| Modulation Type | Packet | Max Dwell Time | Limit (s) | Result |
|---|---|---|---|---|
| GFSK | DH1 | 0.372 ms * 320= 119.04 ms | 0.4 | Pass |
| | DH3 | 1.627 ms * 160= 260.32 ms | 0.4 | Pass |
| | DH5 | 2.881 ms * 107= 308.27 ms | 0.4 | Pass |

AFH mode:

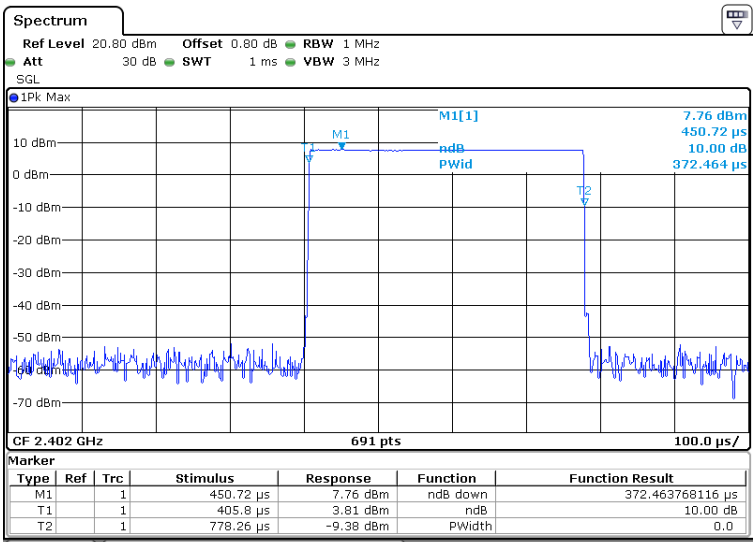
The maximum number of hopping channels in 8s for DH1
=800 / 2 / 20 *8=160

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

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

| Modulation Type | Packet | Max Dwell Time | Limit (s) | Result |
|---|---|---|---|---|
| GFSK | DH1 | 0.372 ms * 160= 59.52 ms | 0.4 | Pass |
| | DH3 | 1.627 ms * 80= 130.16 ms | 0.4 | Pass |
| | DH5 | 2.881 ms * 53.33= 153.64 ms | 0.4 | Pass |

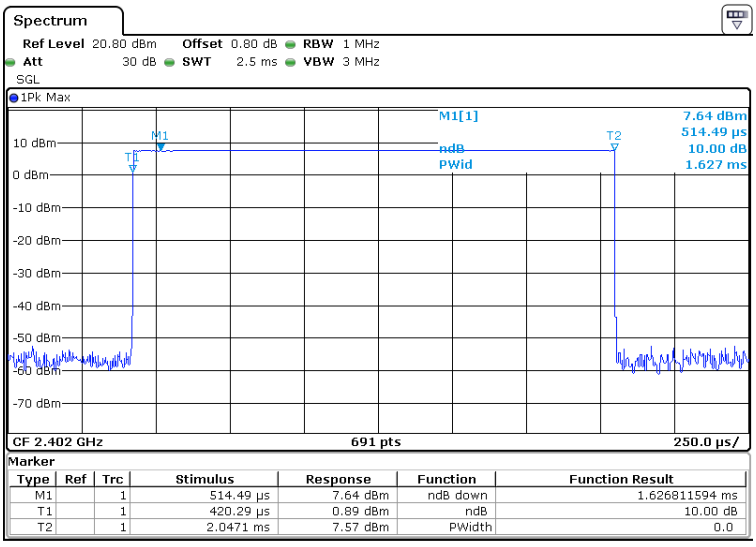
Modulation Type: GFSK
Packet: DH1




Marker

| Type | Ref | Trc | Stimulus | Response | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 450.72 µs | 7.76 dBm | ndB down | 372.463768116 µs |
| T1 | | 1 | 405.8 µs | 3.81 dBm | ndB | 10.00 dB |
| T2 | | 1 | 778.26 µs | -9.38 dBm | PWidth | 0.0 |

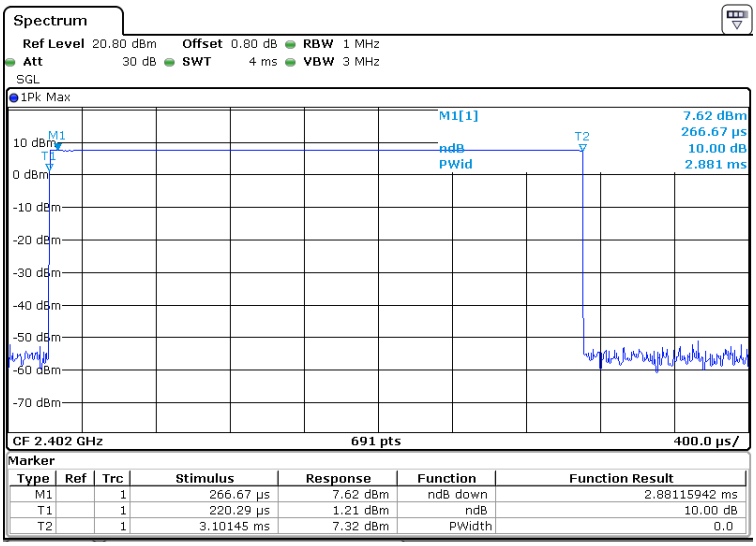
Packet: DH3




Marker

| Type | Ref | Trc | Stimulus | Response | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 514.49 µs | 7.64 dBm | ndB down | 1.626811594 ms |
| T1 | | 1 | 420.29 µs | 0.89 dBm | ndB | 10.00 dB |
| T2 | | 1 | 2.0471 ms | 7.57 dBm | PWidth | 0.0 |

Packet: DH5


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 1 MHz
Att 30 dB SWT 4 ms VBW 3 MHz
SGL
1Pk Max
M1[1]
7.62 dBm
266.67 µs
ndB 10.00 dB
PWid 2.881 ms
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.402 GHz
691 pts
400.0 µs/
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 266.67 µs 7.62 dBm ndB down 2.88115942 ms
T1 1 220.29 µs 1.21 dBm ndB 10.00 dB
T2 1 3.10145 ms 7.32 dBm PWidth 0.0

## 3.8 Band Edge

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

In any 100 KHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

Furthermore, delta measurement technique for measuring bandage emissions was shown as below:

**(i) Lower channel 2402MHz:**

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 105.5dBµv/m-55.70dB
= 49.8dBµv/m

**(ii) Upper channel 2480MHz:**

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 104.9dBµv/m-59.24dB
= 45.7dBµv/m

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

Modulation Type: GFSK

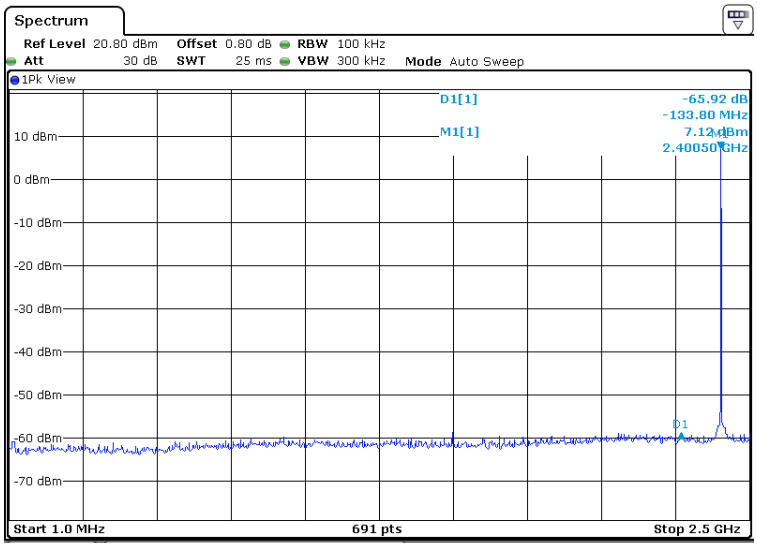

## 3.9 Transmitter Spurious Emissions (Conducted)

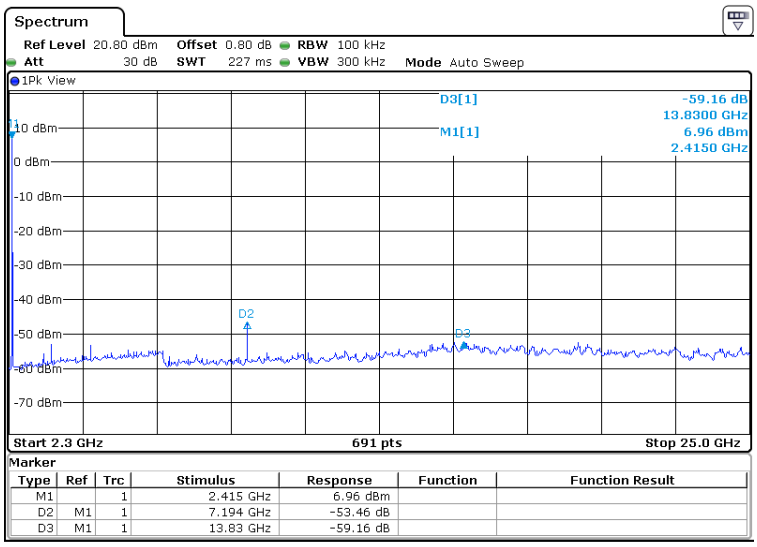
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

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

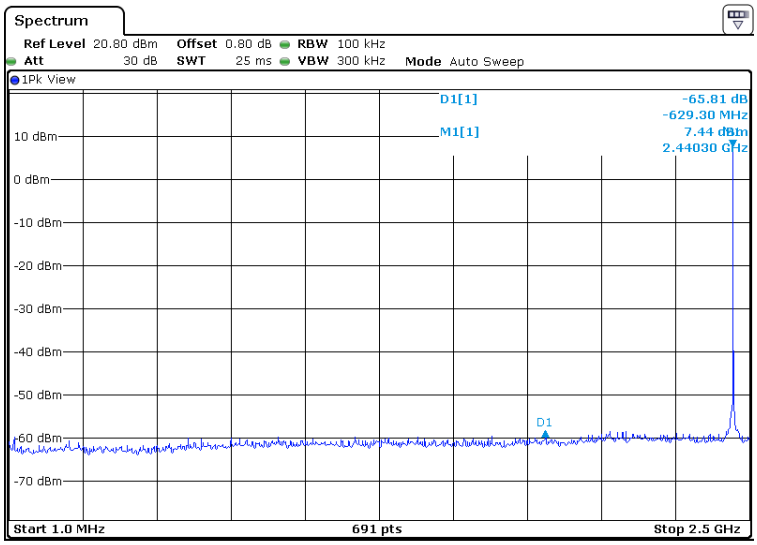
Modulation Type: GFSK

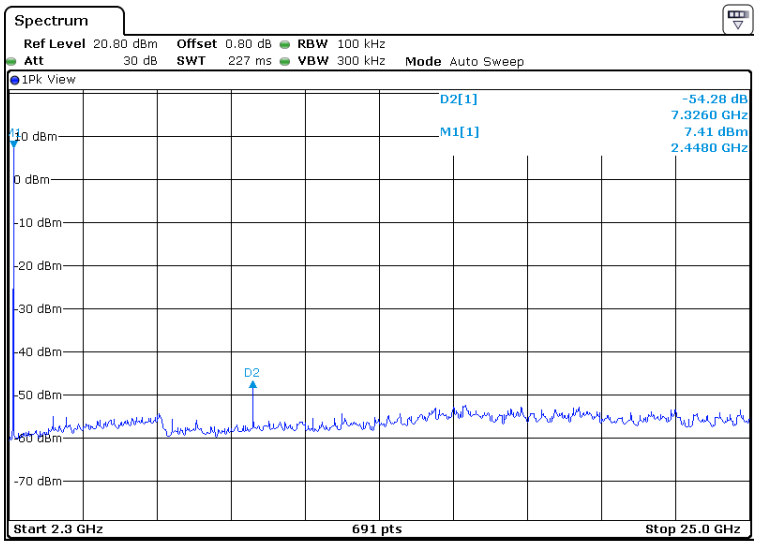
CH00



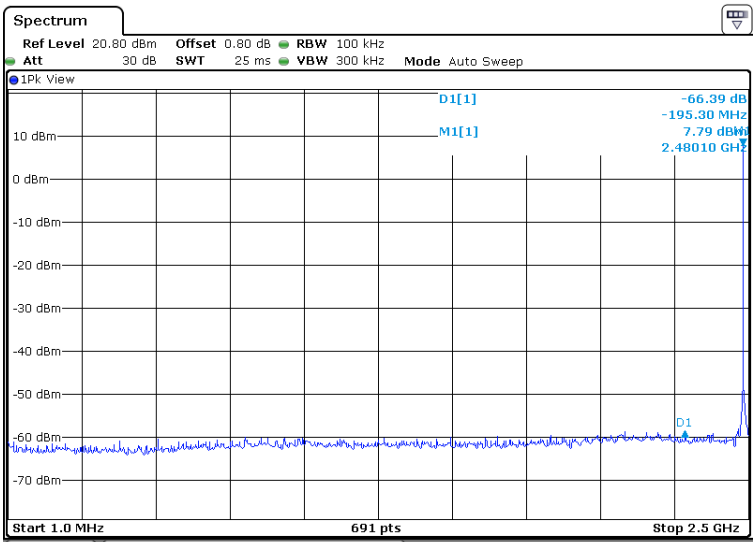



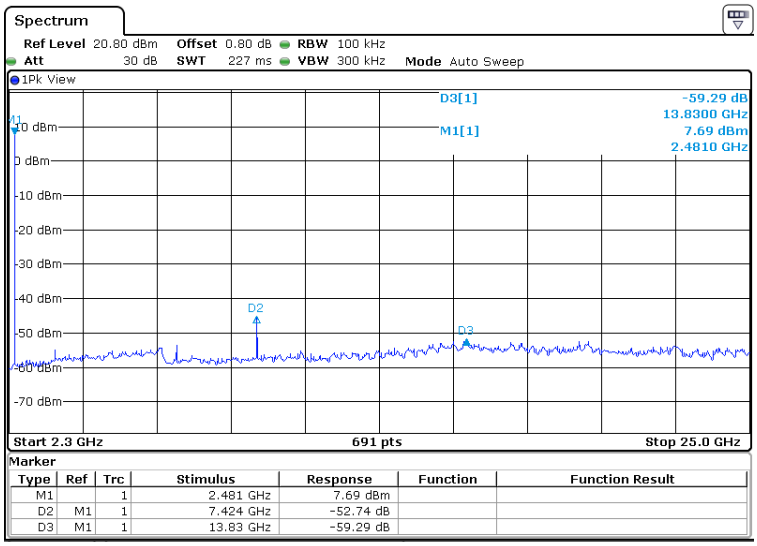
CH39


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D1[1] -65.81 dB
-629.30 MHz
M1[1] 7.44 dBm
2.44030 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D1
Start 1.0 MHz
691 pts
Stop 2.5 GHz


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D2[1] -54.28 dB
7.3260 GHz
M1[1] 7.41 dBm
2.4480 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D2
Start 2.3 GHz
691 pts
Stop 25.0 GHz

CH78


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 100 kHz
Att 30 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D1[1] -66.39 dB
-195.30 MHz
M1[1] 7.79 dBm
2.48010 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D1
Start 1.0 MHz
691 pts
Stop 2.5 GHz


Spectrum
Ref Level 20.80 dBm Offset 0.80 dB RBW 100 kHz
Att 30 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk View
D3[1] -59.29 dB
13.8300 GHz
M1[1] 7.69 dBm
2.4810 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D2
D3
Start 2.3 GHz
691 pts
Stop 25.0 GHz
Marker
Type Ref Trc Stimulus Response Function Function Result
M1 1 2.481 GHz 7.69 dBm
D2 M1 1 7.424 GHz -52.74 dB
D3 M1 1 13.83 GHz -59.29 dB

# EXHIBIT 4

# EQUIPMENT PHOTOGRAPHS

## 4.0 **Equipment Photographs**

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

# EXHIBIT 5

# PRODUCT LABELLING

## 5.0 **Product Labelling**

For electronic filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

# EXHIBIT 6

# TECHNICAL SPECIFICATIONS

## 6.0 Technical Specifications

For electronic filing, the block diagram and schematics of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

# EXHIBIT 7

# INSTRUCTION MANUAL

## 7.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

# EXHIBIT 8

# MISCELLANEOUS INFORMATION

## 8.0 Miscellaneous Information

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

## 8.1 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period ($T_{eff}$) is approximately 625µs for Bluetooth. With a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

## 8.2 Transmitter Duty Cycle Calculation, FCC Rule 15.35(b, c)

Based on the Bluetooth Specification, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length (single-slot and multi-slot). The maximum transmitter ON time for the Bluetooth is 625µs.

Each TX and RX time slot is 625µs in length. A TDD scheme is used where master and slave alternately transmit. For one period for a pseudo-random hopping through all 79 RF channels, for DH5:

Normal Mode:

Channel hop rate=1600 hops/second
Time of 1 hopset (5 TX slots + 1 RX slot) = 0.625 ms x 6 = 3.75 ms
Time of 1 cycle =3.75 ms x 79 = 296.25 ms
Average factor = 20 log (3.125 / 100) = -30.1 dB

AFH Mode:
Channel hop rate = 800 hops/second (AFH Mode)
Adjusted channel hop rate for DH5 mode = 133.33 hops/second
Time per channel hop = 1 / 133.33 hops/second = 7.5 ms
Time to cycle through all channels = 7.5 x 20 channels = 150 ms
Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
Worst case dwell time = 7.5 ms
Duty cycle connection factor = 20log10(7.5ms / 100ms) = -22.5 dB

## 8.3 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4: 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 adjust through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

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

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 150 kHz to 30 MHz.

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

# CONFIDENTIALITY REQUEST

## 9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.

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# EXHIBIT 10

# TEST EQUIPMENT LIST

## 10.0 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-2014 | 21-May-2015 |
| SZ182-02-01 | Power Sensor | Anritsu | MA2411B | 1207429 | 21-May-2014 | 21-May-2015 |
| SZ061-03 | BiConiLog Antenna | ETS | 3142C | 00066460 | 28-Jun-2014 | 28-Jun-2015 |
| SZ185-01 | EMI Receiver | R&S | ESCI | 100547 | 10-Mar-2014 | 10-Mar-2015 |
| SZ061-09 | Horn Antenna | ETS | 3115 | 00092346 | 16-Nov-2013 | 16-Nov-2014 |
| SZ061-07 | Pyramidal Horn Antenna | ETS | 3160-09 | 00083067 | 27-Aug-2013 | 27-Aug-2014 |
| SZ061-06 | Active Loop Antenna | Electro-Metrics | EM-6876 | 217 | 29-Apr-2014 | 29-Apr-2015 |
| EM031-03 | EXA Spectrum Analyzer | R&S | FSV40 | 101506 | 09-Jun-2014 | 09-Jun-2015 |
| SZ181-04 | Preamplifier | Agilent | 8449B | 3008A02474 | 10-Mar-2014 | 10-Mar-2015 |
| SZ188-01 | Anechoic Chamber | ETS | RFD-F/A-100 | 4102 | 19-Apr-2014 | 19-Apr-2015 |
| SZ062-02 | RF Cable | RADIALL | RG 213U | -- | 19-Apr-2014 | 19-Oct-2014 |
| SZ062-05 | RF Cable | RADIALL | 0.04-26.5GHz | -- | 19-Apr-2014 | 19-Oct-2014 |
| SZ062-12 | RF Cable | RADIALL | 0.04-26.5GHz | -- | 19-Apr-2014 | 19-Oct-2014 |
| SZ067-04 | Notch Filter | Micro-Tronics | BRM50702-02 | -- | 21-May-2014 | 21-May-2015 |
| SZ185-02 | EMI Test Receiver | R&S | ESCI | 100692 | 9-Nov-2013 | 9-Nov-2014 |
| SZ187-01 | Two-Line V-Network | R&S | ENV216 | 100072 | 9-Nov-2013 | 9-Nov-2014 |
| SZ187-02 | Two-Line V-Network | R&S | ENV216 | 100073 | 9-Nov-2013 | 9-Nov-2014 |
| SZ188-03 | Shielding Room | ETS | RFD-100 | 4100 | 23-Aug-2013 | 23-Aug-2014 |