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Report No.: GZEM130800379301  
Page: 1 of 67  
FCC ID: 2AANUP8V2

## TEST REPORT

|                             |  |
|-----------------------------|--|
| <b>Application No.:</b>     | GZEM1308003793RF   |
| <b>Applicant:</b>           | WOOX Innovations Ltd.  |
| <b>Manufacturer:</b>        | WOOX Innovations Ltd.  |
| <b>Factory:</b>             | Arts Electronics Co., Ltd.   |
| <b>FCC ID:</b>              | 2AANUP8V2  |
| <b>Product Name:</b>        | Wireless portable speaker  |
| <b>Product Description:</b> | Bluetooth speaker with 2.4 GHz as carrier                          |
| <b>Model No.:</b>           | P8YYY/zz V2 (where "YYY" can be A-Z or blank; "zz" can be 00-99) ♣ |
| ♣                           | Please refer to section 3 of this report for details               |
| <b>Trade mark:</b>          | PHILIPS  |
| <b>Standards:</b>           | 47 CFR PART 15 Subpart C: 2012 section 15.247                      |
| <b>Date of Receipt:</b>     | 2013-08-14   |
| <b>Date of Test:</b>        | 2013-08-13 to 2013-08-25   |
| <b>Date of Issue:</b>       | 2013-11-18   |
| <b>Test Result :</b>        | <b>Pass*</b>   |

\* In the configuration tested, the EUT detailed in this report complied with the standards specified above. Please refer to section 3 of this report for further detail.



The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

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## 2 Version

| Revision Record |         |            |          |          |
|-----------------|---------|------------|----------|----------|
| Version         | Chapter | Date       | Modifier | Remark   |
| 00              |         | 2013-11-18 |          | Original |
|                 |         |            |          |          |
|                 |         |            |          |          |
|                 |         |            |          |          |

|                          |  |  |   |
|--------------------------|--|--|---|
| Authorized for issue by: |  |  |   |
| Tested By                | <br><hr/> <b>(Ryan Yang) /Signature</b>   |  | <hr/> 2013-08-13 to 2013-08-25<br><hr/> <b>Date</b> |
| Prepared By              | <br><hr/> <b>(Dorrit Chen) /Signature</b> |  | <hr/> 2013-11-18<br><hr/> <b>Date</b>               |
| Checked By               | <br><hr/> <b>(Jeffrey Chen) /Reviewer</b> |  | <hr/> 2013-11-18<br><hr/> <b>Date</b>               |



### 3 Test Summary

| Test                                    | Test Requirement                                    | Test method   | Result |
|---|---|---|--------|
| Antenna Requirement                     | FCC PART 15 C section 15.247 (c) and Section 15.203 | FCC PART 15 C section 15.247 (c) and Section 15.203 | PASS   |
| Occupied Bandwidth                      | FCC PART 15 C section 15.247 (a)(1)                 | ANSI C63.10: Clause 6.9.1                           | PASS   |
| Carrier Frequencies Separated           | FCC PART 15 C section 15.247(a)(1)                  | ANSI C63.10: Clause 7.7.2                           | PASS   |
| Hopping Channel Number                  | FCC PART 15 C section 15.247(a)(1)(iii)             | ANSI C63.10: Clause 7.7.3                           | PASS   |
| Dwell Time                              | FCC PART 15 C section 15.247(a)(1)(iii)             | ANSI C63.10: Clause 7.7.4                           | PASS   |
| Pseudorandom Frequency Hopping Sequence | FCC PART 15 C section 15.247(a)(1)                  | ANSI C63.10: Clause 7.7.5                           | PASS   |
| Maximum Peak Output Power               | FCC PART 15 C section 15.247(b)(1)                  | ANSI C63.10: Clause 6.10.1                          | PASS   |
| Conducted Spurious Emission             | FCC PART 15 C section 15.247(d)                     | ANSI C63.10: Clause 6.7                             | PASS   |
| Radiated Spurious Emission              | FCC PART 15 C section 15.247(d)                     | ANSI C63.10: Clause 6.4, 6.5 and 6.6                | PASS   |
| Band Edges Measurement                  | FCC PART 15 C section 15.247 (d) & 15.205           | ANSI C63.10: Clause 6.9.1                           | PASS   |
| Conducted Emissions at Mains Terminals  | FCC PART 15 C section 15.207                        | ANSI C63.10: Clause 6.2                             | PASS   |

**Remark:**

N/A: not applicable. Refer to the relative section for the details.

EUT: In this whole report EUT means Equipment Under Test.

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radio Frequency.

ANSI C63.10: the detail version is ANSI C63.10:2009 in the whole report.

DA 00-705 was used as a guideline in preparing this Test Report.

♣ Model No.: P8YYY/zz V2 (where “YYY” can be A-Z or blank; “zz” can be 00-99)

According to the confirmation from the applicant, since the electrical circuit design, layout, components used and internal wiring were identical for the above models, only differences being the model no., plug portion and exported countries.

Therefore only one model **P8BLK/37 V2** was tested in this report.



## 4 Contents

|      |  |    |
|------|--|----|
| 1    | COVER PAGE.....  | 1  |
| 2    | VERSION .....  | 2  |
| 3    | TEST SUMMARY.....  | 3  |
| 4    | CONTENTS.....  | 4  |
| 5    | GENERAL INFORMATION.....                                       | 5  |
| 5.1  | Client Information .....                                       | 5  |
| 5.2  | General Description of E.U.T. ....                             | 5  |
| 5.3  | Details of E.U.T. ....   | 5  |
| 5.4  | Modulation configure .....                                     | 6  |
| 5.5  | Description of Support Units.....                              | 7  |
| 5.6  | Deviation from Standards .....                                 | 7  |
| 5.7  | Abnormalities from Standard Conditions.....                    | 7  |
| 5.8  | Other Information Requested by the Customer .....              | 7  |
| 5.9  | Test Location .....  | 7  |
| 5.10 | Test Facility .....  | 8  |
| 6    | EQUIPMENT USED DURING TEST.....                                | 9  |
| 7    | TEST RESULTS.....  | 11 |
| 7.1  | E.U.T. test conditions .....                                   | 11 |
| 7.2  | Antenna Requirement .....                                      | 13 |
| 7.3  | Occupied Bandwidth .....                                       | 14 |
| 7.4  | Carrier Frequencies Separated.....                             | 19 |
| 7.5  | Hopping Channel Number.....                                    | 23 |
| 7.6  | Dwell Time .....   | 25 |
| 7.7  | Pseudorandom Frequency Hopping Sequence .....                  | 36 |
| 7.8  | Maximum Peak Output Power .....                                | 38 |
| 7.9  | Conducted Spurious Emissions .....                             | 43 |
| 7.10 | Radiated Spurious Emissions .....                              | 46 |
| 7.11 | Band Edges Requirement .....                                   | 61 |
| 7.12 | Conducted Emissions at Mains Terminals 150 kHz to 30 MHz ..... | 64 |

## 5 General Information

### 5.1 Client Information

Applicant: WOOX Innovations Ltd.  
Address of Applicant: 5/F, 5 Science Park East Avenue, Hong Kong Science Park, Shatin, New Territories, Hong Kong.

### 5.2 General Description of E.U.T.

Product Name: Wireless portable speaker  
Model No.: P8BLK/37 V2

### 5.3 Details of E.U.T.

Operating Frequency 2402 MHz to 2480 MHz  
Type of Modulation: GFSK, ( $\pi/4$ )DQPSK, 8DPSK  
Number of Channels 79 Channels  
Channel Separation: 1 MHz  
Dwell time Per channel is less than 0.4s.  
Antenna Type Integral  
Antenna gain: 2.0 dBi  
Speciality: Bluetooth specification version 2.1 with EDR.  
Function: Speaker with BT function to transmit and receive audio signal.  
Power Supply: AC 100-240V 50/60Hz 800mA MAX  
DC 11.1V 2200mAh rechargeable battery  
Adapter: Model: OH-1028A1502000U-JL  
Input: AC 100-240V 50/60Hz 800mA MAX  
Output: DC 15V 2A  
Power cord: 1.5m x 2wires unscreened DC mains.

Remark: The device meets the requirements stated within Parts 15.247(g) & (h) in that they were developed under the Bluetooth protocol and operate as a true frequency hopping system. The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

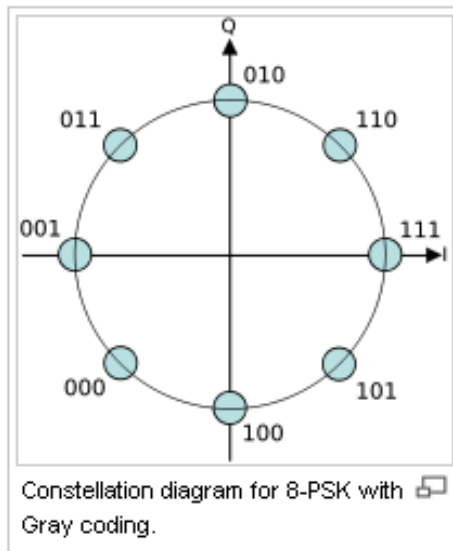
**5.4 Modulation configure**

| Modulation      | Packet | Packet Type | Packet Size |
|-----------------|--------|-------------|-------------|
| GFSK            | DH1    | 4           | 24          |
|                 | DH3    | 11          | 183         |
|                 | DH5    | 15          | 339         |
| $(\pi/4)$ DQPSK | 2DH1   | 20          | 54          |
|                 | 2DH3   | 26          | 367         |
|                 | 2DH5   | 30          | 379         |
| 8DPSK           | 3DH1   | 24          | 83          |
|                 | 3DH3   | 27          | 552         |
|                 | 3DH5   | 31          | 1021        |

**Remark:**

**Modulation 8-DPSK**

The modulation 8 PSK works with 8 phases between 0 and  $2\pi$  (0 and 360 degrees), it can be seeing bellow in the circle.



Normal mode: the Bluetooth has been tested on the Modulation of GFSK;

EDR mode: the Bluetooth has been tested on the Modulation of  $(\pi/4)$ DQPSK and 8DPSK, compliance test and record the worst case on 8DPSK.



## 5.5 Description of Support Units

The EUT has been tested as an independent unit for fixed frequency by testing lab.

## 5.6 Deviation from Standards

Biconical and log periodic antennas were used instead of dipole antennas.

## 5.7 Abnormalities from Standard Conditions

None.

## 5.8 Other Information Requested by the Customer

None.

## 5.9 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory,  
198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technology Development District,  
Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.







## 6 Equipment Used during Test

| RE in Chamber |  |                                  |             |            |              |                      |
|---------------|--|----------------------------------|-------------|------------|--------------|----------------------|
| No.           | Test Equipment                             | Manufacturer                     | Model No.   | Serial No. | Cal.Due date | Calibration Interval |
|               |  |                                  |             |            | (YYYY-MM-DD) |                      |
| EMC0525       | Compact Semi-Anechoic Chamber              | ChangZhou ZhongYu                | N/A         | N/A        | 2014-08-30   | 2Y                   |
| EMC0522       | EMI Test Receiver                          | Rohde & Schwarz                  | ESIB26      | 100283     | 2014-05-06   | 1Y                   |
| EMC0056       | EMI Test Receiver                          | Rohde & Schwarz                  | ESCI        | 100236     | 2014-03-04   | 1Y                   |
| EMC0528       | RI High frequency Cable                    | SGS                              | 20 m        | N/A        | 2014-05-09   | 1Y                   |
| EMC2025       | Trilog Broadband Antenna 30-3000MHz        | SCHWARZBECK MESS-ELEKTRONIK      | VULB 9163   | 9163-450   | 2016-08-31   | 3Y                   |
| EMC0524       | Bi-log Type Antenna                        | Schaffner -Chase                 | CBL6112B    | 2966       | 2016-08-31   | 3Y                   |
| EMC0519       | Bilog Type Antenna                         | Schaffner -Chase                 | CBL6143     | 5070       | 2014-06-02   | 2Y                   |
| EMC2026       | Horn Antenna 1-18GHz                       | SCHWARZBECK MESS-ELEKTRONIK      | BBHA 9120D  | 9120D-841  | 2016-08-31   | 3Y                   |
| EMC0518       | Horn Antenna                               | Rohde & Schwarz                  | HF906       | 100096     | 2014-07-01   | 2Y                   |
| EMC0521       | 1-26.5 GHz Pre-Amplifier                   | Agilent                          | 8449B       | 3008A01649 | 2014-03-04   | 1Y                   |
| EMC2065       | Amplifier                                  | HP                               | 8447F       | N/A        | 2014-08-31   | 1Y                   |
| EMC2063       | 1-26GHz Pre Amplifier                      | Compliance Direction System Inc. | PAP-1G26-48 | 6279.628   | 2014-07-29   | 1Y                   |
| EMC0075       | 310N Amplifier                             | Sonama                           | 310N        | 272683     | 2014-03-04   | 1Y                   |
| EMC0523       | Active Loop Antenna                        | EMCO                             | 6502        | 42963      | 2014-04-07   | 2Y                   |
| EMC2041       | Broad-Band Horn Antenna (14)15-26.5(40)GHz | SCHWARZBECK MESS-ELEKTRONIK      | BBHA 9170   | 9170-375   | 2014-06-01   | 3Y                   |
| EMC2069       | 2.4GHz filter                              | Micro-Tronics                    | BRM 50702   | 149        | 2014-06-05   | 1Y                   |
| EMC0530       | 10m Semi-Anechoic Chamber                  | ETS                              | N/A         | N/A        | 2014-04-27   | 2Y                   |



| Conducted Emission |                                 |                               |                            |                     |              |                      |
|--------------------|---------------------------------|-------------------------------|----------------------------|---------------------|--------------|----------------------|
| No.                | Test Equipment                  | Manufacturer                  | Model No.                  | Serial No.          | Cal.Due date | Calibration Interval |
|                    |                                 |                               |                            |                     | (YYYY-MM-DD) |                      |
| EMC0306            | Shielding Room                  | Zhong Yu                      | 8 x 3 x 3.8 m <sup>3</sup> | N/A                 | N/A          | N/A                  |
| EMC0118            | Two-line v-netwok               | R&S                           | ENV216                     | 100359              | 2014-03-04   | 1Y                   |
| EMC0102            | LISN                            | SCHAFFNER<br>CHASE            | MN2050D/1                  | 1421                | 2014-8-31    | 1Y                   |
| EMC2046            | Artificial Mains Network (LISN) | AFJ Instruments               | LT32C                      | S.N.320311201<br>50 | 2014-03-04   | 1Y                   |
| EMC0506            | EMI Test Receiver               | Rohde & Schwarz               | ESCS30                     | 100085              | 2014-03-04   | 1Y                   |
| EMC0107            | Coaxial Cable                   | SGS                           | 2m                         | N/A                 | 2014-07-25   | 2Y                   |
| EMC0106            | Voltage Probe                   | SGS                           | N/A                        | N/A                 | N/A          | 1Y                   |
| EMC0120            | 8 Line ISN                      | Fischer Custom Communications | FCC-TLISN-T8-02            | 20550               | 2014-8-31    | 1Y                   |
| EMC0121            | 4 Line ISN                      | Fischer Custom Communications | FCC-TLISN-T4-02            | 20549               | 2014-8-31    | 1Y                   |
| EMC0122            | 2 Line ISN                      | Fischer Custom Communications | FCC-TLISN-T2-02            | 20548               | 2014-8-31    | 1Y                   |
| EMC2047            | CDN                             | Elektronik-Feinmechanik       | L-801:AF2                  | 2793                | 2014-11-11   | 3Y                   |
| EMC2048            | CDN                             | Elektronik-Feinmechanik       | L-801:M2/M3                | 2738                | 2014-11-11   | 3Y                   |
| EMC2062            | 6dB Attenuator                  | HP                            | 8491A                      | 24487               | 2014-01-04   | 1Y                   |
| EMC167             | Conical metal housing           | SGS-EMC                       | N/A                        | N/A                 | 2014-2-16    | 2Y                   |

| General used equipment |                |              |           |            |              |                      |
|------------------------|----------------|--------------|-----------|------------|--------------|----------------------|
| No.                    | Test Equipment | Manufacturer | Model No. | Serial No. | Cal.Due date | Calibration Interval |
|                        |                |              |           |            | (YYYY-MM-DD) |                      |
| EMC0006                | DMM            | Fluke        | 73        | 70681569   | 2014-09-13   | 1Y                   |
| EMC0007                | DMM            | Fluke        | 73        | 70671122   | 2014-09-13   | 1Y                   |

## 7 Test Results

### 7.1 E.U.T. test conditions

**Test Voltage:** AC 120V 60Hz  
**Temperature:** 20.0 -25.0 °C  
**Humidity:** 38-50 % RH  
**Atmospheric Pressure:** 1000 -1010 mbar

**Test frequencies and frequency range:** According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

According to the 15.33 (a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

#### Number of fundamental frequencies to be tested in EUT transmit band

| Frequency range in which device operates | Number of frequencies | Location in frequency range of operation    |
|--|-----------------------|---|
| 1 MHz or less                            | 1                     | Middle                                      |
| 1 MHz to 10 MHz                          | 2                     | 1 near top and 1 near bottom                |
| More than 10 MHz                         | 3                     | 1 near top, 1 near middle and 1 near bottom |

#### Frequency range of radiated emission measurements

| Lowest frequency generated in the device | Upper frequency range of measurement  |
|--|---|
| 9 kHz to below 10 GHz                    | 10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower                             |
| At or above 10 GHz to below 30 GHz       | 5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower                             |
| At or above 30 GHz                       | 5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified |



EUT channels and frequencies list:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|
| 0       | 2402            | 27      | 2429            | 54      | 2456            |
| 1       | 2403            | 28      | 2430            | 55      | 2457            |
| 2       | 2404            | 29      | 2431            | 56      | 2458            |
| 3       | 2405            | 30      | 2432            | 57      | 2459            |
| 4       | 2406            | 31      | 2433            | 58      | 2460            |
| 5       | 2407            | 32      | 2434            | 59      | 2461            |
| 6       | 2408            | 33      | 2435            | 60      | 2462            |
| 7       | 2409            | 34      | 2436            | 61      | 2463            |
| 8       | 2410            | 35      | 2437            | 62      | 2464            |
| 9       | 2411            | 36      | 2438            | 63      | 2465            |
| 10      | 2412            | 37      | 2439            | 64      | 2466            |
| 11      | 2413            | 38      | 2440            | 65      | 2467            |
| 12      | 2414            | 39      | 2441            | 66      | 2468            |
| 13      | 2415            | 40      | 2442            | 67      | 2469            |
| 14      | 2416            | 41      | 2443            | 68      | 2470            |
| 15      | 2417            | 42      | 2444            | 69      | 2471            |
| 16      | 2418            | 43      | 2445            | 70      | 2472            |
| 17      | 2419            | 44      | 2446            | 71      | 2473            |
| 18      | 2420            | 45      | 2447            | 72      | 2474            |
| 19      | 2421            | 46      | 2448            | 73      | 2475            |
| 20      | 2422            | 47      | 2449            | 74      | 2476            |
| 21      | 2423            | 48      | 2450            | 75      | 2477            |
| 22      | 2424            | 49      | 2451            | 76      | 2478            |
| 23      | 2425            | 50      | 2452            | 77      | 2479            |
| 24      | 2426            | 51      | 2453            | 78      | 2480            |
| 25      | 2427            | 52      | 2454            | /       | /               |
| 26      | 2428            | 53      | 2455            | /       | /               |

Test frequencies are the lowest channel: 0 channel(2402 MHz), middle channel: 39 channel(2441 MHz) and highest channel: 78 channel(2480 MHz)

## 7.2 Antenna Requirement

### Standard requirement

15.203 requirement:

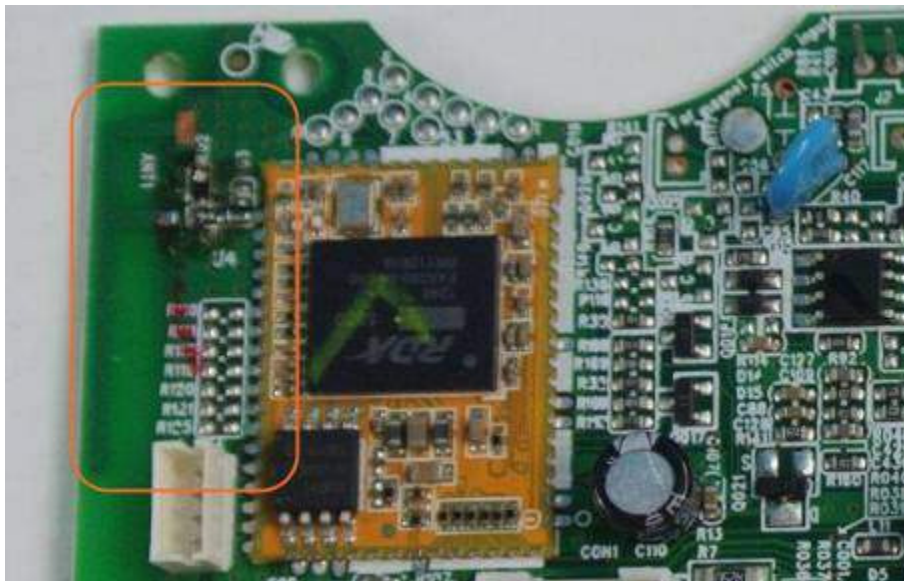
For intentional device. According to 15.203. an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

### EUT Antenna

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 2.0 dBi.



**Test result: The unit does meet the FCC requirements.**

### 7.3 Occupied Bandwidth

**Test Requirement:** FCC Part 15 C section 15.247

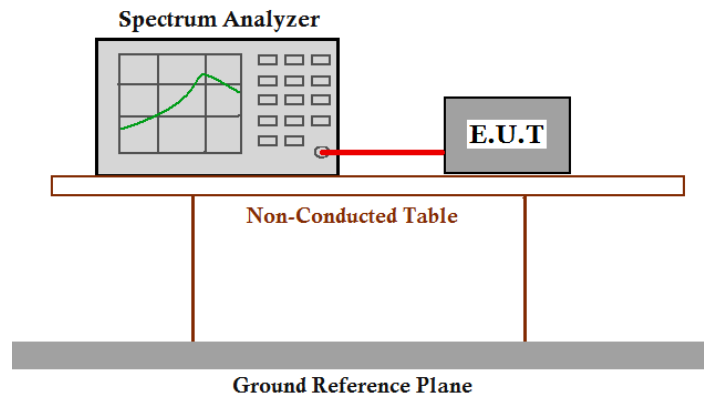
(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

**Test Method:** ANSI C63.10: Clause 6.9.1

**Test Status:** Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data package. Compliance test in normal mode (DH5) and EDR mode (3DH5) as the worst case was found.

Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**



**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: Span = approximately 2 to 3 times the 20Db bandwidth, centring on a hopping channel;
3. Set the spectrum analyzer: RBW  $\geq$  1% of the 20dB bandwidth VBW  $\geq$  RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20 dB points bandwidth.



**Test result:**

**Normal mode:**

| Test Channel | Bandwidth(MHz) | 2/3 bandwidth(MHz) |
|--------------|----------------|--------------------|
| Lowest       | 1.142          | 0.761              |
| Middle       | 1.152          | 0.768              |
| Highest      | 1.152          | 0.768              |

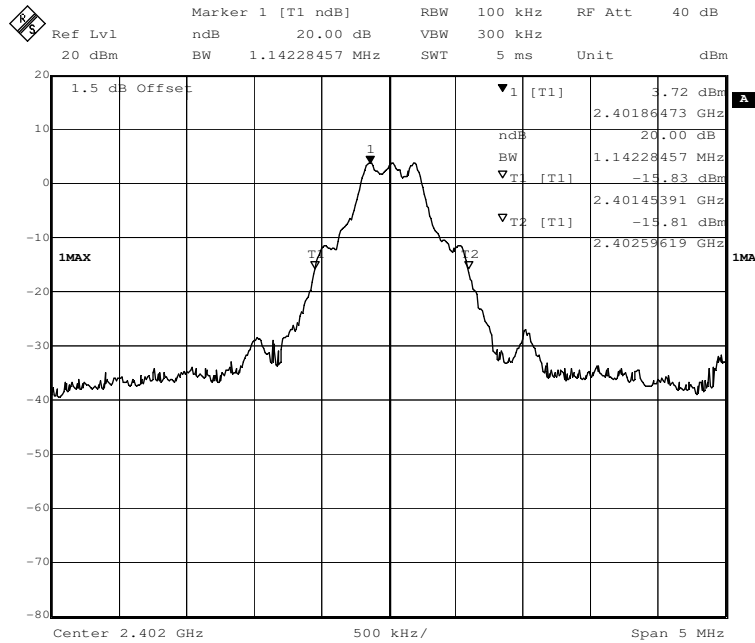
**EDR mode:**

| Test Channel | bandwidth | 2/3 bandwidth |
|--------------|-----------|---------------|
| Lowest       | 1.303     | 0.869         |
| Middle       | 1.303     | 0.869         |
| Highest      | 1.293     | 0.862         |

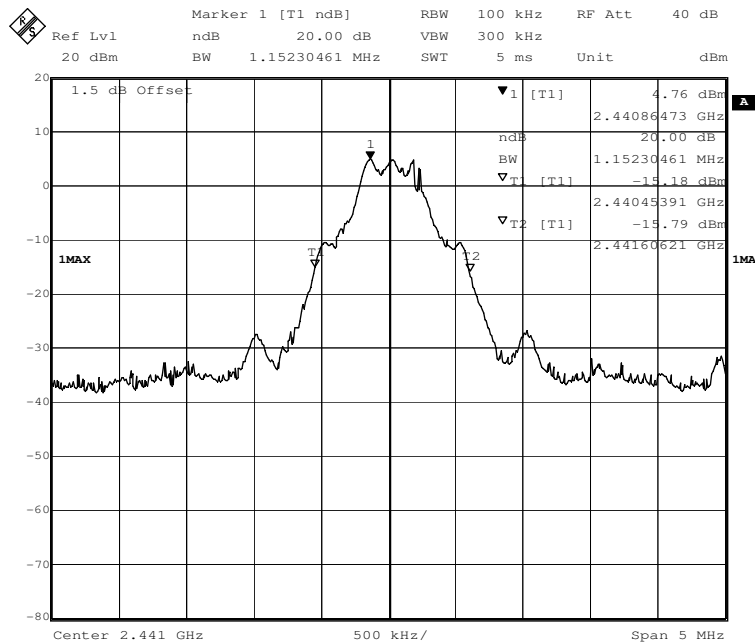
**Result plot as follows:**

**Normal mode (DH5):**

**Lowest Channel(2.402 GHz):**



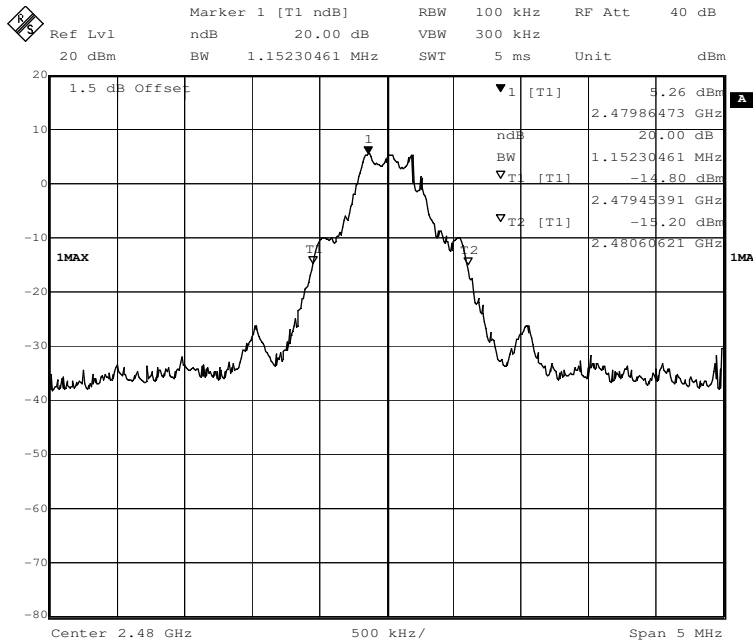
**Middle Channel(2.441 GHz):**





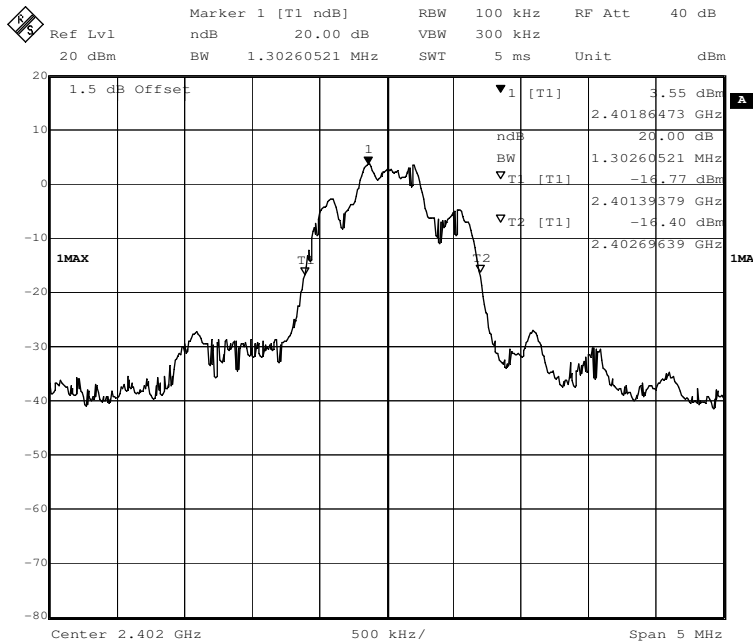


Highest Channel(2.480 GHz):

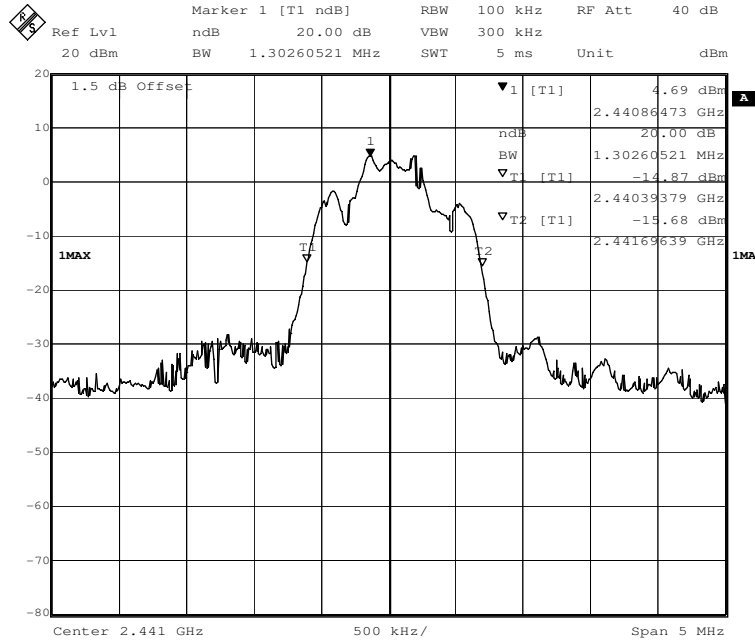


EDR mode (3DH5):

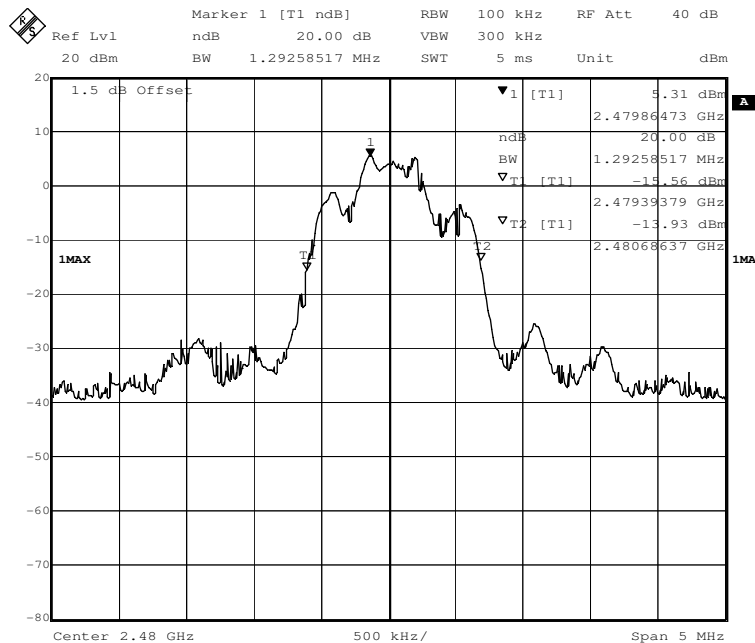
Lowest channel(2.402 GHz):



Middle channel(2.441 GHz):



Highest channel(2.480 GHz):



## 7.4 Carrier Frequencies Separated

**Test Requirement:** FCC Part 15 C section 15.247

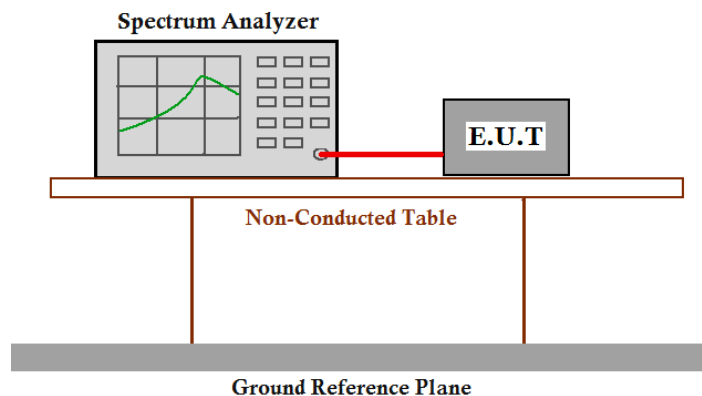
(a),(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

**Test Method:** ANSI C63.10: Clause 7.7.2

**Test Status:** Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in hopping with EDR mode (3DH5) as the worst case was found.

Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**



**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW  $\geq$  1% of the span, VBW  $\geq$  RBW,. Sweep = auto; Detector Function = Peak. Trace = Max, hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.



**Test result:**

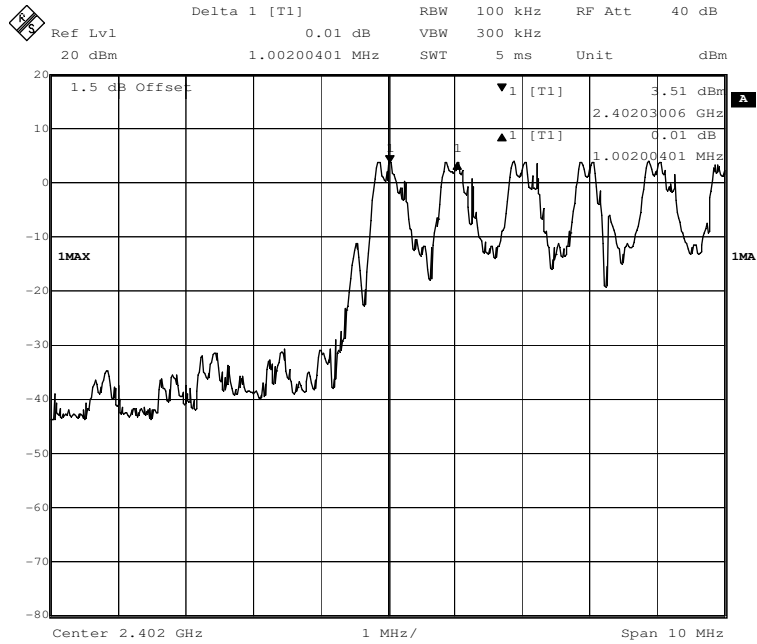
| Test Channel                                   | Carrier Frequencies Separated | Pass/Fail |
|--|-------------------------------|-----------|
| Lower Channels<br>(channel 0 and channel 1)    | 1.002 MHz                     | Pass      |
| Middle Channels<br>(channel 39 and channel 40) | 1.022 MHz                     | Pass      |
| Upper Channels<br>(channel 77 and channel 78)  | 1.002 MHz                     | Pass      |

**Remark:**

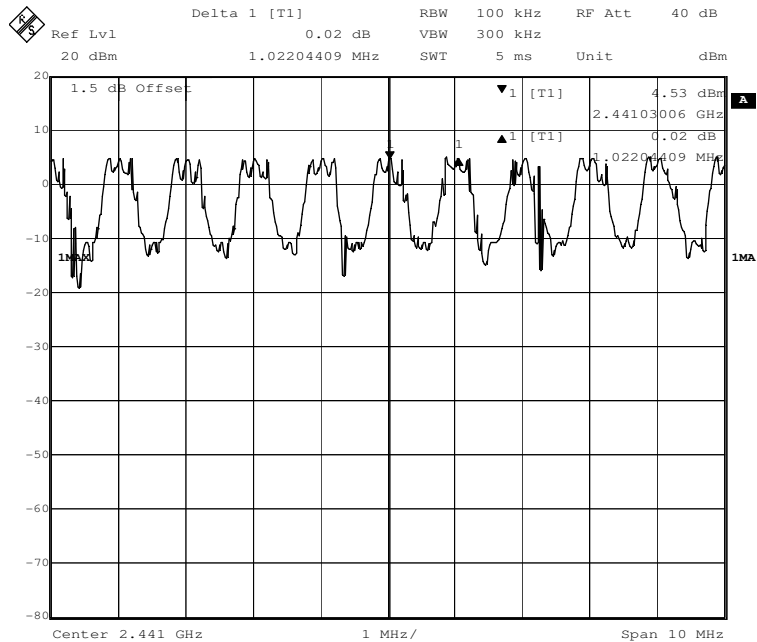
The limit is maximum two-thirds of the 20 dB bandwidth: 869 KHz.

Result plot as follows:

Lowest Channels: **Carrier Frequencies Separated**

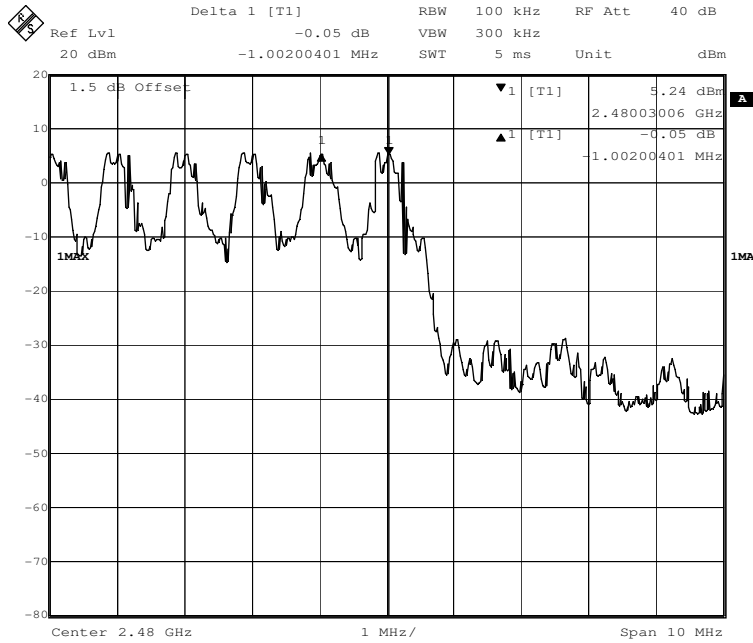


Middle Channels: **Carrier Frequencies Separated**





Highest Channels: **Carrier Frequencies Separated**



**Test result: The unit does meet the FCC requirements.**

## 7.5 Hopping Channel Number

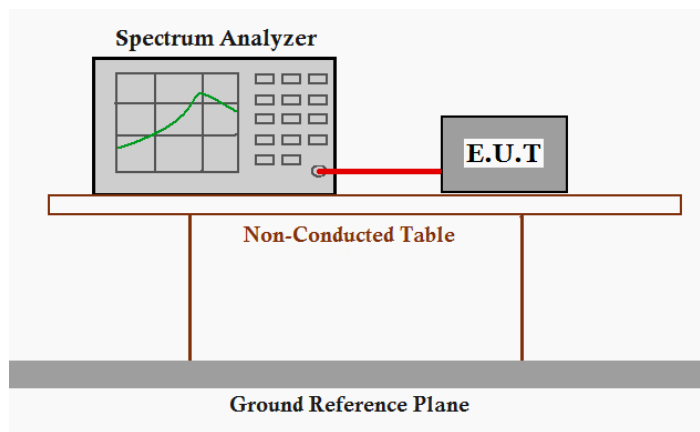
**Test Requirement:** FCC Part15 C section 15.247

(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

**Test Method:** ANSI C63.10: Clause 7.7.3

**Test Status:** Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with EDR mode (3DH5) as the worst case was found.  
 Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**

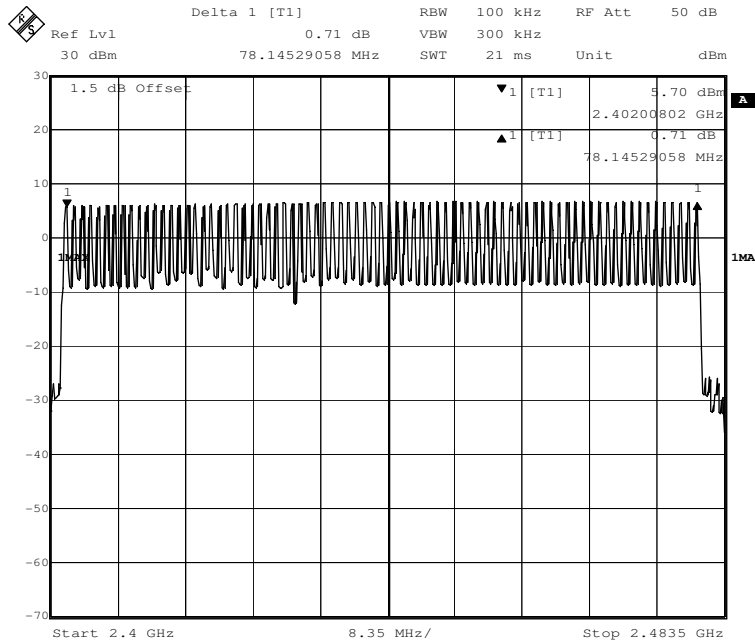


**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 100 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: start frequency = 2400 MHz. stop frequency = 2483.5 MHz. Submit the test result graph.



Test result: Total channels are 79 channels.



Test result: The unit does meet the FCC requirements.



## 7.6 Dwell Time

**Test Requirement:** FCC Part 15 C section 15.247

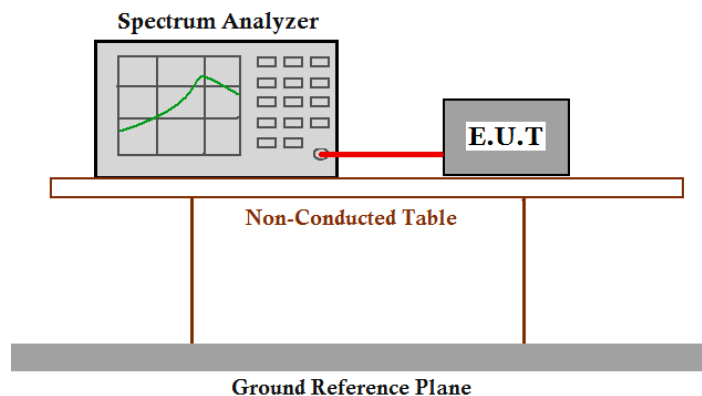
(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

**Test Method:** ANSI C63.10: Clause 7.7.4

**Test Status:** Test the EUT in hopping mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in hopping mode with EDR mode (3DH1, 3DH3 and 3DH5) as the worst case was found.

Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**



**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
  2. Set spectrum analyzer span = 0. centered on a hopping channel;
  3. Set RBW = 1 MHz and VBW = 1 MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = Max hold;
  4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). Repeat this test for each variation.
- The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.



**Test Result:**

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

|                                |   |       |      |   |    |   |             |   |         |    |
|--------------------------------|---|-------|------|---|----|---|-------------|---|---------|----|
| <b>1. Channel 0: 2.402GHz</b>  |   |       |      |   |    |   |             |   |         |    |
| 3DH1 time slot                 | = | 0.401 | (ms) | * | 33 | * | (31.6/3.16) | = | 132.330 | ms |
| 3DH3 time slot                 | = | 1.622 | (ms) | * | 16 | * | (31.6/3.16) | = | 259.520 | ms |
| 3DH5 time slot                 | = | 2.892 | (ms) | * | 11 | * | (31.6/3.16) | = | 318.120 | ms |
| <b>2. Channel 39: 2.441GHz</b> |   |       |      |   |    |   |             |   |         |    |
| 3DH1 time slot                 | = | 0.401 | (ms) | * | 33 | * | (31.6/3.16) | = | 132.330 | ms |
| 3DH3 time slot                 | = | 1.561 | (ms) | * | 16 | * | (31.6/3.16) | = | 249.760 | ms |
| 3DH5 time slot                 | = | 2.610 | (ms) | * | 11 | * | (31.6/3.16) | = | 287.100 | ms |
| <b>3. Channel 78: 2.480GHz</b> |   |       |      |   |    |   |             |   |         |    |
| 3DH1 time slot                 | = | 0.406 | (ms) | * | 33 | * | (31.6/3.16) | = | 133.980 | ms |
| 3DH3 time slot                 | = | 1.676 | (ms) | * | 16 | * | (31.6/3.16) | = | 268.160 | ms |
| 3DH5 time slot                 | = | 2.698 | (ms) | * | 11 | * | (31.6/3.16) | = | 296.780 | ms |

The average time of occupancy in the specified 31.6 second period is equal to pulse width\*(# of pulse in observation period)\*(test period / observation period)

The results are not greater than 0.4 seconds.

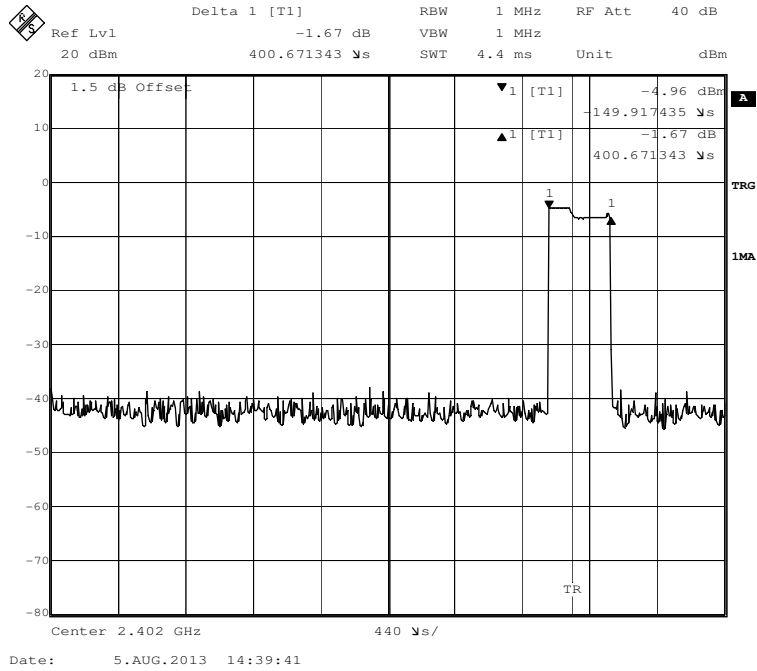
**The unit does meet the FCC requirements.**

Result plot as follows:

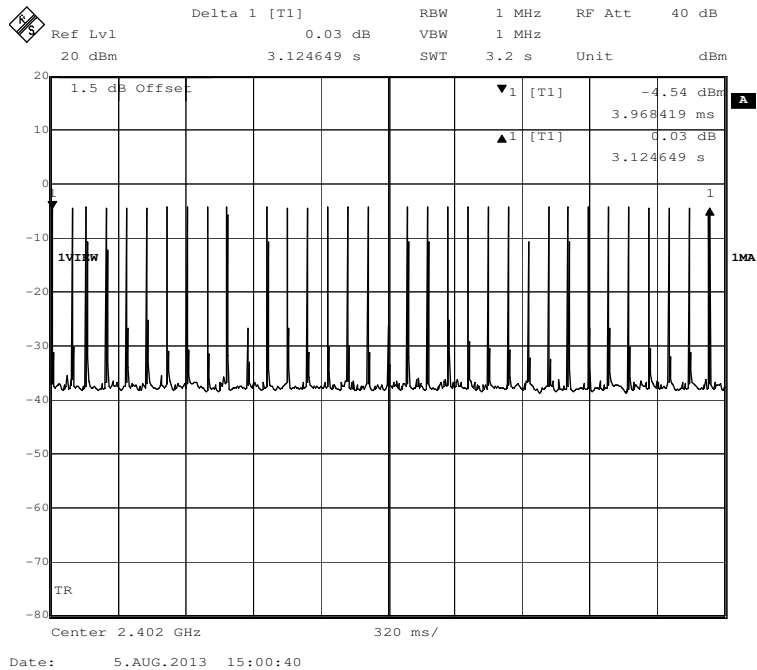
1. Lowest channel (2.402 GHz):

(1). 3DH1

Pulse Width:

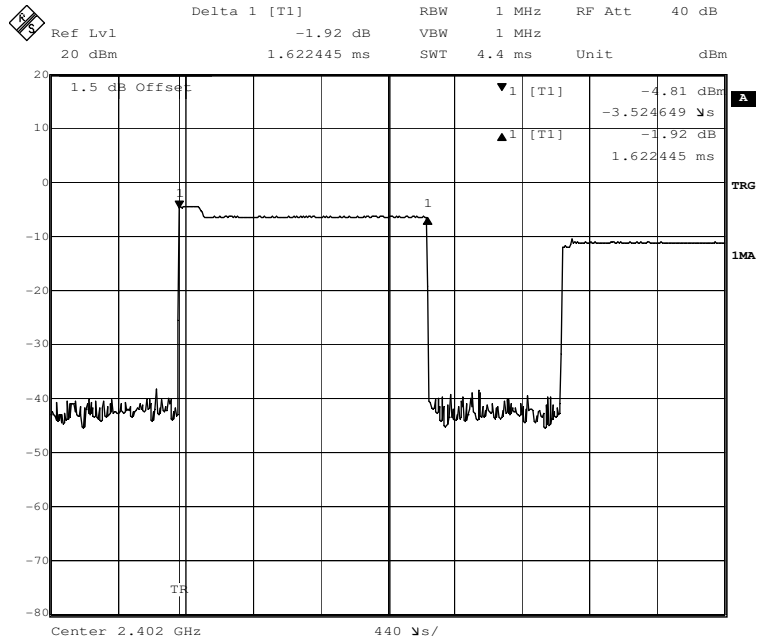


Number of Pulses in 3.16 S observation period:



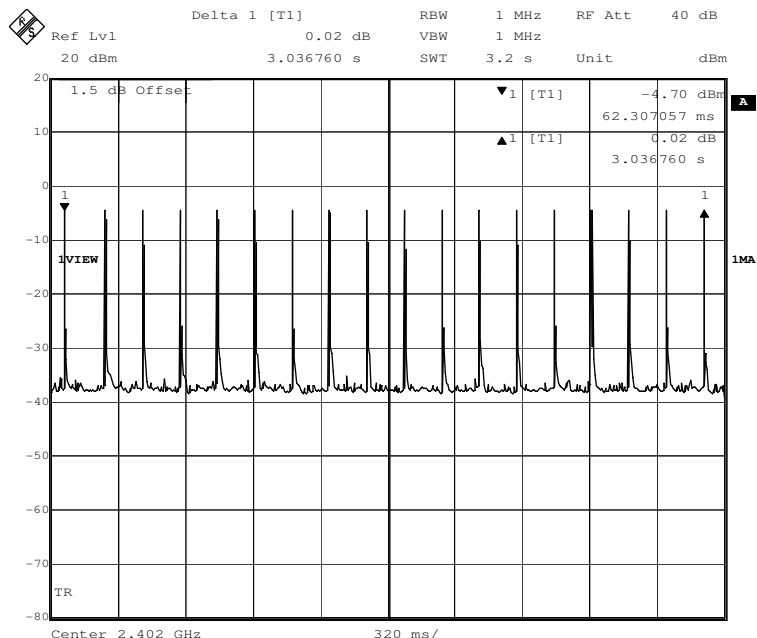
(2) 3DH3

Pulse Width:



Date: 5 AUG 2013 15:06:38

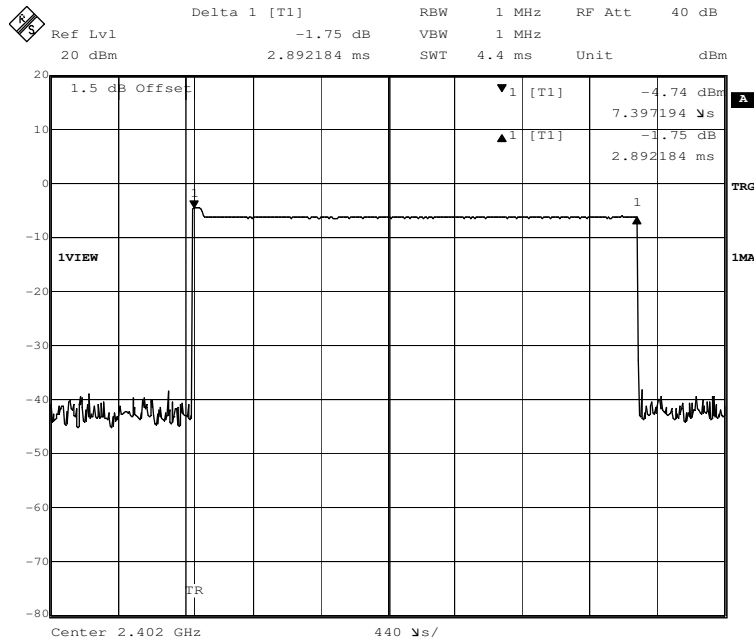
Number of Pulses in 3.16 S observation period:



Date: 5.AUG.2013 15:20:39

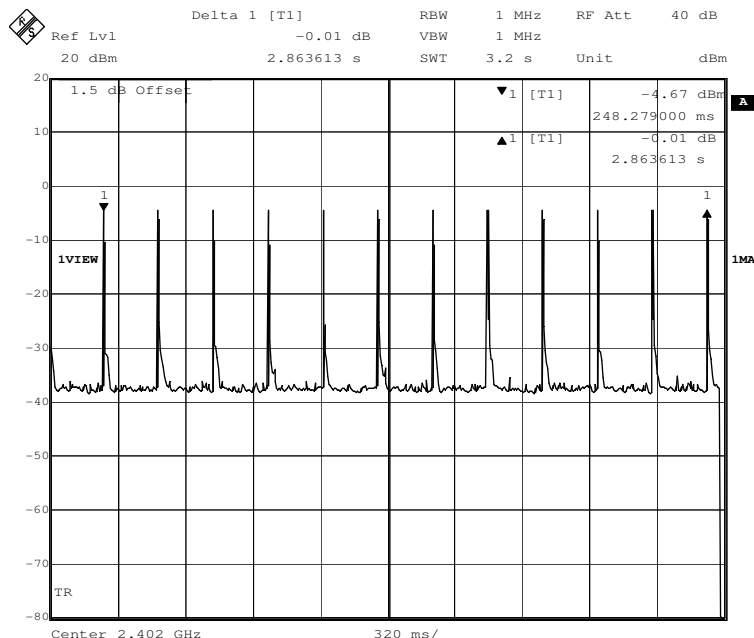
(3) 3DH5

Pulse Width:



Date: 5.AUG.2013 15:26:07

Number of Pulses in 3.16 S observation period:

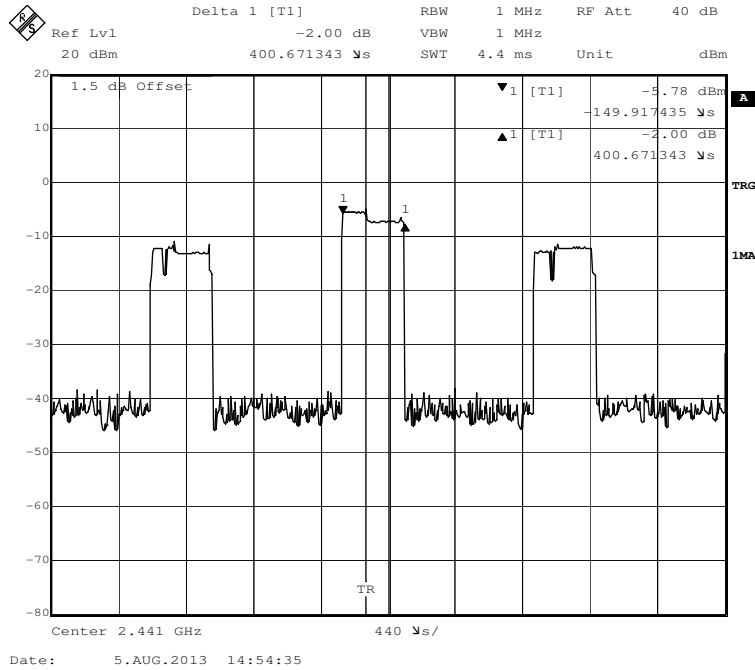


Date: 5.AUG.2013 15:22:35

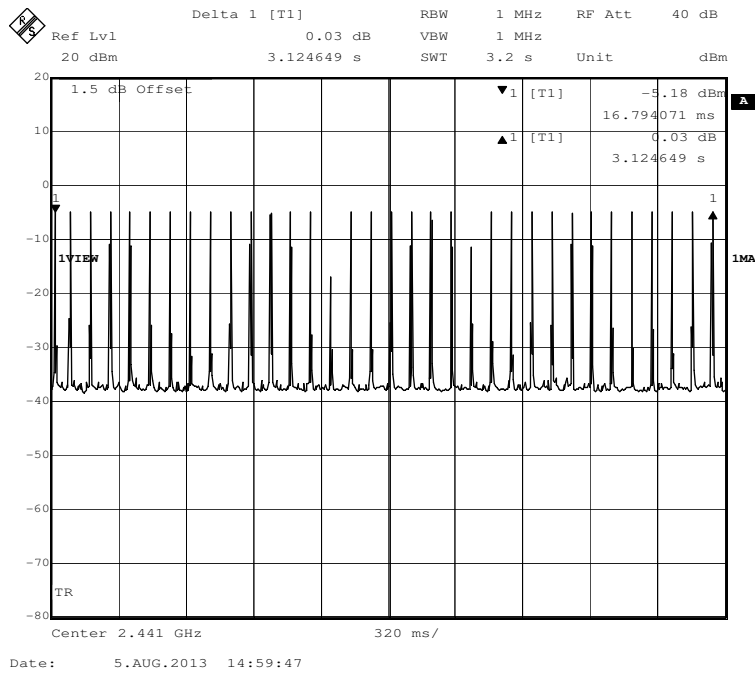
**2. Middle Channel (2.441 GHz):**

(1). 3DH1

Pulse Width:

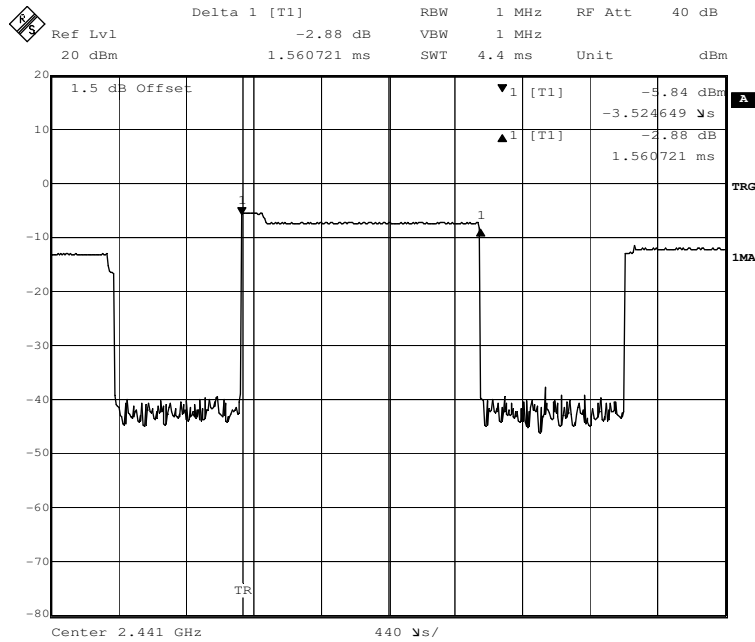


Number of Pulses in 3.16 S observation period:



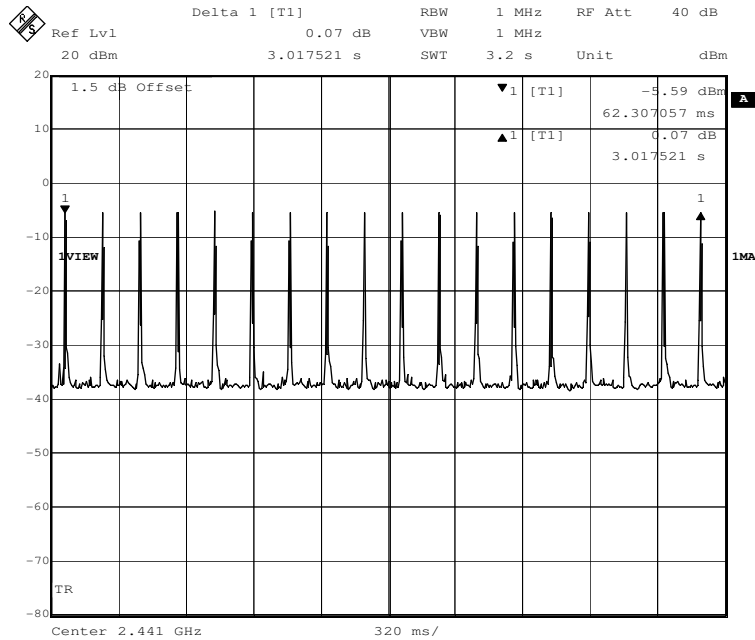
(2) 3DH3

Pulse Width:



Date: 5.AUG.2013 15:07:24

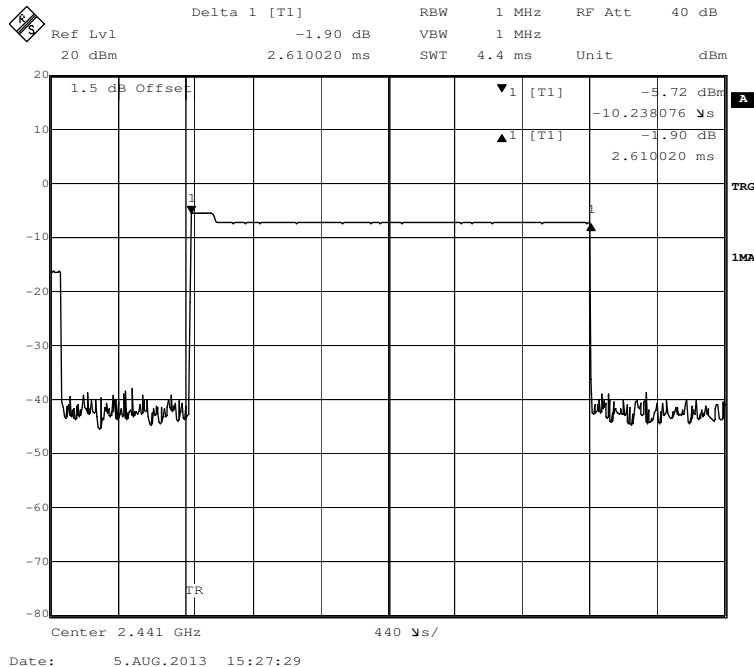
Number of Pulses in 3.16 S observation period:



Date: 5.AUG.2013 15:21:10

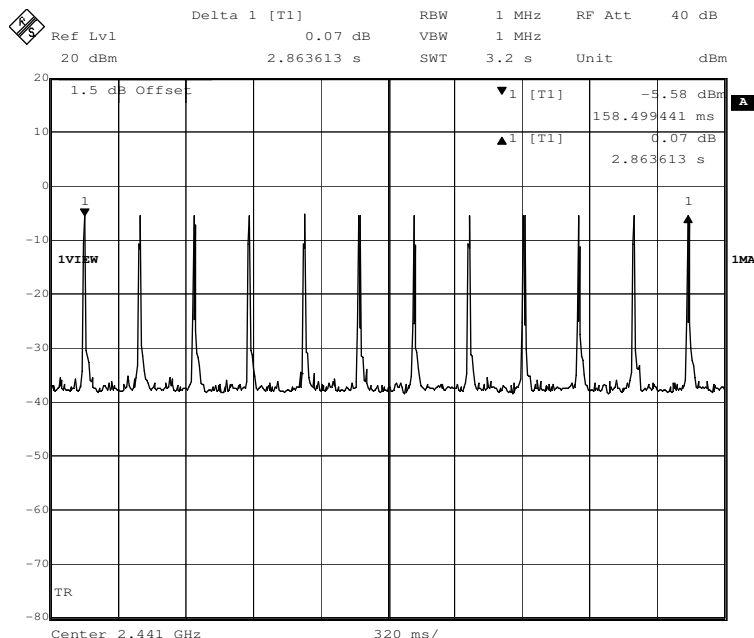
(3) 3DH5

Pulse Width:



Date: 5.AUG.2013 15:27:29

Number of Pulses in 3.16 S observation period:



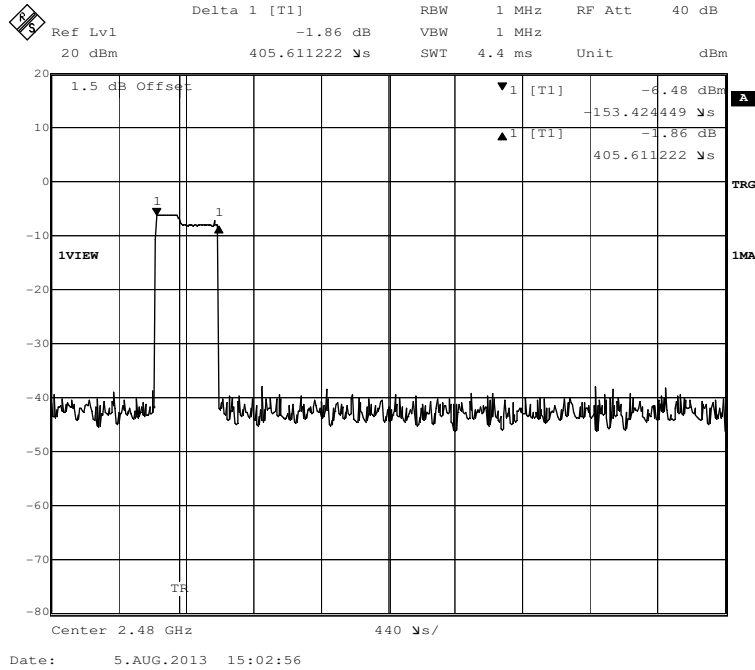
Date: 5.AUG.2013 15:23:14



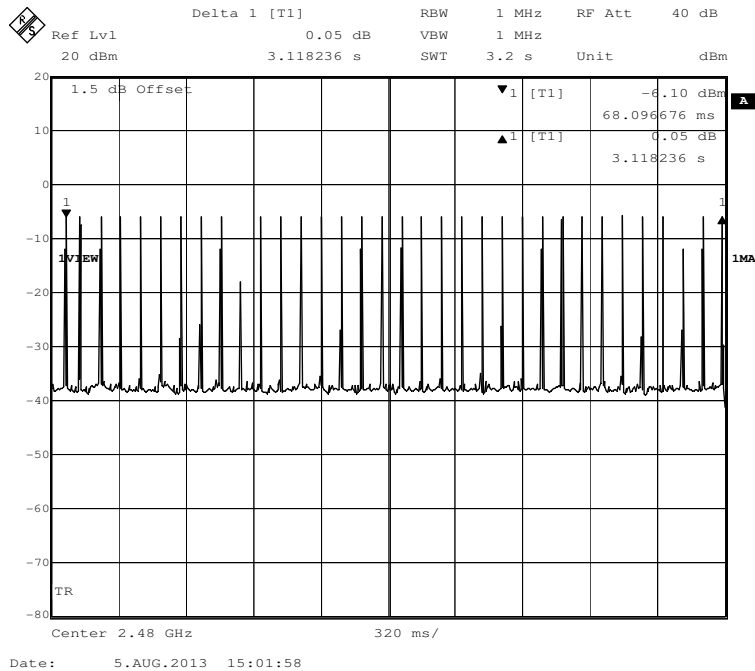
**3. Highest Channel (2.480 GHz):**

(1). 3DH1

Pulse Width:

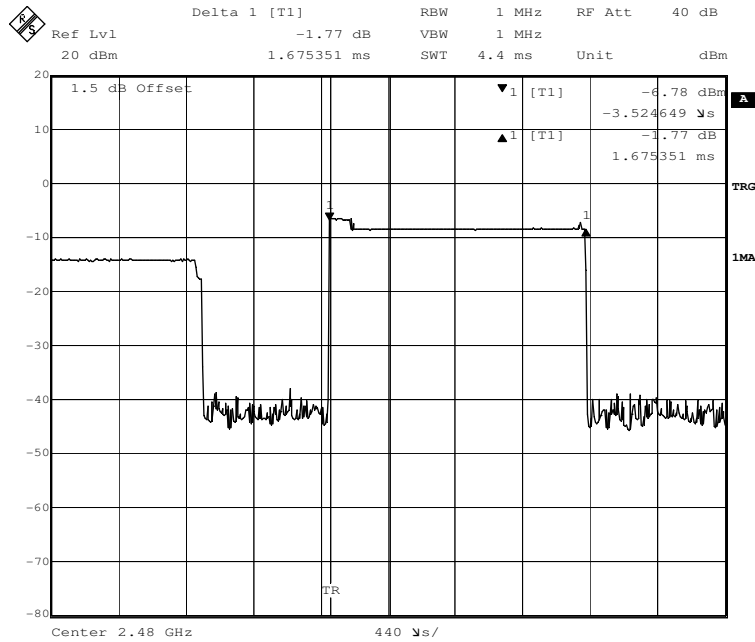


Number of Pulses in 3.16 S observation period:



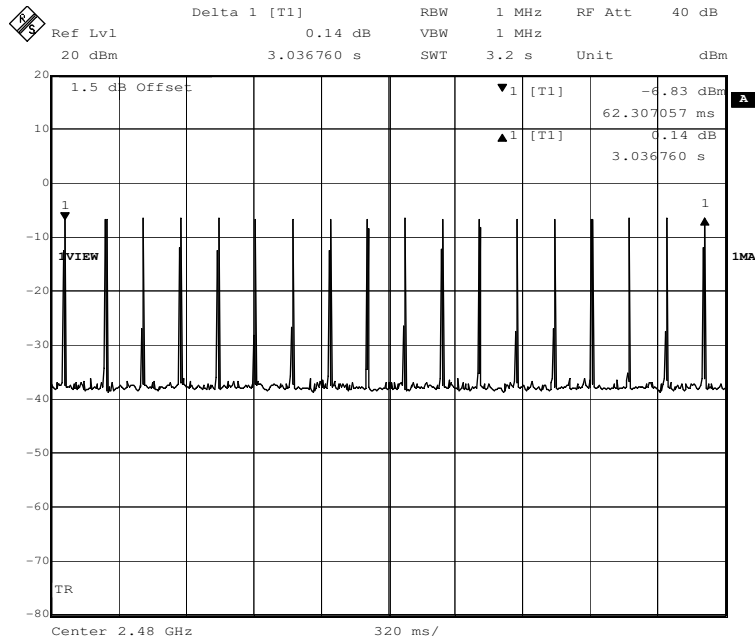
(2) 3DH3

Pulse Width:



Date: 5.AUG.2013 15:08:28

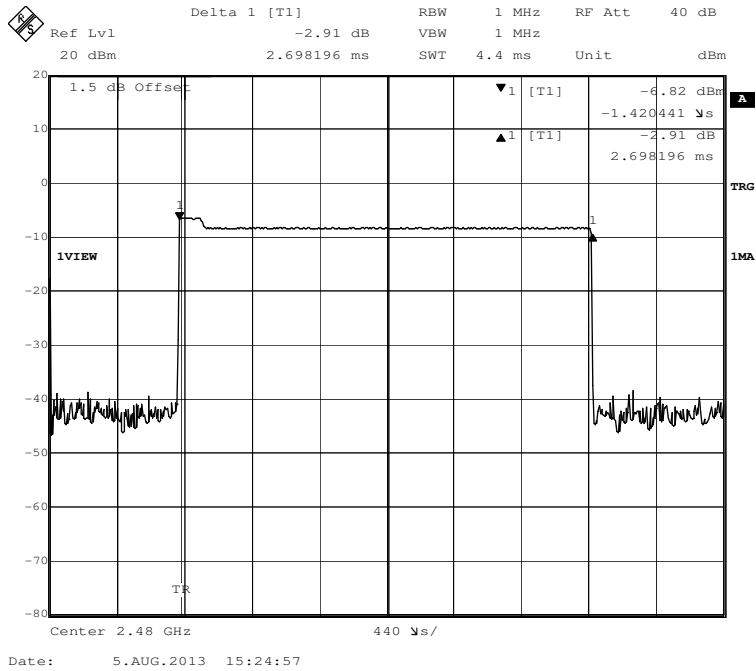
Number of Pulses in 3.16 S observation period:



Date: 5.AUG.2013 15:09:10

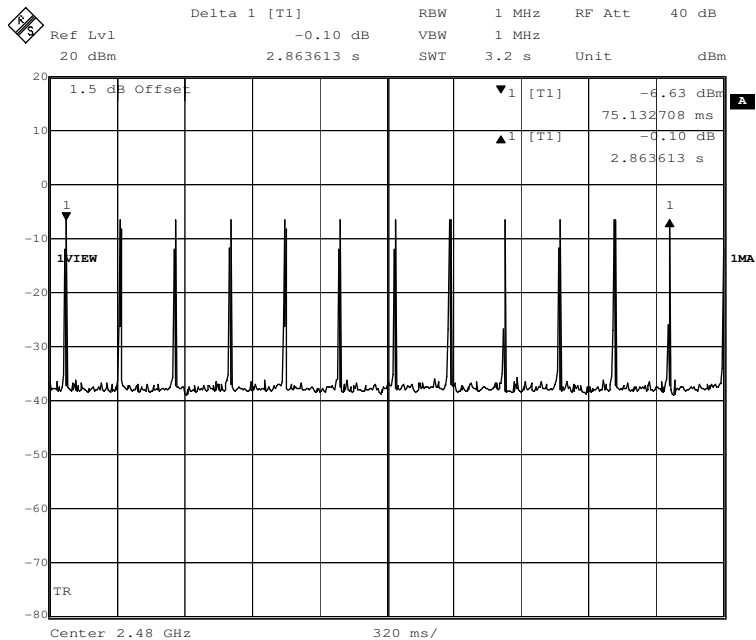
(3) 3DH5

Pulse Width:



Date: 5.AUG.2013 15:24:57

Number of Pulses in 3.16 S observation period:



Date: 5.AUG.2013 15:23:56



## 7.7 Pseudorandom Frequency Hopping Sequence

### 7.7.1 Standard requirement

15.247(a)(1) requirement:

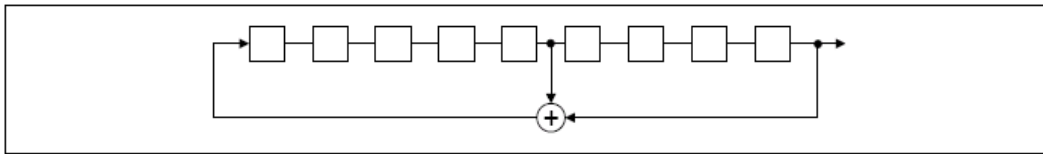
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively. 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, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### 7.7.2 EUT Pseudorandom Frequency Hopping Sequence

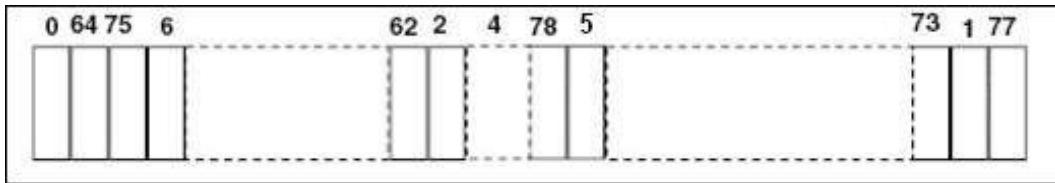
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits
- Longest sequence of zeros: 8 (non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

## 7.8 Maximum Peak Output Power

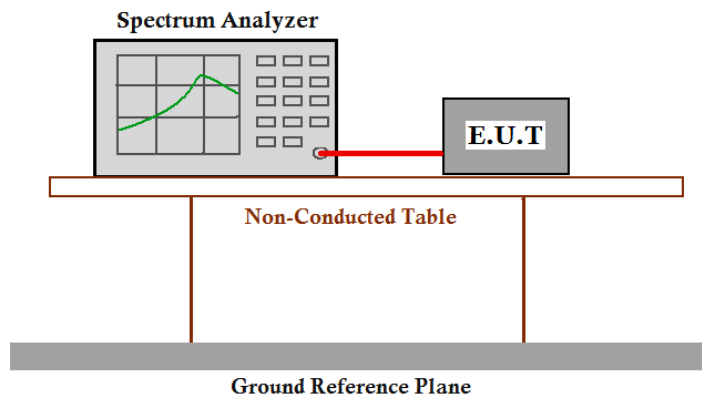
**Test Requirement:** FCC Part 15 C section 15.247  
 (b)(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.  
 Refer to the result "Hopping channel number" of this document. The 1 watt (30.0 dBm) limit applies.

**Test Method:** ANSI C63.10: Clause 6.10.1

**Test Limit:**

**Test mode:** Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal (DH5) and EDR mode (3DH5) as the worst case was found.  
 Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**



**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 2 MHz. VBW = 2 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

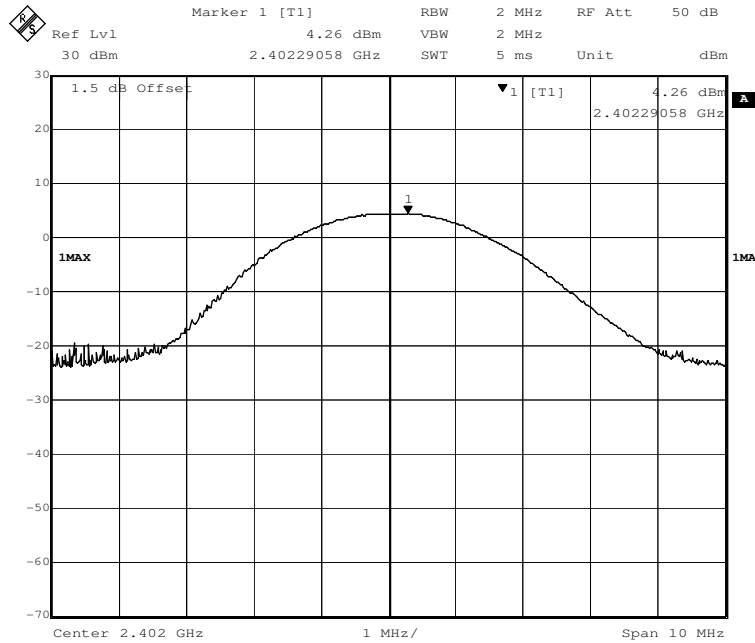


| <b>Test Result:</b>  |                             |                    |             |        |
|--|-----------------------------|--------------------|-------------|--------|
| <b>Normal mode:</b>  |                             |                    |             |        |
| Test Channel   | Fundamental Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Result |
| Lowest   | 2402                        | 4.26               | 30.0        | Pass   |
| Middle   | 2441                        | 5.12               | 30.0        | Pass   |
| Highest  | 2480                        | 5.82               | 30.0        | Pass   |
| <b>EDR mode:</b>   |                             |                    |             |        |
| Test Channel   | Fundamental Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Result |
| Lowest   | 2402                        | 4.34               | 30.0        | Pass   |
| Middle   | 2441                        | 5.26               | 30.0        | Pass   |
| Highest  | 2480                        | 5.88               | 30.0        | Pass   |
| <b>Remark: cable lose=1.5 dB</b>                             |                             |                    |             |        |
| <b>Test result: The unit does meet the FCC requirements.</b> |                             |                    |             |        |

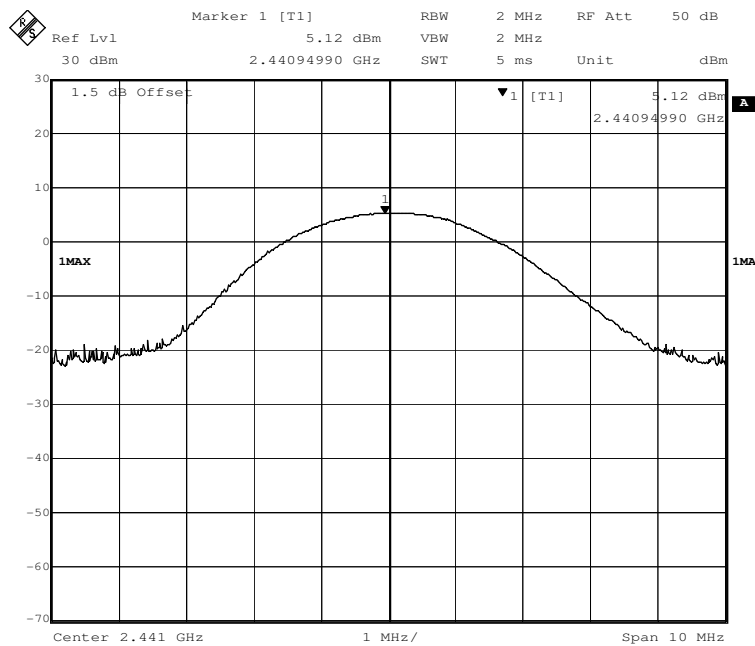
**Result plot as follows:**

**Normal mode:**

**Lowest Channel(2.402 MHz):**



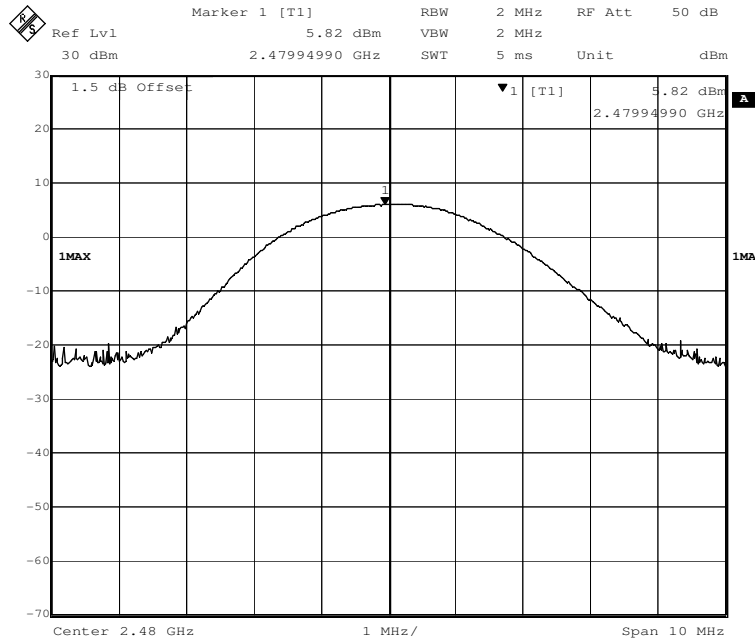
**Middle Channel(2.441 GHz):**





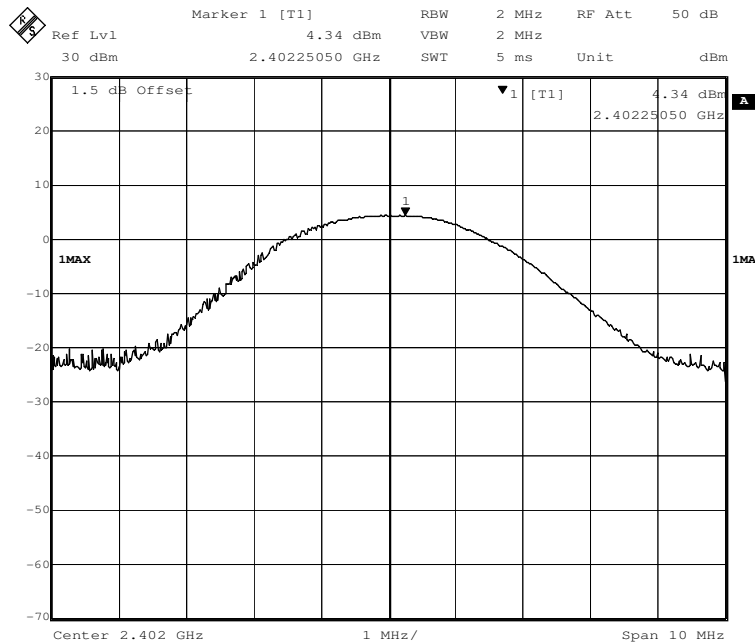


Highest Channel(2.480 GHz):

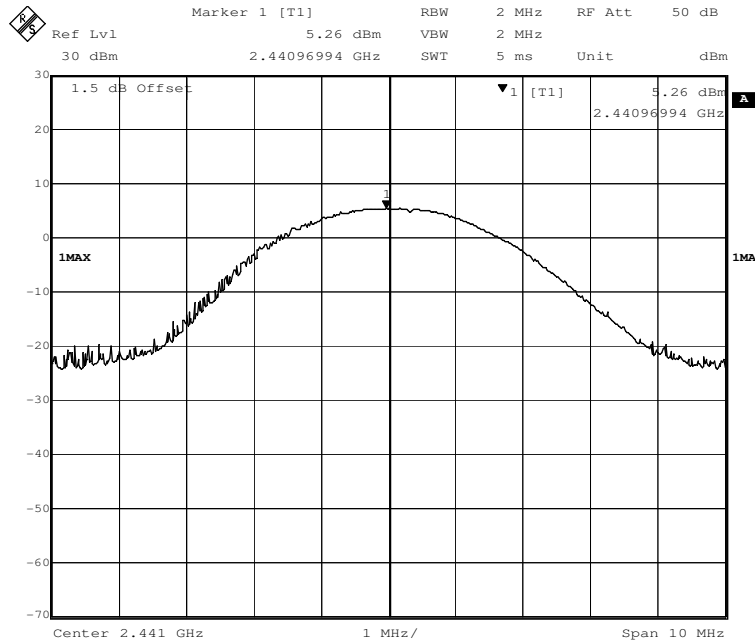


EDR mode:

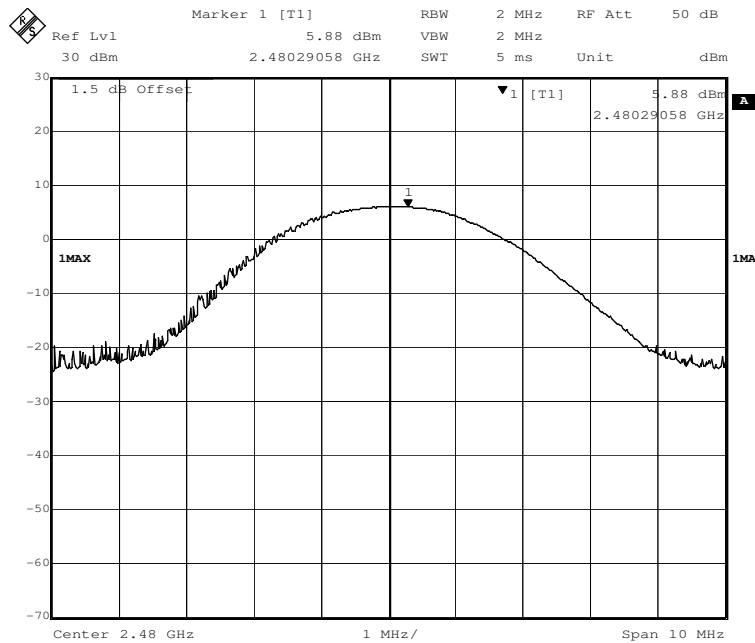
Lowest channel(2.402 GHz):



Middle channel(2.441 GHz):



Highest channel(2.480 GHz):



## 7.9 Conducted Spurious Emissions

**Test Requirement:** FCC Part15 C section 15.247

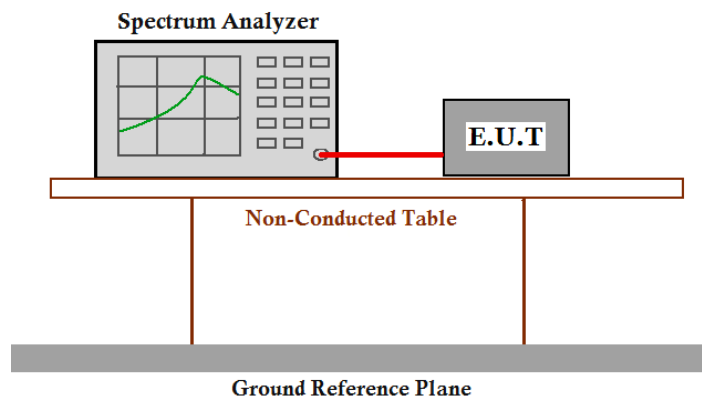
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Based on either an RF conducted or a radiated measurement. Provided the transmitter demonstrates compliance with the peak conducted power limits.

**Test Method:** ANSI C63.10: Clause 6.7

**Test Status:** Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**



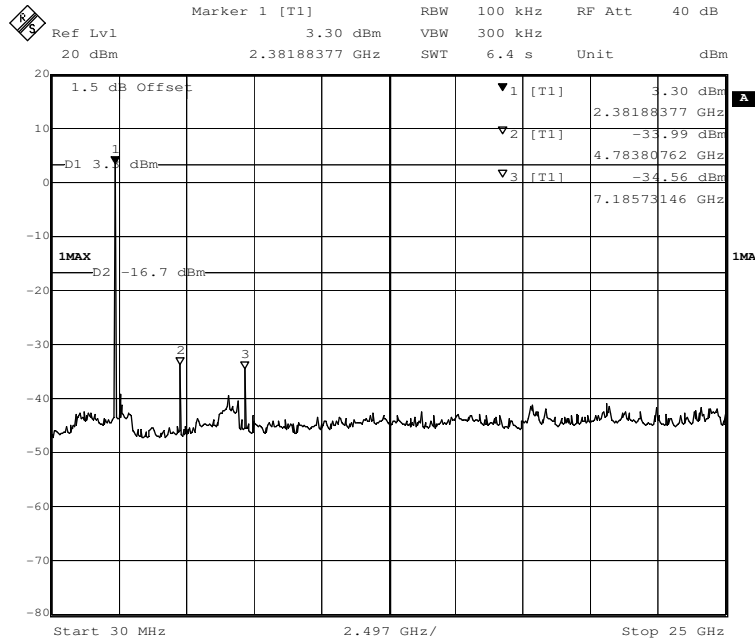
**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW  $\geq$  RBW. Sweep = auto; Detector Function = Peak (Max. hold).

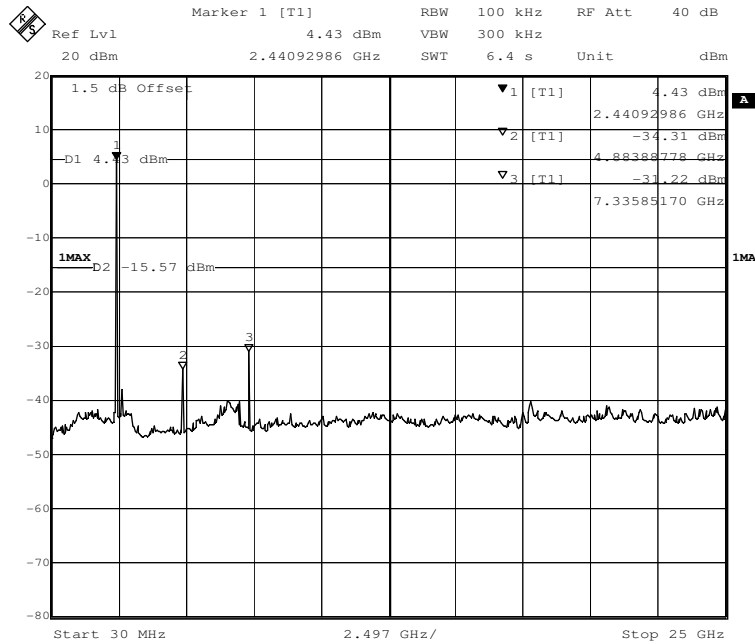


Result plot as follows:

Lowest Channel: 30 M to 25 GHz

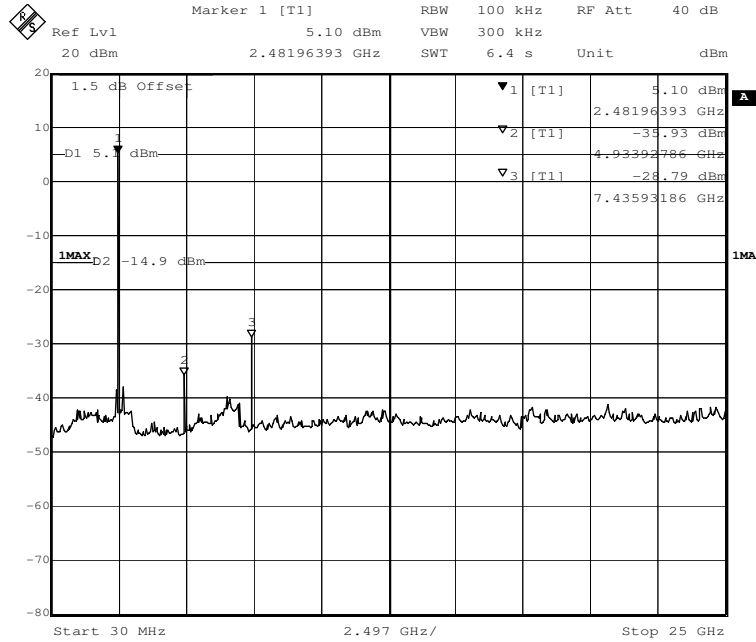


Middle Channel: 30 M to 25 GHz





Highest Channel: 30 M to 25 GHz

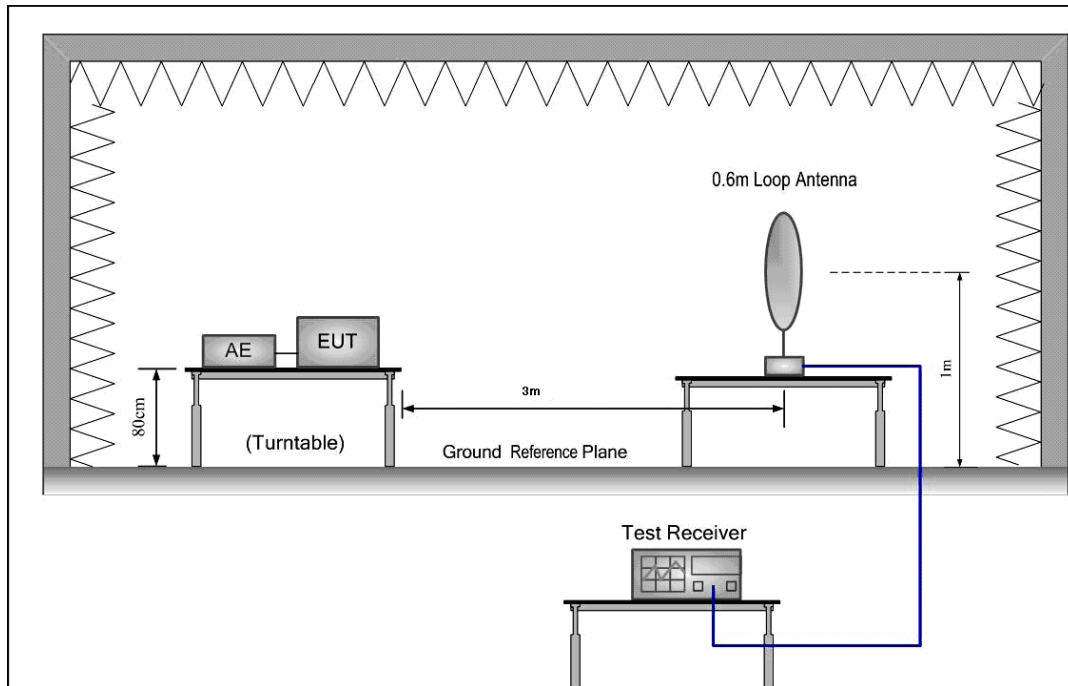


## 7.10 Radiated Spurious Emissions

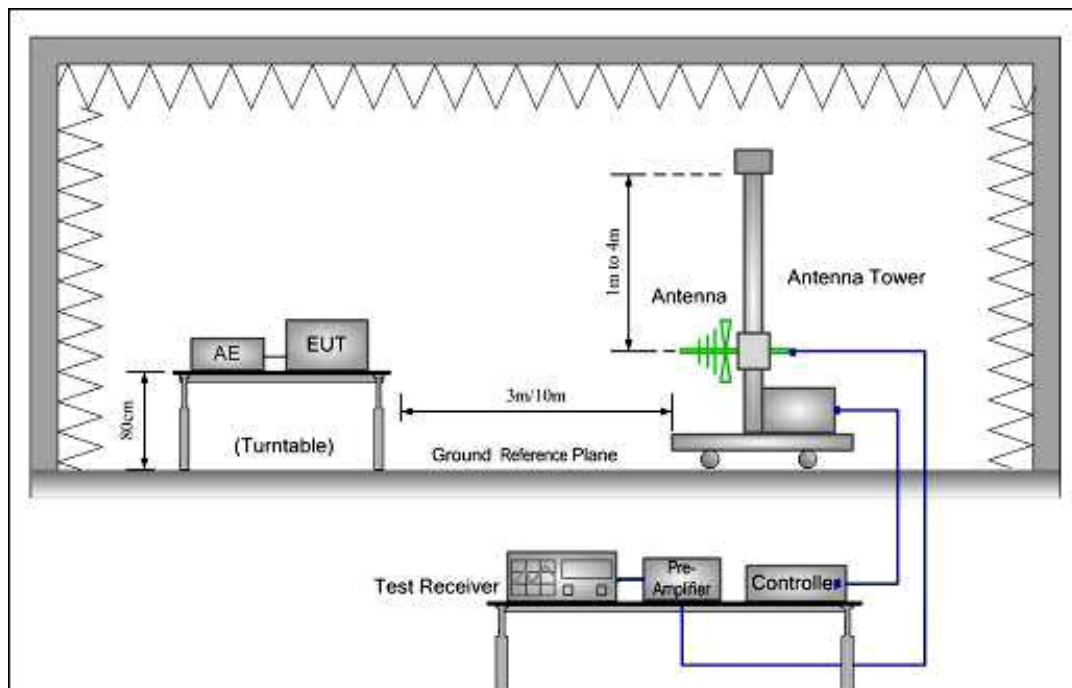
|                          |  |
|--------------------------|--|
| <b>Test Requirement:</b> | FCC Part15 C section 15.247<br><br>(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that Contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, and provided the transmitter demonstrates compliance with the peak conducted power limits. |
| <b>Test Method:</b>      | ANSI C63.10: Clause 6.4, 6.5 and 6.6   |
| <b>Test Status:</b>      | Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.<br><br>Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.   |
| <b>Detector:</b>         | For PK value:<br>RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz<br>VBW $\geq$ RBW<br>Sweep = auto<br>Detector function = peak<br>Trace = max hold<br><br>For AV value:<br>RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz<br>VBW =10 Hz<br>Sweep = auto<br>Detector function = peak<br>Trace = max hold   |
| <b>15.209 Limit:</b>     | 40.0 dB $\mu$ V/m between 30MHz & 88MHz<br>43.5 dB $\mu$ V/m between 88MHz & 216MHz<br>46.0 dB $\mu$ V/m between 216MHz & 960MHz<br>54.0 dB $\mu$ V/m above 960MHz   |

**Test Configuration:**

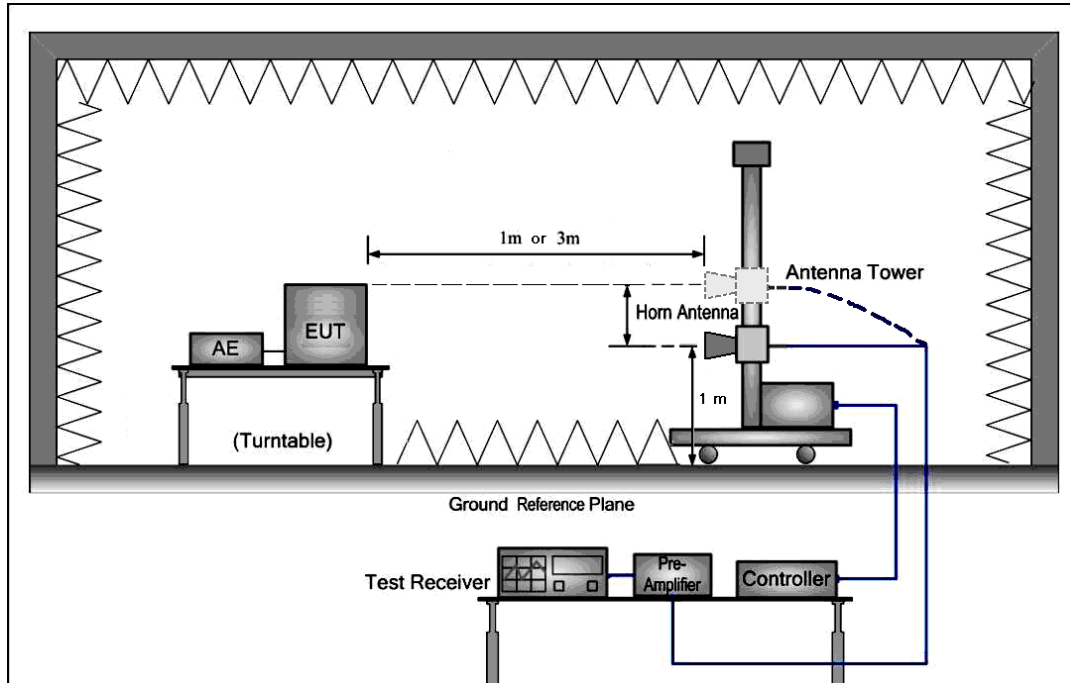
- 1) 9 kHz to 30 MHz emissions:



- 2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



**Test Procedure:**

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

The receiver scanned from the lowest frequency generated within the EUT to 25GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

For hand-held or body-worn devices rotated through three orthogonal axes(X,Y,Z) to determine which attitude (orientation) and equipment arrangement produces the highest emission relative to the limit; the attitude and equipment arrangement that produces the highest emission relative to the limit was used in making final radiated emission measurements.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from  $20\log(\text{dwell time}/100 \text{ ms})$ , in an effort to demonstrate compliance with the 15.209 limit.

Submit this data.





**7.10.1 Harmonic and other spurious emissions**

**7.10.1.1 Test at low Channel in transmitting status**

9 kHz~30 MHz Field Strength of Unwanted Emissions.Quasi-Peak Measurement

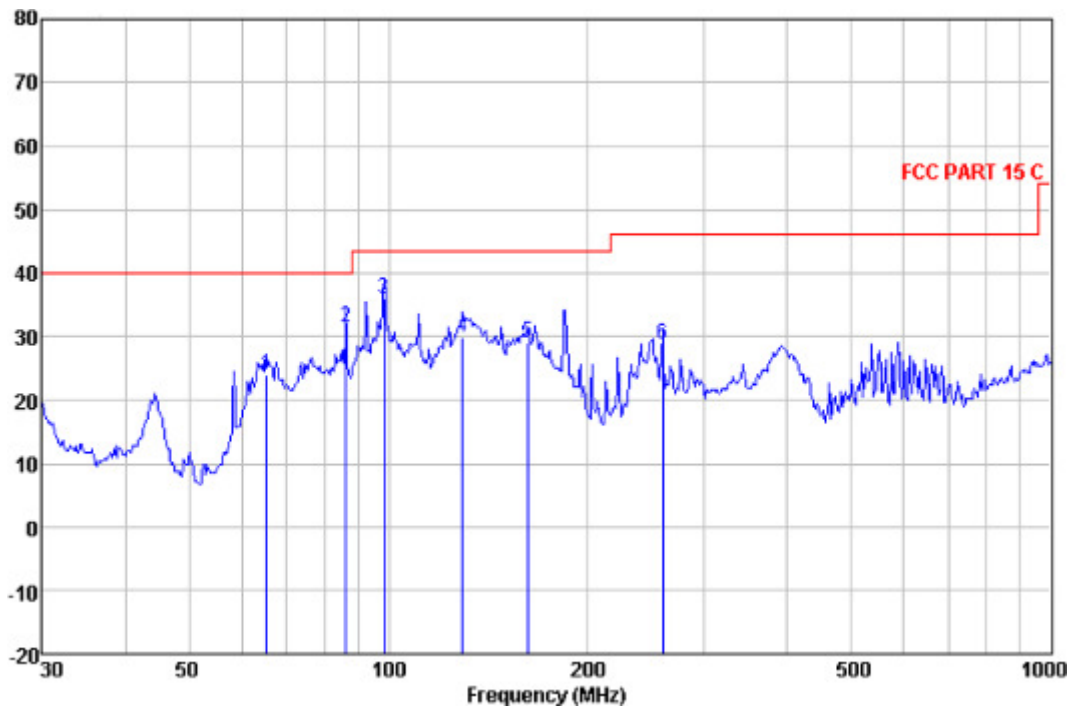
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

**Vertical:**

Peak scan

Level (dB $\mu$ V/m)



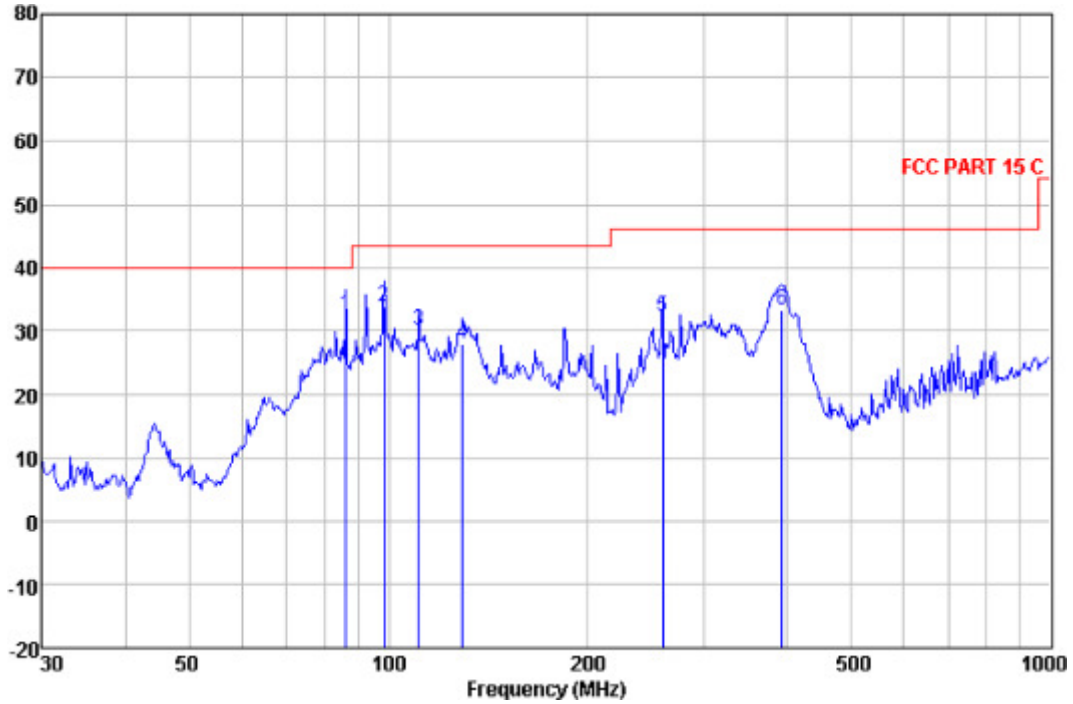
Quasi-peak measurement

| Freq    | ReadAntenna Level | Antenna Factor | Cable Loss | Preamp Factor | Level  | Limit Line | Over Limit | Remark |
|---------|-------------------|----------------|------------|---------------|--------|------------|------------|--------|
| MHz     | dBuV              | dB/m           | dB         | dB            | dBuV/m | dBuV/m     | dB         |        |
| 65.343  | 45.87             | 4.51           | 0.18       | 26.67         | 23.89  | 40.00      | -16.11     | QP     |
| 86.200  | 49.81             | 7.95           | 0.23       | 26.61         | 31.38  | 40.00      | -8.62      | QP     |
| 98.487  | 51.95             | 10.51          | 0.21       | 26.58         | 36.09  | 43.50      | -7.41      | QP     |
| 129.468 | 44.06             | 11.99          | 0.39       | 26.45         | 29.99  | 43.50      | -13.51     | QP     |
| 162.041 | 45.97             | 8.90           | 0.53       | 26.32         | 29.08  | 43.50      | -14.42     | QP     |
| 259.234 | 41.67             | 12.40          | 0.80       | 25.98         | 28.89  | 46.00      | -17.11     | QP     |

**Horizontal:**

Peak scan

Level (dB $\mu$ V/m)



Quasi-peak measurement

| Freq    | ReadAntenna Level | Antenna Factor | Cable Loss | Preamp Factor | Level        | Limit Line   | Over Limit | Remark |
|---------|-------------------|----------------|------------|---------------|--------------|--------------|------------|--------|
| MHz     | dB $\mu$ V        | dB/m           | dB         | dB            | dB $\mu$ V/m | dB $\mu$ V/m | dB         |        |
| 86.200  | 50.93             | 7.95           | 0.23       | 26.61         | 32.50        | 40.00        | -7.50      | QP     |
| 98.487  | 49.76             | 10.51          | 0.21       | 26.58         | 33.90        | 43.50        | -9.60      | QP     |
| 110.957 | 44.55             | 11.87          | 0.25       | 26.55         | 30.12        | 43.50        | -13.38     | QP     |
| 129.468 | 41.96             | 11.99          | 0.39       | 26.45         | 27.89        | 43.50        | -15.61     | QP     |
| 259.234 | 44.92             | 12.40          | 0.80       | 25.98         | 32.14        | 46.00        | -13.86     | QP     |
| 392.095 | 42.87             | 15.70          | 1.20       | 26.43         | 33.34        | 46.00        | -12.66     | QP     |



1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss (dB) | Preamp factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|------------------------|-----------------|--------------------|----------------------|-------------------------|----------------|----------------------|
| 4804.00         | 31.53                  | 8.98            | 49.30              | 60.07                | 51.28                   | 74.00          | V                    |
| 7206.00         | 36.47                  | 12.32           | 49.73              | 56.18                | 55.24                   | 74.00          | V                    |
| 9608.00         | 38.08                  | 16.30           | 49.89              | 54.32                | 58.81                   | 74.00          | V                    |
| 4804.00         | 31.53                  | 8.98            | 49.30              | 59.22                | 50.43                   | 74.00          | H                    |
| 7206.00         | 36.47                  | 12.32           | 49.73              | 56.79                | 55.85                   | 74.00          | H                    |
| 9608.00         | 38.08                  | 16.30           | 49.89              | 54.95                | 59.44                   | 74.00          | H                    |

Average Measurement:

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss (dB) | Preamp factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|------------------------|-----------------|--------------------|----------------------|-------------------------|----------------|----------------------|
| 4804.00         | 31.53                  | 8.98            | 49.30              | 54.07                | 45.28                   | 54.00          | V                    |
| 7206.00         | 36.47                  | 12.32           | 49.73              | 51.18                | 50.24                   | 54.00          | V                    |
| 9608.00         | 38.08                  | 16.30           | 49.89              | 45.32                | 49.81                   | 54.00          | V                    |
| 4804.00         | 31.53                  | 8.98            | 49.30              | 51.22                | 42.43                   | 54.00          | H                    |
| 7206.00         | 36.47                  | 12.32           | 49.73              | 50.79                | 49.85                   | 54.00          | H                    |
| 9608.00         | 38.08                  | 16.30           | 49.89              | 45.95                | 50.44                   | 54.00          | H                    |

**7.10.1.2 Test at middle Channel in transmitting status**

9 kHz~30 MHz Field Strength of Unwanted Emissions.Quasi-Peak Measurement

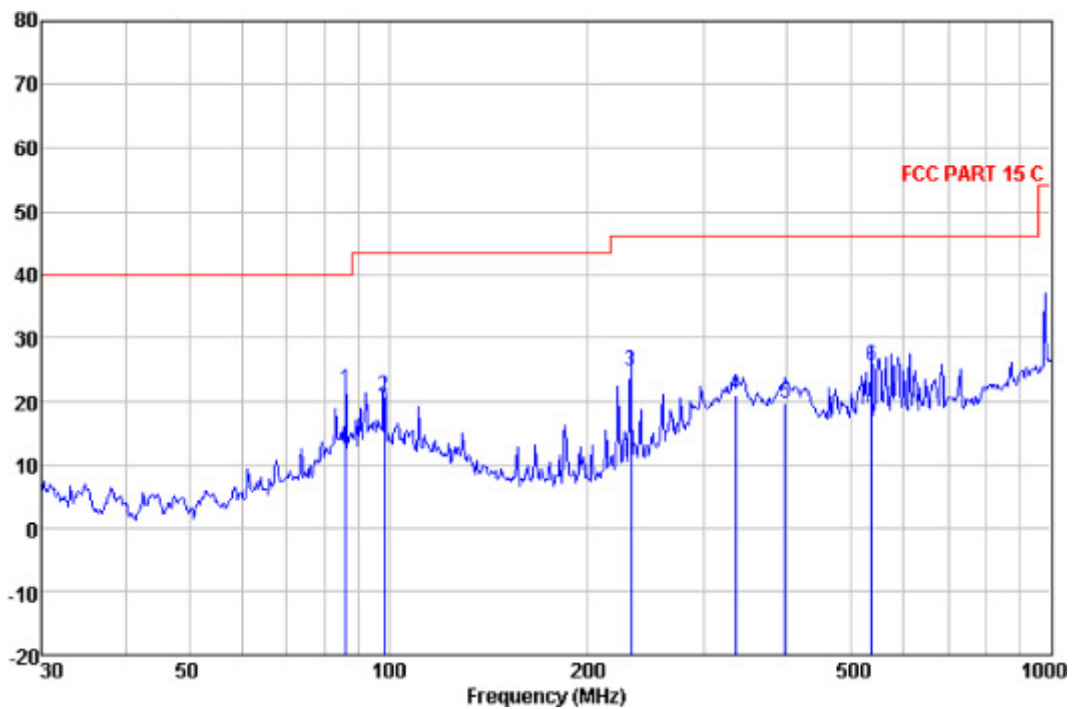
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

**Vertical:**

Peak scan

Level (dBuV/m)



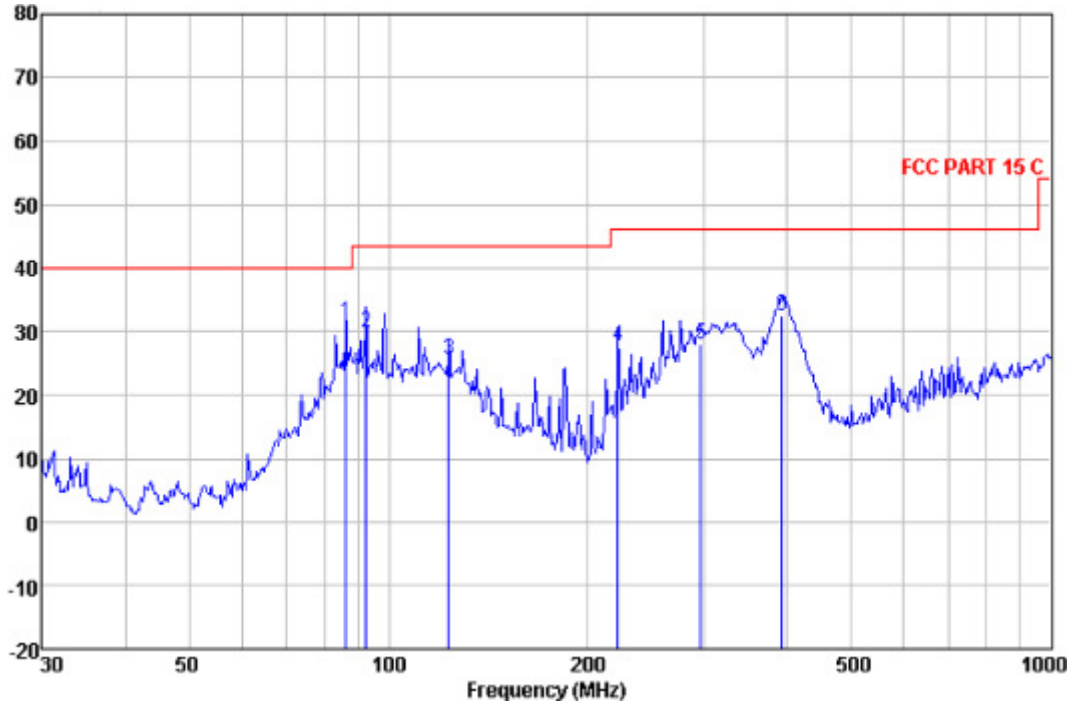
Quasi-peak measurement

| Freq    | ReadAntenna Level | Antenna Factor | Cable Loss | Preamp Factor | Level  | Limit Line | Over Limit | Remark |
|---------|-------------------|----------------|------------|---------------|--------|------------|------------|--------|
| MHz     | dBuV              | dB/m           | dB         | dB            | dBuV/m | dBuV/m     | dB         |        |
| 86.200  | 40.38             | 7.95           | 0.23       | 26.61         | 21.95  | 40.00      | -18.05     | QP     |
| 98.487  | 36.61             | 10.51          | 0.21       | 26.58         | 20.75  | 43.50      | -22.75     | QP     |
| 231.718 | 39.77             | 10.20          | 0.76       | 26.03         | 24.70  | 46.00      | -21.30     | QP     |
| 333.687 | 32.10             | 13.77          | 1.14       | 26.00         | 21.01  | 46.00      | -24.99     | QP     |
| 397.633 | 29.11             | 15.90          | 1.20       | 26.46         | 19.75  | 46.00      | -26.25     | QP     |
| 535.707 | 33.30             | 18.08          | 1.47       | 27.17         | 25.68  | 46.00      | -20.32     | QP     |

**Horizontal:**

Peak scan

Level (dB $\mu$ V/m)



Quasi-peak measurement

| Freq    | ReadAntenna Level | Antenna Factor | Cable Loss | Preamp Factor | Level        | Limit Line   | Over Limit | Remark |
|---------|-------------------|----------------|------------|---------------|--------------|--------------|------------|--------|
| MHz     | dB $\mu$ V        | dB/m           | dB         | dB            | dB $\mu$ V/m | dB $\mu$ V/m | dB         |        |
| 86.200  | 49.90             | 7.95           | 0.23       | 26.61         | 31.47        | 40.00        | -8.53      | QP     |
| 92.462  | 46.93             | 9.40           | 0.23       | 26.59         | 29.97        | 43.50        | -13.53     | QP     |
| 123.266 | 39.96             | 11.87          | 0.32       | 26.50         | 25.65        | 43.50        | -17.85     | QP     |
| 222.170 | 43.94             | 9.06           | 0.75       | 26.06         | 27.69        | 46.00        | -18.31     | QP     |
| 296.184 | 40.20             | 12.60          | 0.98       | 25.83         | 27.95        | 46.00        | -18.05     | QP     |
| 392.095 | 42.11             | 15.70          | 1.20       | 26.43         | 32.58        | 46.00        | -13.42     | QP     |



1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss (dB) | Preamp factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|------------------------|-----------------|--------------------|----------------------|-------------------------|----------------|----------------------|
| 4882.00         | 31.57                  | 8.63            | 49.30              | 60.69                | 51.59                   | 74.00          | V                    |
| 7323.00         | 36.50                  | 12.23           | 49.74              | 56.09                | 55.08                   | 74.00          | V                    |
| 9764.00         | 38.51                  | 15.70           | 49.89              | 55.37                | 59.69                   | 74.00          | V                    |
| 4882.00         | 31.57                  | 8.63            | 49.30              | 57.48                | 48.38                   | 74.00          | H                    |
| 7323.00         | 36.50                  | 12.23           | 49.74              | 57.02                | 56.01                   | 74.00          | H                    |
| 9764.00         | 38.51                  | 15.70           | 49.89              | 55.97                | 60.29                   | 74.00          | H                    |

Average Measurement:

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss (dB) | Preamp factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|------------------------|-----------------|--------------------|----------------------|-------------------------|----------------|----------------------|
| 4882.00         | 31.57                  | 8.63            | 49.30              | 53.69                | 44.59                   | 54.00          | V                    |
| 7323.00         | 36.50                  | 12.23           | 49.74              | 50.09                | 49.08                   | 54.00          | V                    |
| 9764.00         | 38.51                  | 15.70           | 49.89              | 46.37                | 50.69                   | 54.00          | V                    |
| 4882.00         | 31.57                  | 8.63            | 49.30              | 52.48                | 43.38                   | 54.00          | H                    |
| 7323.00         | 36.50                  | 12.23           | 49.74              | 50.02                | 49.01                   | 54.00          | H                    |
| 9764.00         | 38.51                  | 15.70           | 49.89              | 45.97                | 50.29                   | 54.00          | H                    |

### 7.10.1.3 Test at high Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions.Quasi-Peak Measurement

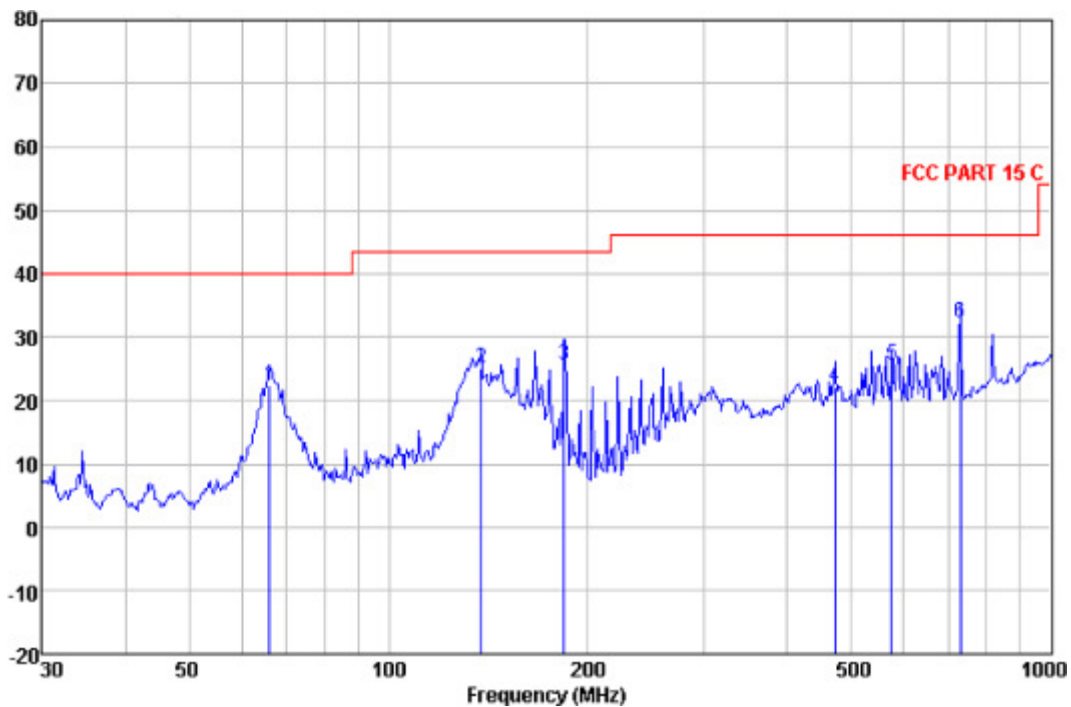
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

**Vertical:**

Peak scan

Level (dB $\mu$ V/m)



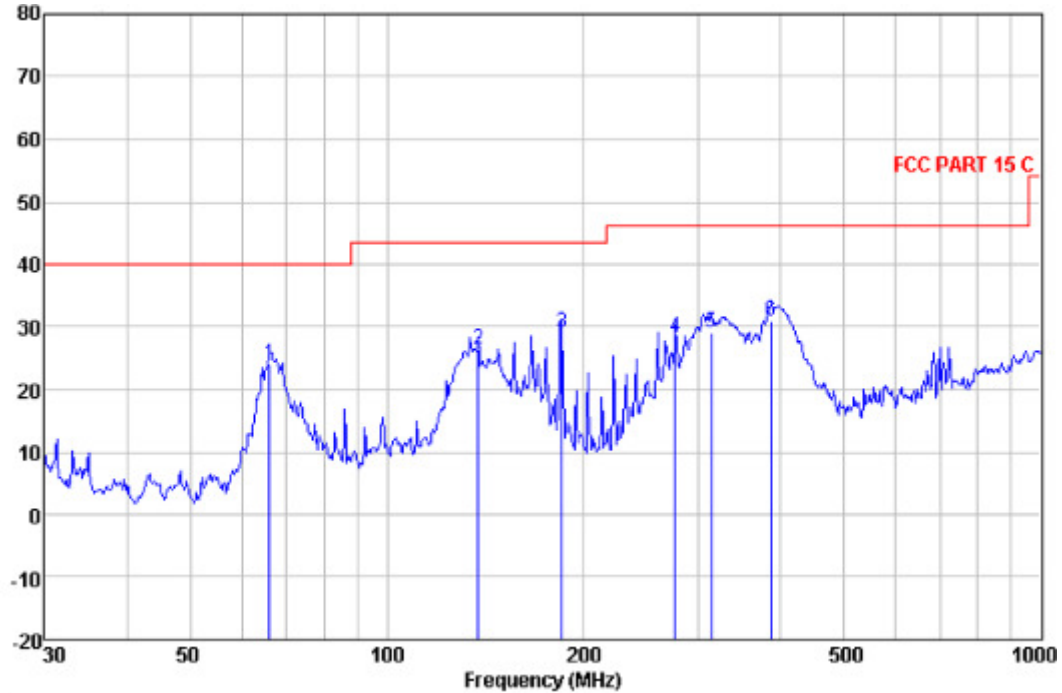
Quasi-peak measurement

| Freq    | ReadAntenna Level | Antenna Factor | Cable Loss | Preamplifier Factor | Level        | Limit Line   | Over Limit | Remark |
|---------|-------------------|----------------|------------|---------------------|--------------|--------------|------------|--------|
| MHz     | dB $\mu$ V        | dB/m           | dB         | dB                  | dB $\mu$ V/m | dB $\mu$ V/m | dB         |        |
| 66.266  | 44.47             | 4.53           | 0.17       | 26.67               | 22.50        | 40.00        | -17.50     | QP     |
| 137.903 | 39.70             | 11.22          | 0.44       | 26.41               | 24.95        | 43.50        | -18.55     | QP     |
| 183.844 | 42.95             | 8.12           | 0.68       | 26.16               | 25.59        | 43.50        | -17.91     | QP     |
| 472.176 | 30.51             | 17.13          | 1.42       | 26.94               | 22.12        | 46.00        | -23.88     | QP     |
| 574.626 | 32.98             | 18.44          | 1.48       | 27.22               | 25.68        | 46.00        | -20.32     | QP     |
| 729.358 | 37.66             | 19.70          | 1.86       | 27.08               | 32.14        | 46.00        | -13.86     | QP     |

**Horizontal:**

Peak scan

Level (dB $\mu$ V/m)



Quasi-peak measurement

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Level        | Limit        | Over   | Remark |
|---------|------------|----------------|------------|---------------|--------------|--------------|--------|--------|
| MHz     | dB $\mu$ V | dB/m           | dB         | dB            | dB $\mu$ V/m | dB $\mu$ V/m | dB     |        |
| 66.266  | 46.00      | 4.53           | 0.17       | 26.67         | 24.03        | 40.00        | -15.97 | QP     |
| 137.903 | 41.05      | 11.22          | 0.44       | 26.41         | 26.30        | 43.50        | -17.20 | QP     |
| 185.138 | 46.19      | 8.30           | 0.69       | 26.15         | 29.03        | 43.50        | -14.47 | QP     |
| 276.124 | 41.19      | 12.14          | 0.89       | 25.90         | 28.32        | 46.00        | -17.68 | QP     |
| 313.276 | 40.54      | 13.30          | 1.03       | 25.86         | 29.01        | 46.00        | -16.99 | QP     |
| 386.634 | 40.52      | 15.57          | 1.20       | 26.39         | 30.90        | 46.00        | -15.10 | QP     |





1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss (dB) | Preamp factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|------------------------|-----------------|--------------------|----------------------|-------------------------|----------------|----------------------|
| 4960.00         | 31.70                  | 8.28            | 49.30              | 58.87                | 49.55                   | 74.00          | V                    |
| 7440.00         | 36.60                  | 12.14           | 49.76              | 57.07                | 56.05                   | 74.00          | V                    |
| 9920.00         | 38.68                  | 15.10           | 49.90              | 54.15                | 58.03                   | 74.00          | V                    |
| 4960.00         | 31.70                  | 8.28            | 49.30              | 58.49                | 49.17                   | 74.00          | H                    |
| 7440.00         | 36.60                  | 12.14           | 49.76              | 56.64                | 55.62                   | 74.00          | H                    |
| 9920.00         | 38.68                  | 15.10           | 49.90              | 53.43                | 57.31                   | 74.00          | H                    |

Average Measurement:

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss (dB) | Preamp factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|------------------------|-----------------|--------------------|----------------------|-------------------------|----------------|----------------------|
| 4960.00         | 31.70                  | 8.28            | 49.30              | 52.87                | 43.55                   | 54.00          | V                    |
| 7440.00         | 36.60                  | 12.14           | 49.76              | 51.07                | 50.05                   | 54.00          | V                    |
| 9920.00         | 38.68                  | 15.10           | 49.90              | 46.15                | 50.03                   | 54.00          | V                    |
| 4960.00         | 31.70                  | 8.28            | 49.30              | 51.49                | 42.17                   | 54.00          | H                    |
| 7440.00         | 36.60                  | 12.14           | 49.76              | 48.64                | 47.62                   | 54.00          | H                    |
| 9920.00         | 38.68                  | 15.10           | 49.90              | 45.43                | 49.31                   | 54.00          | H                    |

Remark:

- 1). The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:  
Final Test Level =Receiver Reading + Antenna Factor + Cable Loss –Preamplifier Factor.
- 2). As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.
- 3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

**Test result: The unit does meet the FCC requirements.**



## 7.10.2 Radiated Emissions which fall in the restricted bands

**Test Requirement:** FCC Part15 C Section 15.247

(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

**Test Method:** ANSI C63.10: Clause 6.4, 6.5 and 6.6

**Test Status:** Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Measurement Distance:** 3m (Semi-Anechoic Chamber)

**Distance:**

**Limit:** Section 15.209(a)

40.0 dB $\mu$ V/m between 30MHz & 88MHz;

43.5 dB $\mu$ V/m between 88MHz & 216MHz;

46.0 dB $\mu$ V/m between 216MHz & 960MHz;

54.0 dB $\mu$ V/m above 960MHz.

**Detector:** For PK value:

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

For AV value:

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW = 10 Hz

Sweep = auto

Detector function = peak

Trace = max hold

**Test Result:**

**1. Low Channel**

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss(dB) | Preamp factor(dB) | Peak Reading Level (dBμV) | Average Reading Level (dBμV) | Peak Emission Level (dBμV/m) | Average Emission Level (dBμV/m) |
|-----------------|------------------------|----------------|-------------------|---------------------------|------------------------------|------------------------------|---------------------------------|
| 2310.00         | 27.93                  | 5.98           | 49.46             | 54.89                     | 51.89                        | 39.34                        | 36.34                           |
| 2390.00         | 27.61                  | 6.14           | 49.43             | 56.06                     | 52.06                        | 40.38                        | 36.38                           |
| 2483.50         | 27.55                  | 6.30           | 49.41             | 55.96                     | 52.91                        | 40.40                        | 37.35                           |
| 2500.00         | 27.55                  | 6.30           | 49.40             | 56.18                     | 52.13                        | 40.63                        | 36.58                           |

**2. Middle Channel**

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss(dB) | Preamp factor(dB) | Peak Reading Level (dBμV) | Average Reading Level (dBμV) | Peak Emission Level (dBμV/m) | Average Emission Level (dBμV/m) |
|-----------------|------------------------|----------------|-------------------|---------------------------|------------------------------|------------------------------|---------------------------------|
| 2310.00         | 27.93                  | 5.98           | 49.46             | 55.53                     | 52.53                        | 39.98                        | 36.98                           |
| 2390.00         | 27.61                  | 6.14           | 49.43             | 55.94                     | 52.94                        | 40.26                        | 37.26                           |
| 2483.50         | 27.55                  | 6.30           | 49.41             | 54.93                     | 51.93                        | 39.37                        | 36.37                           |
| 2500.00         | 27.55                  | 6.30           | 49.40             | 55.37                     | 52.37                        | 39.82                        | 36.82                           |

**3. High Channel**

| Frequency (MHz) | Antenna factors (dB/m) | Cable loss(dB) | Preamp factor(dB) | Peak Reading Level (dBμV) | Average Reading Level (dBμV) | Peak Emission Level (dBμV/m) | Average Emission Level (dBμV/m) |
|-----------------|------------------------|----------------|-------------------|---------------------------|------------------------------|------------------------------|---------------------------------|
| 2310.00         | 27.93                  | 5.98           | 49.46             | 55.15                     | 50.15                        | 39.60                        | 34.60                           |
| 2390.00         | 27.61                  | 6.14           | 49.43             | 54.73                     | 51.73                        | 39.05                        | 36.05                           |
| 2483.50         | 27.55                  | 6.30           | 49.41             | 55.57                     | 51.57                        | 40.01                        | 36.01                           |
| 2500.00         | 27.55                  | 6.30           | 49.40             | 55.50                     | 52.50                        | 39.95                        | 36.95                           |

Remark: No any other emission which falls in restricted bands can be detected and be reported.

**Test result: The unit does meet the FCC requirements.**



Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                        | MHz                   | MHz             | GHz           |
|----------------------------|-----------------------|-----------------|---------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15    |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46   |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75   |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5   |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2     |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5     |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7   |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4  |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5  |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2  |
| 8.362 - 8.366              | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4   |
| 8.37625 - 8.38675          | 156.7 - 156.9         | 2655 - 2900     | 22.01 - 23.12 |
| 8.41425 - 8.41475          | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0   |
| 12.29 - 12.293             | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8   |
| 12.51975 - 12.52025        | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5  |
| 12.57675 - 12.57725        | 322 - 335.4           | 3600 - 4400     |               |
| 13.36 - 13.41              |                       |                 |               |

### 7.11 Band Edges Requirement

**Test Requirement:** FCC Part15 C section 15.247

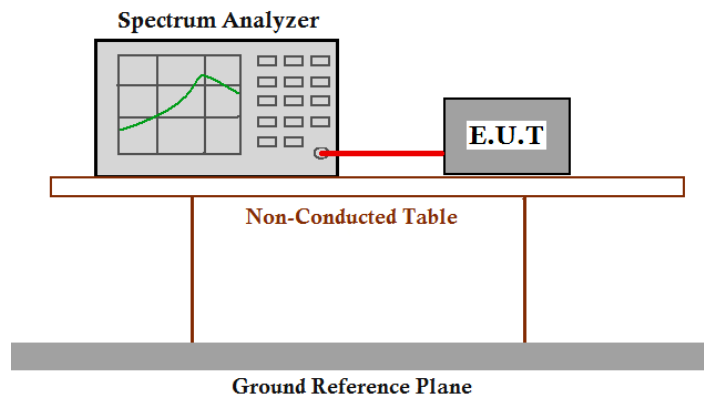
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

**Frequency Band:** 2400 MHz to 2483.5 MHz

**Test Method:** ANSI C63.10: Clause 6.9.2

**Test Status:** Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in continuous transmitting mode with normal (DH5) and EDR mode (3DH5) as the worst case was found.  
 Pre-test the EUT in AC mode and B/O mode, find worse case in AC mode.

**Test Configuration:**



**Test Procedure:** Set RBW of spectrum analyzer to 100 kHz and VBW of spectrum analyzer to 100 kHz with suitable frequency span including 100 kHz bandwidth from band edge.

The band edges was measured and recorded Result:

The Lower Edges attenuated more than 20dB.

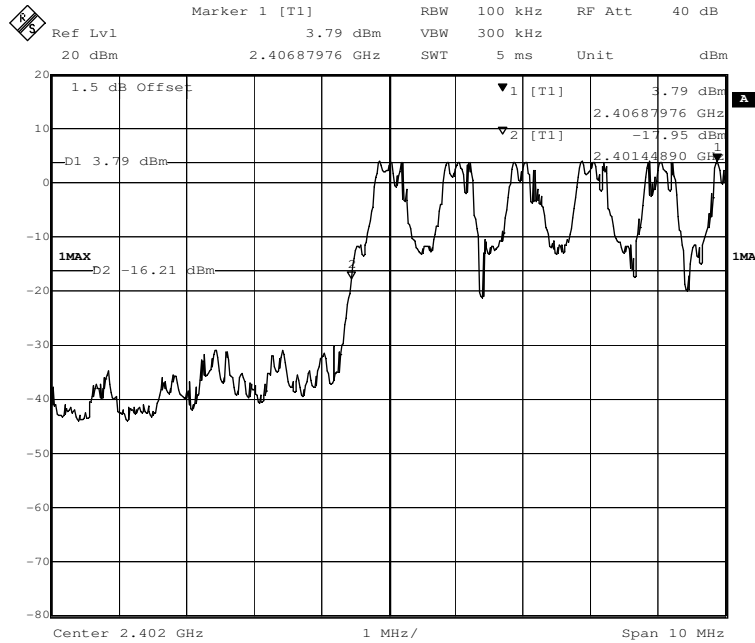
The Upper Edges attenuated more than 20dB.

The graph as below. Represents the emissions take for this device.

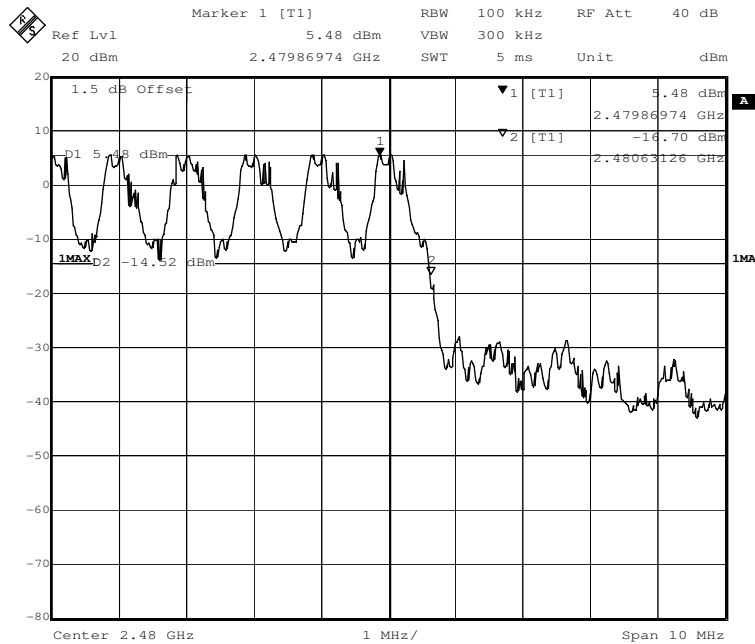
Result plot as follows:

Normal mode: DH5

Lowest channel(2.402 GHz):

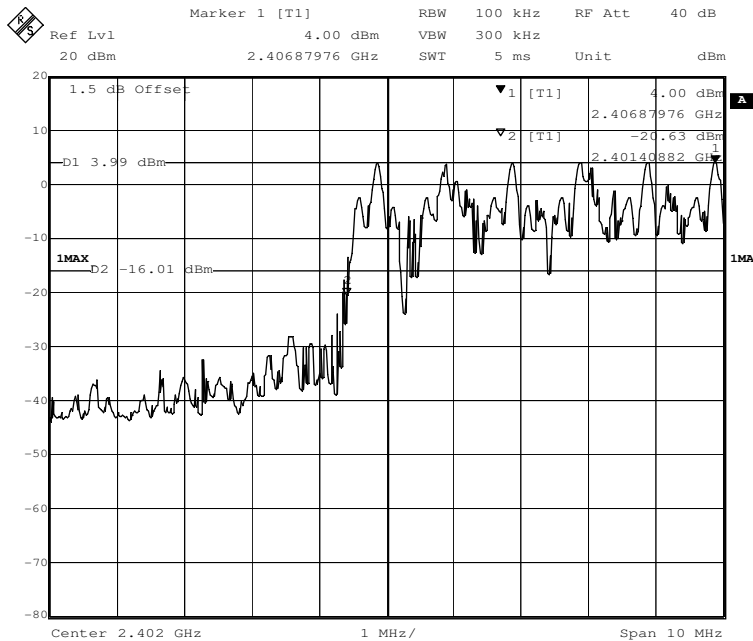


Highest Channel(2.480 GHz):

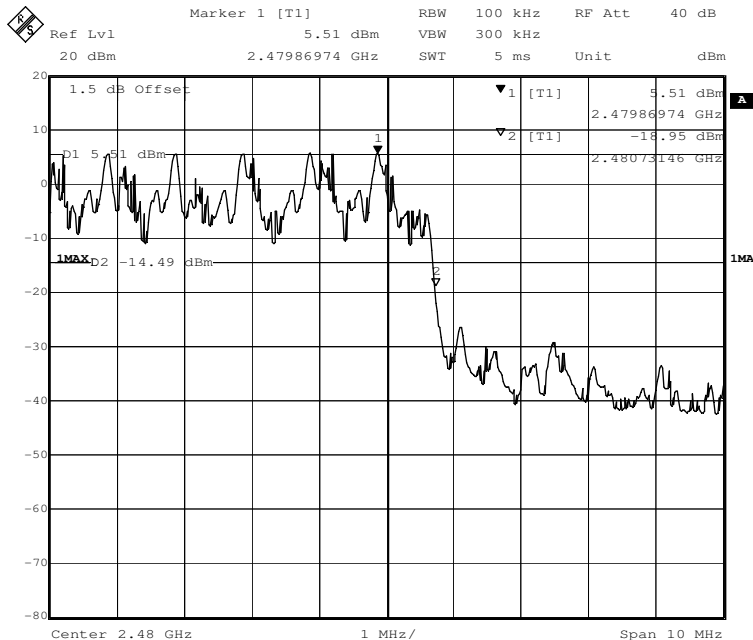


EDR mode: 3DH5

Lowest channel(2.402 GHz):



Highest Channel(2.480 GHz):



**Test result: The unit does meet the FCC requirements.**



### 7.12 Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

**Test Requirement:** FCC Part 15 C section 15.207  
**Test Method:** ANSI C63.10: Clause 6.2  
**Frequency Range:** 150 kHz to 30 MHz  
**Detector:** Peak for pre-scan (9 kHz Resolution Bandwidth)  
**Test Limit**

**Limits for conducted disturbance at the mains ports of class B**

| Frequency Range<br>(MHz) | Class B Limit dB(μV) |          |
|--------------------------|----------------------|----------|
|                          | Quasi-peak           | Average  |
| 0.15 to 0.50             | 66 to 56             | 56 to 46 |
| 0.50 to 5                | 56                   | 46       |
| 5 to 30                  | 60                   | 50       |

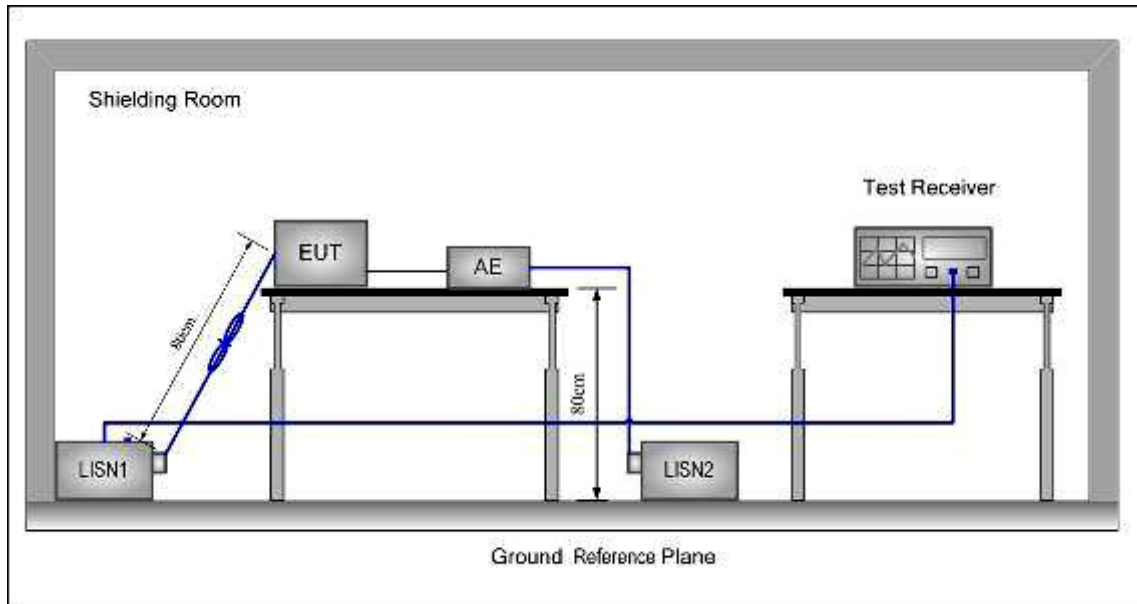
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.

**EUT Operation:** Test in normal operating mode. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).



**Test Configuration:**



**Test procedure:**

1. The mains terminal disturbance voltage test was conducted in a shielded room.
2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a  $50\Omega/50\mu\text{H} + 5\Omega$  linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.
4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.

### 7.12.1 Measurement Data

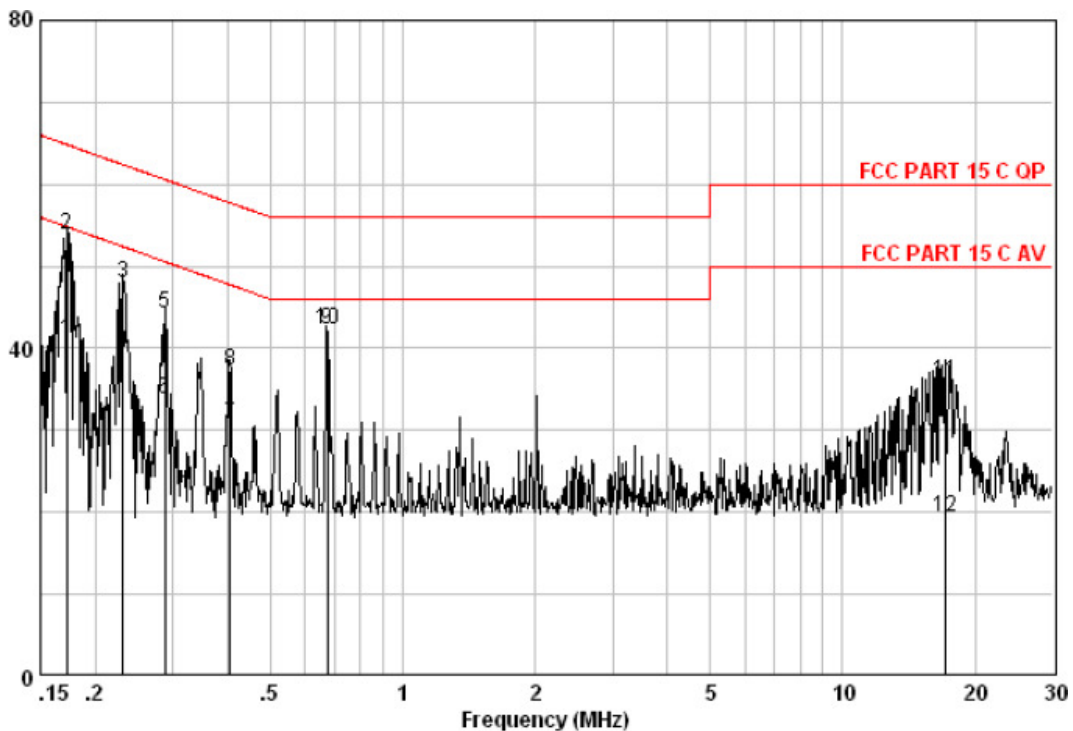
An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected. For EUT the communicating was worst case mode.

**The following Quasi-Peak and Average measurements were performed on the EUT:**

Neutral Line

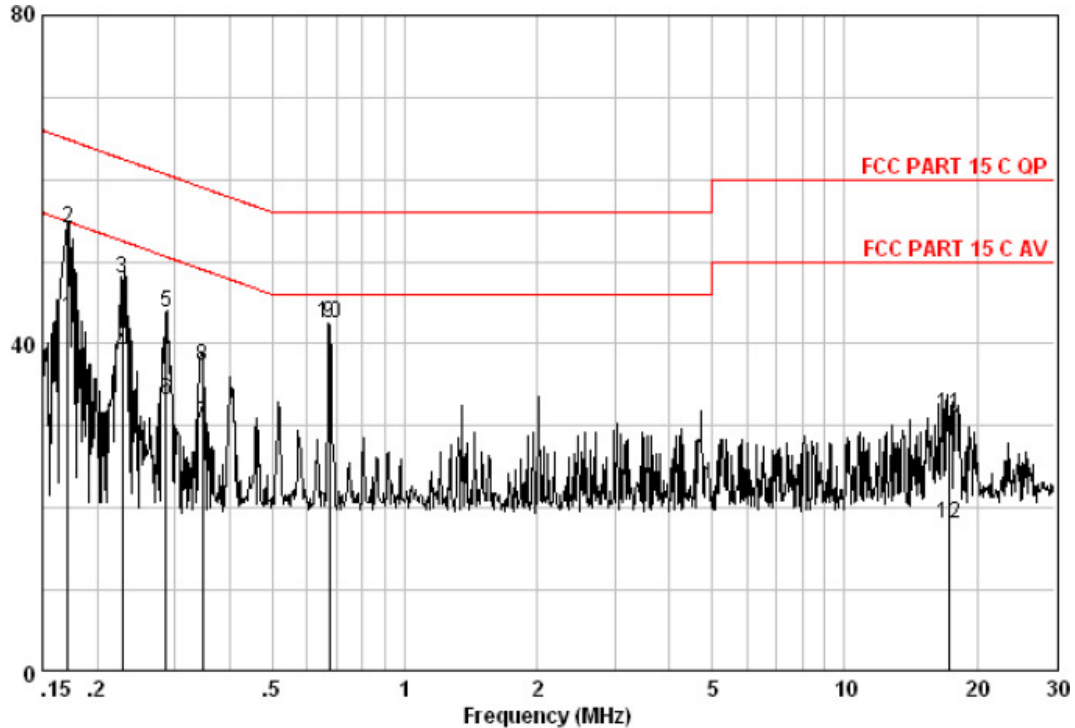
Level(dBμV)



Measure data:

| Freq   | Read Level | Cable Loss | LISN Factor | Level | Limit Line | Over Limit | Remark  |
|--------|------------|------------|-------------|-------|------------|------------|---------|
| MHz    | dBμV       | dB         | dB          | dBμV  | dBμV       | dB         |         |
| 0.172  | 31.31      | 0.09       | 9.51        | 40.92 | 54.86      | -13.94     | AVERAGE |
| 0.172  | 44.26      | 0.09       | 9.51        | 53.87 | 64.86      | -10.99     | QP      |
| 0.232  | 38.32      | 0.11       | 9.52        | 47.96 | 62.39      | -14.44     | QP      |
| 0.232  | 29.92      | 0.11       | 9.52        | 39.56 | 52.39      | -12.84     | AVERAGE |
| 0.288  | 34.56      | 0.10       | 9.53        | 44.19 | 60.59      | -16.40     | QP      |
| 0.288  | 24.25      | 0.10       | 9.53        | 33.88 | 50.59      | -16.71     | AVERAGE |
| 0.404  | 21.03      | 0.06       | 9.56        | 30.65 | 47.77      | -17.12     | AVERAGE |
| 0.404  | 27.74      | 0.06       | 9.56        | 37.36 | 57.77      | -20.41     | QP      |
| 0.673  | 32.66      | 0.06       | 9.58        | 42.30 | 46.00      | -3.70      | AVERAGE |
| 0.673  | 32.72      | 0.06       | 9.58        | 42.36 | 56.00      | -13.64     | QP      |
| 17.109 | 25.58      | 0.38       | 10.11       | 36.07 | 60.00      | -23.93     | QP      |
| 17.109 | 8.89       | 0.38       | 10.11       | 19.38 | 50.00      | -30.62     | AVERAGE |

Live Line  
 Level(dBμV)



Measure result:

| Freq   | Read Level | Cable Loss | LISN Factor | Level | Limit Line | Over Limit | Remark  |
|--------|------------|------------|-------------|-------|------------|------------|---------|
| MHz    | dBμV       | dB         | dB          | dBμV  | dBμV       | dB         |         |
| 0.172  | 33.51      | 0.09       | 9.49        | 43.09 | 54.88      | -11.79     | AVERAGE |
| 0.172  | 44.54      | 0.09       | 9.49        | 54.12 | 64.88      | -10.76     | QP      |
| 0.228  | 38.32      | 0.11       | 9.51        | 47.94 | 62.53      | -14.59     | QP      |
| 0.228  | 29.17      | 0.11       | 9.51        | 38.79 | 52.53      | -13.74     | AVERAGE |
| 0.287  | 34.10      | 0.10       | 9.51        | 43.71 | 60.62      | -16.91     | QP      |
| 0.287  | 23.60      | 0.10       | 9.51        | 33.21 | 50.62      | -17.41     | AVERAGE |
| 0.346  | 20.78      | 0.08       | 9.53        | 30.39 | 49.05      | -18.66     | AVERAGE |
| 0.346  | 27.76      | 0.08       | 9.53        | 37.37 | 59.05      | -21.68     | QP      |
| 0.673  | 32.82      | 0.06       | 9.54        | 42.43 | 46.00      | -3.57      | AVERAGE |
| 0.673  | 32.84      | 0.06       | 9.54        | 42.45 | 56.00      | -13.55     | QP      |
| 17.232 | 21.30      | 0.38       | 9.77        | 31.45 | 60.00      | -28.55     | QP      |
| 17.232 | 7.93       | 0.38       | 9.77        | 18.08 | 50.00      | -31.92     | AVERAGE |

--End of Report--