# MEASUREMENT REPORT
## FCC PART 15.247 Bluetooth

| | |
|---|---|
| **FCC ID:** | 2AEY7-S8A002 |
| **APPLICANT:** | Bak USB Technologies Corp. |
| **Application Type:** | Certification |
| **Product:** | MID |
| **Model No.:** | Seal 8 pro |
| **FCC Classification:** | FCC Part 15 Spread Spectrum Transmitter(DSS) |
| **FCC Rule Part(s):** | Part 15.247 |
| **Test Procedure(s):** | ANSI C63.10-2013, DA 00-705 |
| **Test Date:** | November 08, 2016 ~ March 25, 2017 |

Reviewed By Manager : Robin Wu
( Robin Wu )

Approved By CEO : Marlinchen
( Marlin Chen )

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and DA 00-705. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

# Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 1611RSU01004 | Rev. 01 | Initial report | 03-26-2017 | Valid |
| | | | | |

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## §2.1033 General Information

| | |
|---|---|
| **Applicant:** | Bak USB Technologies Corp. |
| **Applicant Address:** | 425 Michigan Avenue, Buffalo, NY 14203, USA |
| **Manufacturer:** | Shenzhen Wisky Technology Co., LTD. |
| **Manufacturer Address:** | 5th Floor, W2-A Building, Hi-tech Park South 1st Road, Nanshan District, Shenzhen, China |
| **Test Site:** | MRT Technology (Suzhou) Co., Ltd |
| **Test Site Address:** | D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China |
| **MRT Registration No.:** | 809388 |
| **FCC Rule Part(s):** | Part 15.247 |
| **Model No.** | Seal 8 pro |
| **FCC ID:** | 2AEY7-S8A002 |
| **Test Device Serial No.:** | N/A ☐ Production ☒ Pre-Production ☐ Engineering |
| **FCC Classification:** | Spread Spectrum Transmitter(DSS) |

### Test Facility / Accreditations

**Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.**

- **MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.**

Accredited Laboratory
A2LA has accredited
MRT TECHNOLOGY (SUZHOU) CO., LTD.
Suzhou, Jiangsu, People's Republic of China
for technical competence in the field of
Electrical Testing
This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated 8 January 2009).
Senior Director of Quality and Communications
On the Accreditation Council
Certificate Number 3628.01
Valid to August 31, 2018
For the scope of accreditation details, please refer to the laboratory's Electronic Scope of Accreditation.

# 1. INTRODUCTION

## 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

## 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.

# 2. PRODUCT INFORMATION

## 2.1. Equipment Description

| | |
|---|---|
| Product Name | MID |
| FCC ID | 2AEY7-S8A002 |
| Model No. | Seal 8 pro |
| LTE Specification | LTE Band 2 / 4 / 5 / 13 / 17 |
| Wi-Fi Specification | 802.11a//b/g/n/ac |
| Bluetooth Version | v4.0 dual mode |
| NFC | 13.56MHz |
| RF ID | 920.25 ~ 924.75MHz |
| **Components** | |
| Adapter | M/N: BCT050500-C02U<br>INPUT: 100-240V ~ 50/60Hz, 0.6A Max<br>OUTPUT: 5Vdc, 5.0A |

## 2.2. Product Specification Subjective to this Standard

| | |
|---|---|
| Operating Frequency | 2402~2480MHz |
| Type of modulation | FHSS |
| Data Rate | 1Mbps(GFSK), 2Mbps(Pi/4 DQPSK), 3Mbps (8DPSK) |
| Antenna Type | PIFA Antenna |
| Antenna Gain | 3.21dBi |

The equipment under test (EUT) is the **MID**. The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

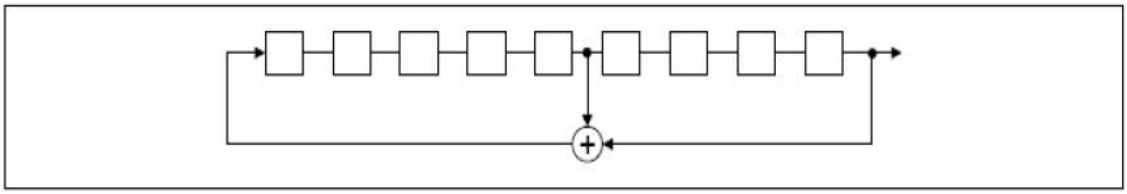
## 2.3. Operation Frequency / Channel List

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 00 | 2402 MHz | 01 | 2403 MHz | 02 | 2404 MHz |
| 03 | 2405 MHz | 04 | 2406 MHz | 05 | 2407 MHz |
| 06 | 2408 MHz | 07 | 2409 MHz | 08 | 2410 MHz |
| 09 | 2411 MHz | 10 | 2412 MHz | 11 | 2413 MHz |
| 12 | 2414 MHz | 13 | 2415 MHz | 14 | 2416 MHz |
| 15 | 2417 MHz | 16 | 2418 MHz | 17 | 2419 MHz |
| 18 | 2420 MHz | 19 | 2421 MHz | 20 | 2422 MHz |
| 21 | 2423 MHz | 22 | 2424 MHz | 23 | 2425 MHz |
| 24 | 2426 MHz | 25 | 2427 MHz | 26 | 2428 MHz |
| 27 | 2429 MHz | 28 | 2430 MHz | 29 | 2431 MHz |
| 30 | 2432 MHz | 31 | 2433 MHz | 32 | 2434 MHz |
| 33 | 2435 MHz | 34 | 2436 MHz | 35 | 2437 MHz |
| 36 | 2438 MHz | 37 | 2439 MHz | 38 | 2440 MHz |
| 39 | 2441 MHz | 40 | 2442 MHz | 41 | 2443 MHz |
| 42 | 2444 MHz | 43 | 2445 MHz | 44 | 2446 MHz |
| 45 | 2447 MHz | 46 | 2448 MHz | 47 | 2449 MHz |
| 48 | 2450 MHz | 49 | 2451 MHz | 50 | 2452 MHz |
| 51 | 2453 MHz | 52 | 2454 MHz | 53 | 2455 MHz |
| 54 | 2456 MHz | 55 | 2457 MHz | 56 | 2458 MHz |
| 57 | 2459 MHz | 58 | 2460 MHz | 59 | 2461 MHz |
| 60 | 2462 MHz | 61 | 2463 MHz | 62 | 2464 MHz |
| 63 | 2465 MHz | 64 | 2466 MHz | 65 | 2467 MHz |
| 66 | 2468 MHz | 67 | 2469 MHz | 68 | 2470 MHz |
| 69 | 2471 MHz | 70 | 2472 MHz | 71 | 2473 MHz |
| 72 | 2474 MHz | 73 | 2475 MHz | 74 | 2476 MHz |
| 75 | 2477 MHz | 76 | 2478 MHz | 77 | 2479 MHz |
| 78 | 2480 MHz | N/A | N/A | N/A | N/A |

## 2.4. Pseudorandom Frequency Hopping Sequence

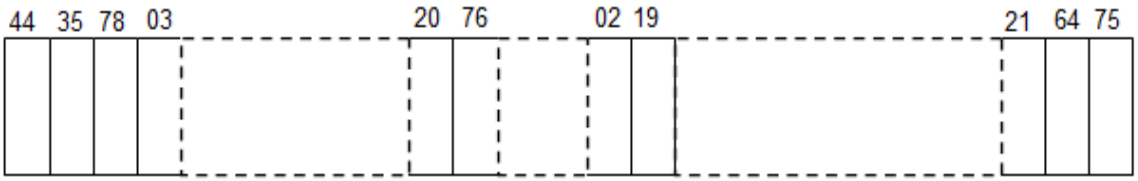
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized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

## 2.5. Device Capabilities

5GHz WLAN (UNII), 2.4GHz WLAN (DTS), Bluetooth (v4.0 Dual mode), LTE (FDD), RF ID, NFC

## 2.6. Test Configuration

The **MID** was tested per the guidance of ANSI C63.10-2013 and DA 00-705. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

## 2.7. Test Software

The test utility software used during testing was engineering directive order by applicant.

## 2.8. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.9. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

# 3. DESCRIPTION of TEST

## 3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” (DA 00-705) were used in the measurement of the **MID.**
**Deviation from measurement procedure…….....None**

## 3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.
The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.
Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions were used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.
An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.
Line conducted emissions test results are shown in Section 7.11.

## 3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. An MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

# 4. ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the **MID** is **permanently attached.**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The **MID** unit complies with the requirement of §15.203.

# 5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

| Instrument | Manufacturer | Type No. | Serial No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | 102030 | 1 year | 2017/05/08 |
| Two-Line V-Network | R&S | ENV216 | 101683 | 1 year | 2017/06/21 |
| Two-Line V-Network | R&S | ENV216 | 101684 | 1 year | 2017/06/21 |
| Temperature/Humidity Meter | Yuhuaze | HTC-2 | N/A | 1 year | 2017/12/22 |
| Shielding Anechoic Chamber | MIX-BEP | Chamber-SR2 | N/A | 1 year | 2017/05/10 |

Radiated Emissions - AC2

| Instrument | Manufacturer | Type No. | Serial No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| MXE EMI Receiver | Agilent | N9038A | MY51210182 | 1 year | 2017/08/03 |
| Broadband Coaxial Preamplifier | Schwarzbeck | BBV 9718 | MY52090106 | 1 year | 2017/12/10 |
| Preamplifier | Schwarzbeck | BBV 9721 | 9721-008 | 1 year | 2017/04/16 |
| Loop Antenna | Schwarzbeck | FMZB1519 | 100982 | 1 year | 2017/12/21 |
| TRILOG Antenna | Schwarzbeck | VULB9162 | 9162-047 | 1 year | 2017/10/22 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | 1457 | 1 year | 2017/11/19 |
| Broadband Horn Antenna | Schwarzbeck | BBHA9170 | BBHA9170549 | 1 year | 2018/01/04 |
| Digitial Thermometer & Hygrometer | Minggao | ETH529 | N/A | 1 year | 2017/11/30 |
| Anechoic Chamber | RIKEN | Chamber-AC2 | N/A | 1 year | 2017/05/10 |

Conducted Test Equipment - TR3

| Instrument | Manufacturer | Type No. | Serial No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY52090106 | 1 year | 2017/05/08 |
| USB wideband power sensor | Boonton | 55006 | 8911 | 1 year | 2017/05/08 |
| Temperature/Humidity Meter | Yuhuaze | HTC-2 | N/A | 1 year | 2017/12/22 |

| **Software** | **Version** | **Function** |
|---|---|---|
| e3 | V 8.3.5 | EMI Test Software |

# 6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

| AC Conducted Emission Measurement – SR2 |
|---|
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>150kHz~30MHz: 3.46dB |
| **Radiated Emission Measurement – AC2** |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>9kHz ~ 1GHz: 4.18dB<br>1GHz ~ 25GHz: 4.76dB |

# 7. TEST RESULT

## 7.1. Summary

**Company Name:** **Bak USB Technologies Corp.**
**FCC ID:** **2AEY7-S8A002**
**Method/System:** **Frequency Hopping Spread Spectrum (FHSS)**
**Number of Channels:** **79**

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 15.247(a)(1) | 20dB Bandwidth | N/A | Conducted | PASS | Section 7.2 |
| 15.247(b)(1) | Peak Transmitter Output Power | <1 Watt if > 75 non-overlapping channels used | | PASS | Section 7.3 |
| 15.247(a)(1) | Channel Separation | > 2/3 of 20 dB BW for systems with Output Power < 125mW | | PASS | Section 7.4 |
| 15.247(a)(1)(iii) | Number of Channels | > 15 Channels | | PASS | Section 7.5 |
| 15.247(a)(1)(iii) | Time of Occupancy | < 0.4 sec in 31.6 sec period | | PASS | Section 7.6 |
| 15.247(d) | Band Edge / out- of-Band Emissions | Conducted ≥ 20dBc | | PASS | Section 7.7<br>Section 7.8 |
| 15.205, 15.209 | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | Radiated | PASS | Section 7.9<br>Section 7.10 |
| 15.207 | AC Conducted Emissions 150kHz - 30MHz | < FCC 15.207 limits | Line Conducted | Pass | Section 7.11 |

**Notes:**

1) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

## 7.2. 20dB Bandwidth Measurement

### 7.2.1. Test Limit

N/A

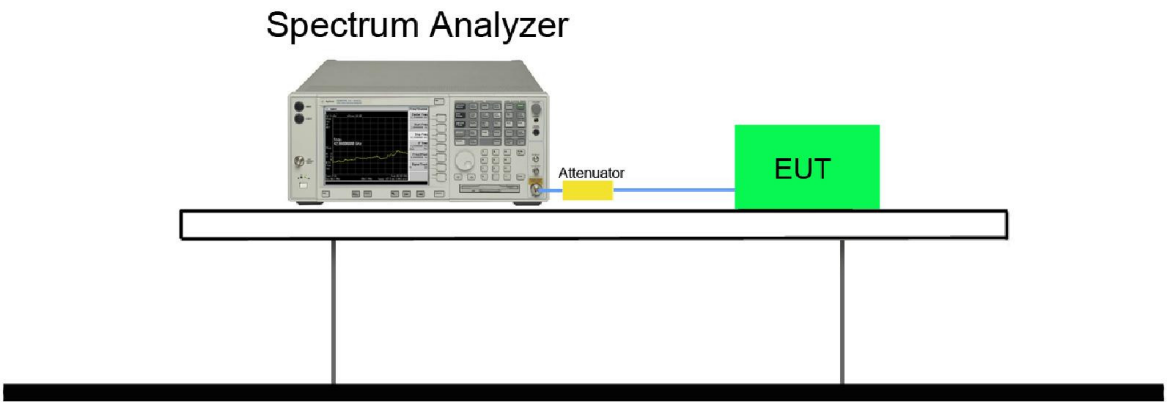
### 7.2.2. Test Procedure used

ANSI C63.10-2013 - Section 6.9.2

### 7.2.3. Test Setting

1. Set RBW ≥ 1% of the 20dB bandwidth
2. VBW ≥ 3 × RBW
3. Span = approximately 2 to 5 times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

### 7.2.4. Test Setup

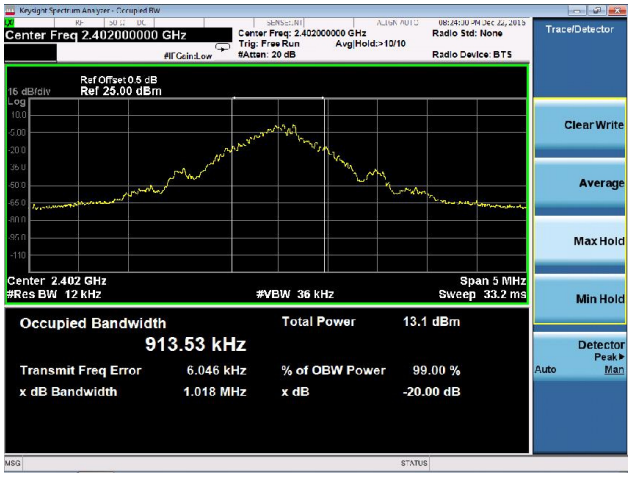


### 7.2.5. Test Result

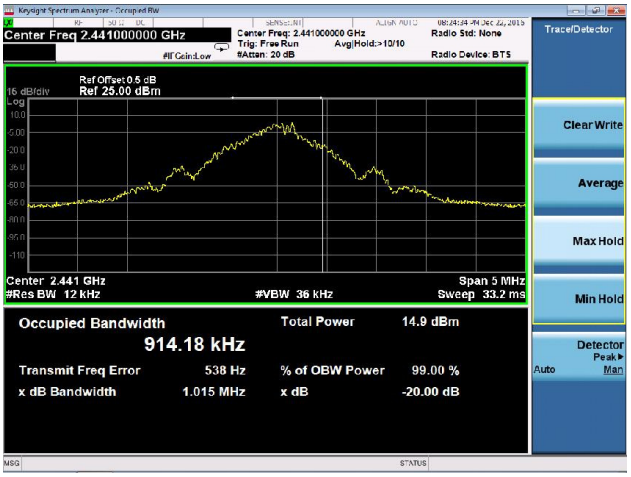
| Test Mode | Channel No. | Frequency (MHz) | 20dB Bandwidth (kHz) | Result |
|---|---|---|---|---|
| DH5 | 00 | 2402 | 1.018 | Pass |
| DH5 | 39 | 2441 | 1.015 | Pass |
| DH5 | 78 | 2480 | 0.951 | Pass |
| 2DH5 | 00 | 2402 | 1.336 | Pass |
| 2DH5 | 39 | 2441 | 1.336 | Pass |
| 2DH5 | 78 | 2480 | 1.334 | Pass |
| 3DH5 | 00 | 2402 | 1.275 | Pass |
| 3DH5 | 39 | 2441 | 1.333 | Pass |
| 3DH5 | 78 | 2480 | 1.275 | Pass |

**DH5 20dB Bandwidth**

**Channel 00 (2402MHz)**




**Channel 39 (2441MHz)**



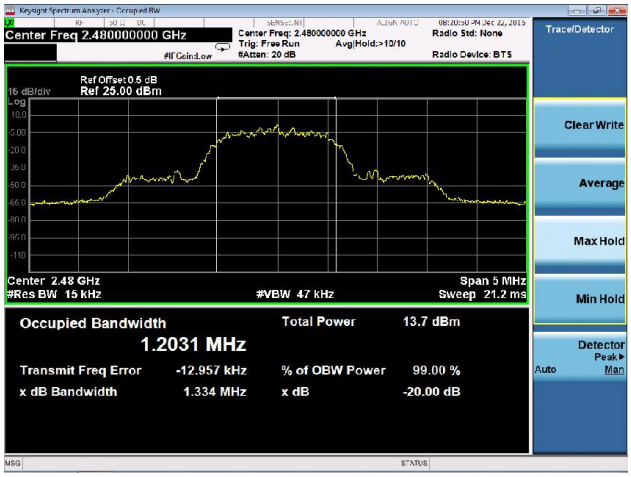

**Channel 78 (2480MHz)**

## 2DH5 20dB Bandwidth

### Channel 00 (2402MHz)

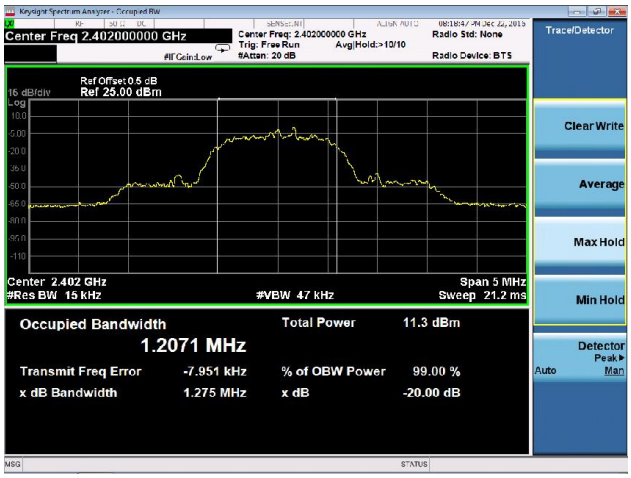
### Channel 39 (2441MHz)

### Channel 78 (2480MHz)

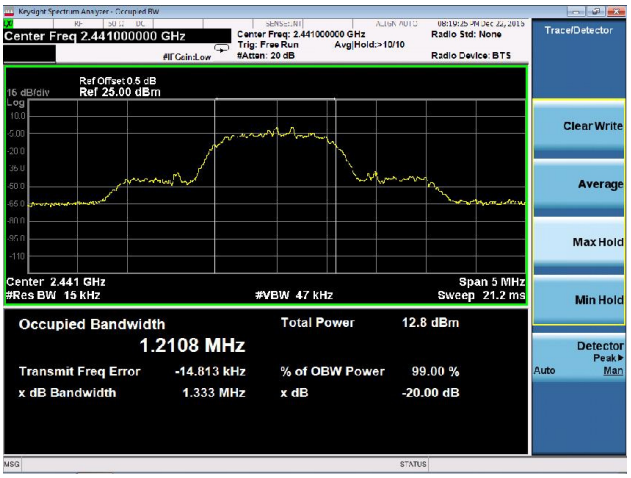


## 3DH5 20dB Bandwidth

### Channel 00 (2402MHz)




### Channel 39 (2441MHz)




### Channel 78 (2480MHz)

## 7.3. Output Power Measurement

### 7.3.1. Test Limit

The maximum out power permissible output power is 1 Watt for all other frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels.

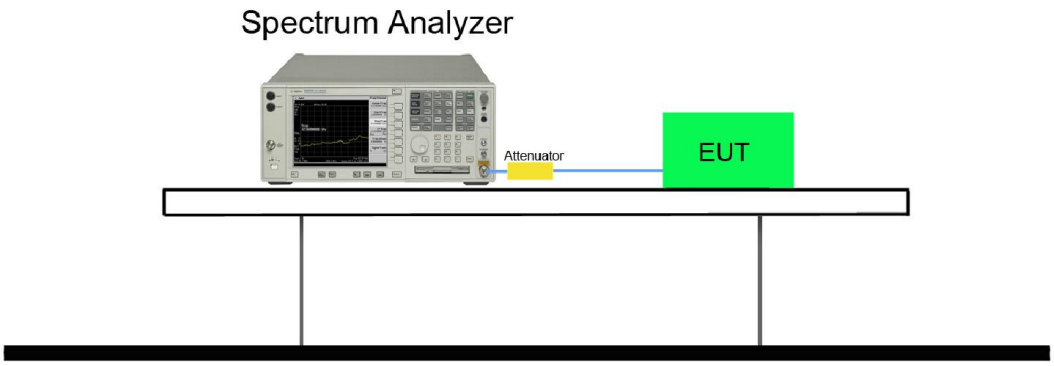
### 7.3.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.5

### 7.3.3. Test Setting

1. Set RBW ≥ the 20 dB bandwidth of the emission being measured.
2. VBW ≥ 3 × RBW
3. Span = approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (don't forget added the external attenuation and cable loss)

### 7.3.4. Test Setup



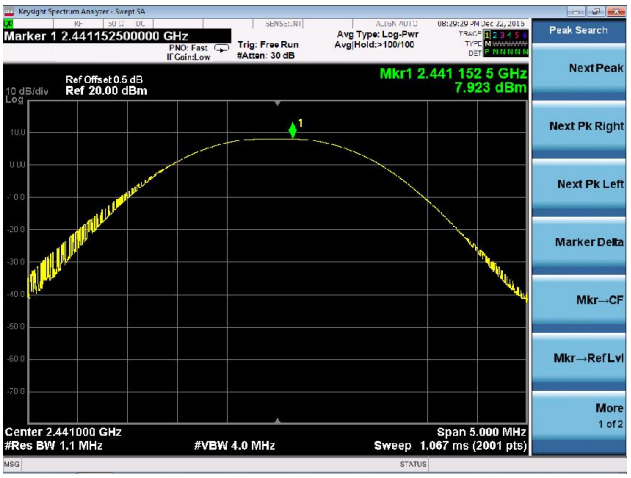
### 7.3.5. Test Result

| Test Mode | Channel No. | Frequency (MHz) | Peak Power (dBm) | Peak Power Limit (dBm) |
|---|---|---|---|---|
| DH5 | 00 | 2402 | 6.04 | < 30 |
| DH5 | 39 | 2441 | 7.92 | < 30 |
| DH5 | 78 | 2480 | 8.92 | < 30 |
| 2DH5 | 00 | 2402 | 5.59 | < 30 |
| 2DH5 | 39 | 2441 | 7.22 | < 30 |
| 2DH5 | 78 | 2480 | 8.07 | < 30 |
| 3DH5 | 00 | 2402 | 5.91 | < 30 |
| 3DH5 | 39 | 2441 | 7.49 | < 30 |
| 3DH5 | 78 | 2480 | 8.35 | < 30 |

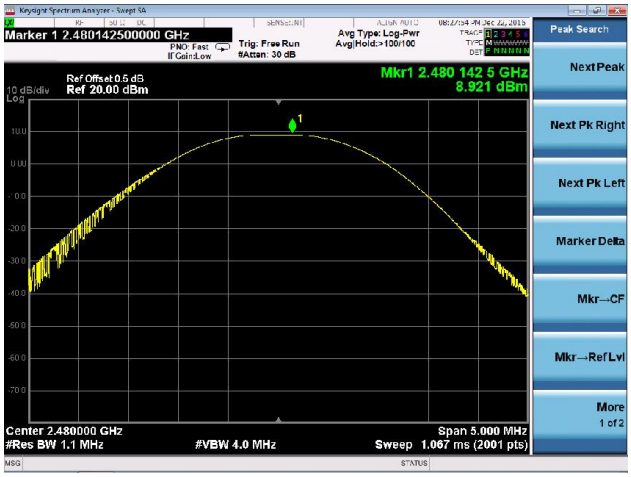
## DH5 Output Power

### Channel 00 (2402MHz)

### Channel 39 (2441MHz)




### Channel 78 (2480MHz)

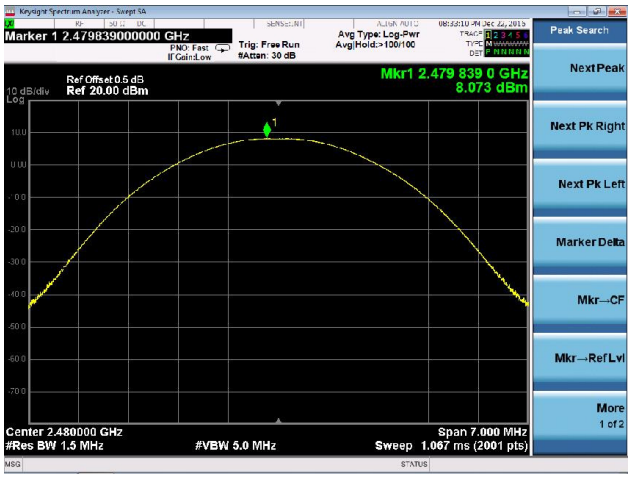


## 2DH5 Output Power

### Channel 00 (2402MHz)

### Channel 39 (2441MHz)

### Channel 78 (2480MHz)



## 3DH5 Output Power

### Channel 00 (2402MHz)

### Channel 39 (2441MHz)

### Channel 78 (2480MHz)

## 7.4. Carrier Frequency Separation Measurement

### 7.4.1. Test Limit

The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.

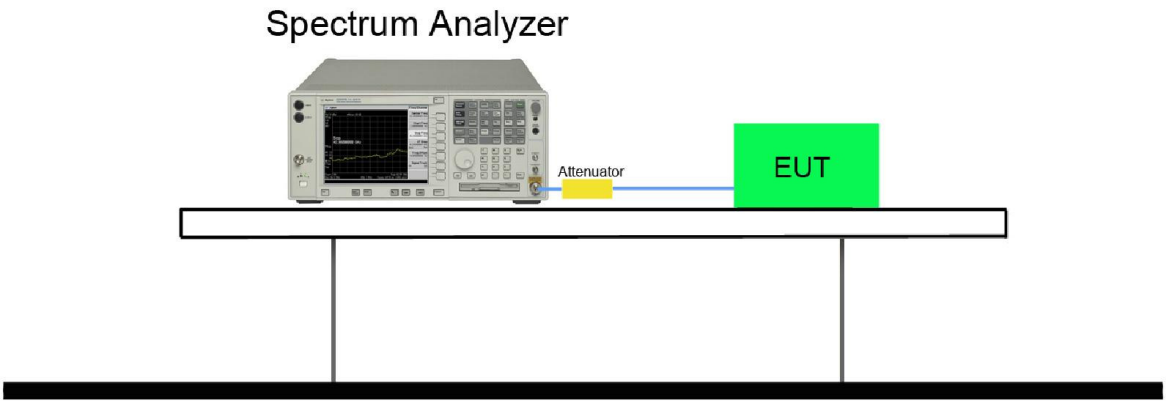
### 7.4.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.2

### 7.4.3. Test Setting

1. Span = wide enough to capture the peaks of two adjacent channels.
2. RBW ≥ 1 % of the span
3. VBW ≥ RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

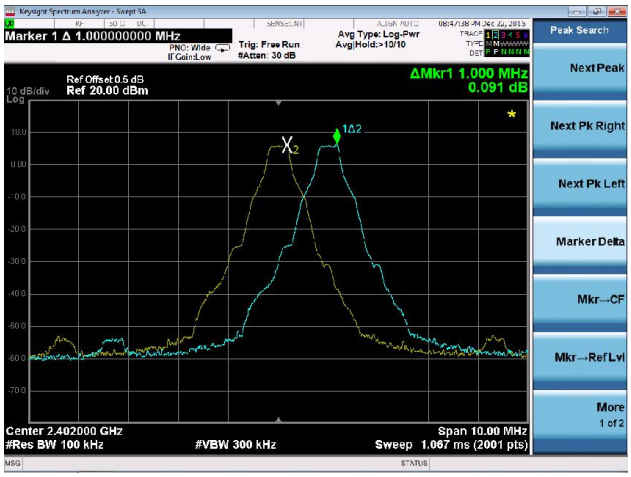
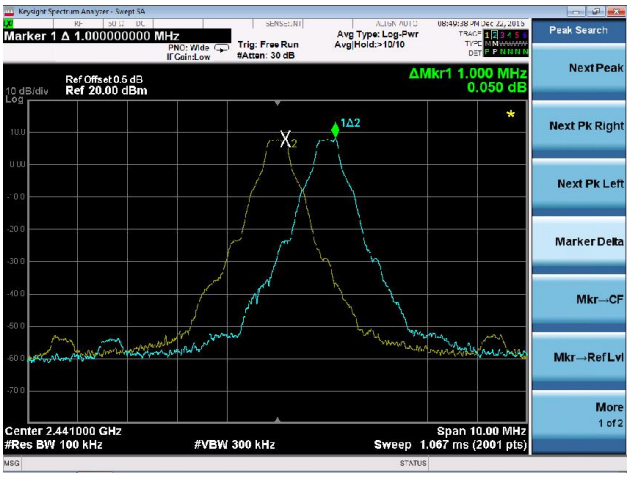
### 7.4.4. Test Setup

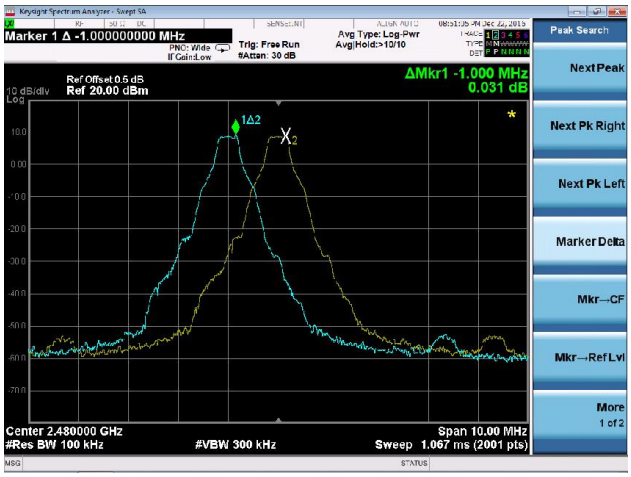


### 7.4.5. Test Result

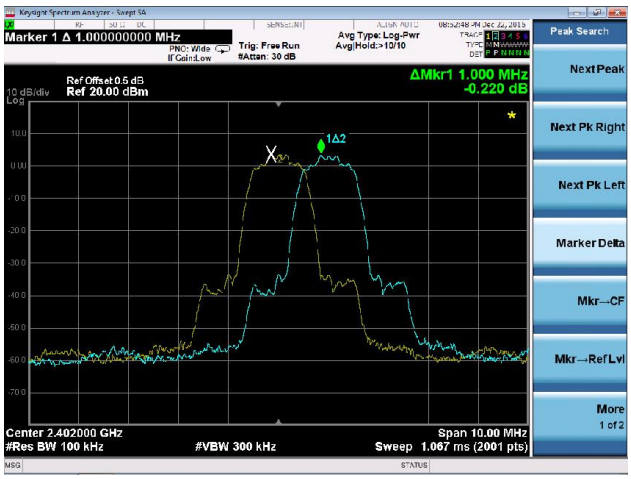
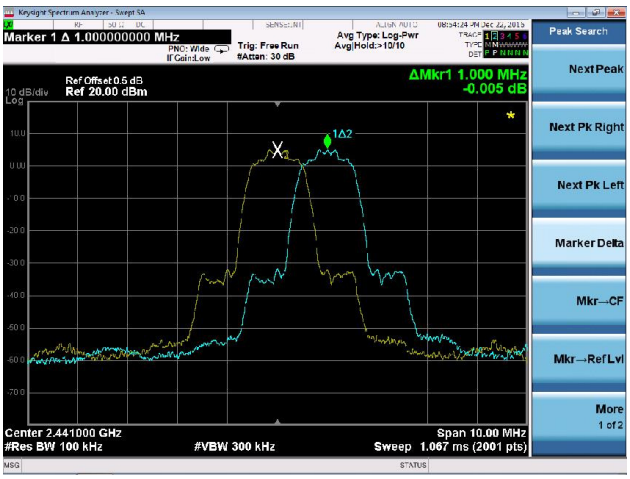
| Test Mode | Channel No. | Frequency (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| DH5 | 00 | 2402 | ≥ 678.67 | Pass |
| DH5 | 39 | 2441 | ≥ 676.67 | Pass |
| DH5 | 78 | 2480 | ≥ 634.00 | Pass |
| 2DH5 | 00 | 2402 | ≥ 890.67 | Pass |
| 2DH5 | 39 | 2441 | ≥ 890.67 | Pass |
| 2DH5 | 78 | 2480 | ≥ 889.33 | Pass |
| 3DH5 | 00 | 2402 | ≥ 850.00 | Pass |
| 3DH5 | 39 | 2441 | ≥ 888.67 | Pass |
| 3DH5 | 78 | 2480 | ≥ 850.00 | Pass |

Note: The Limit is 2/3 the value of the 20dB BW.

| DH5 Carrier Frequency Separation | |
|---|---|
| **Channel 00 (2402MHz)** | **Channel 39 (2441MHz)** |
|  |  |

| Channel 78 (2480MHz) | |
|---|---|
|  | |

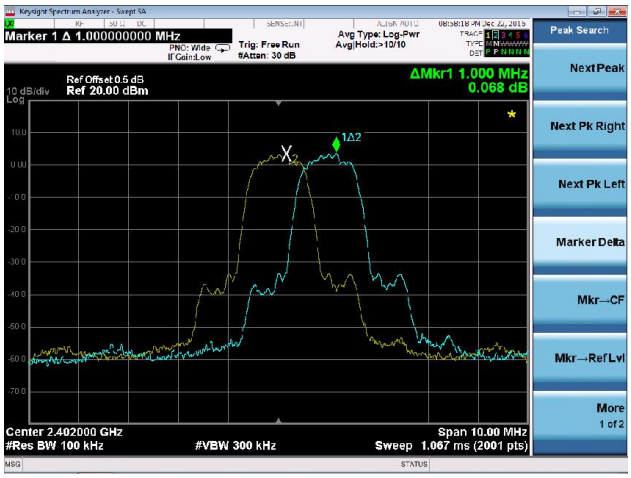
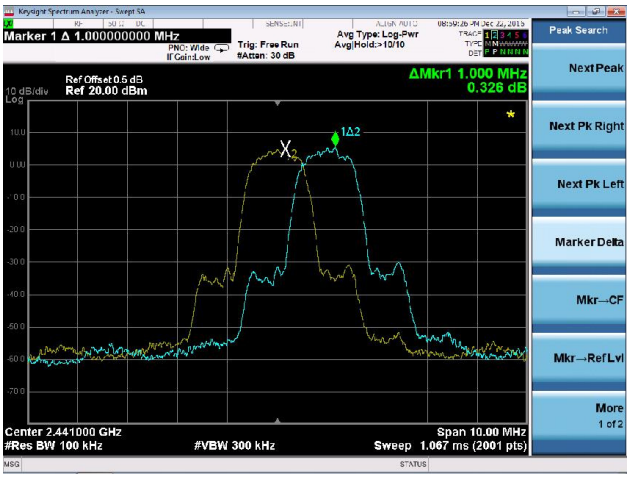
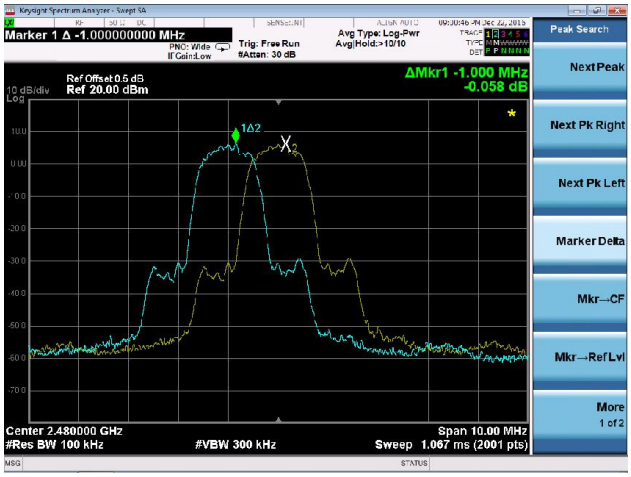


| 2DH5 Carrier Frequency Separation | |
|---|---|
| Channel 00 (2402MHz) | Channel 39 (2441MHz) |
|  |  |





| Channel 78 (2480MHz) | |
|---|---|
| | |

| 3DH5 Carrier Frequency Separation | |
|---|---|
| **Channel 00 (2402MHz)** | **Channel 39 (2441MHz)** |
|   |   |
| **Channel 78 (2480MHz)** | |
|   | |

## 7.5. Number of Hopping Channels Measurement

### 7.5.1. Test Limit

This frequency hopping system must employ a minimum of 15 hopping channels.

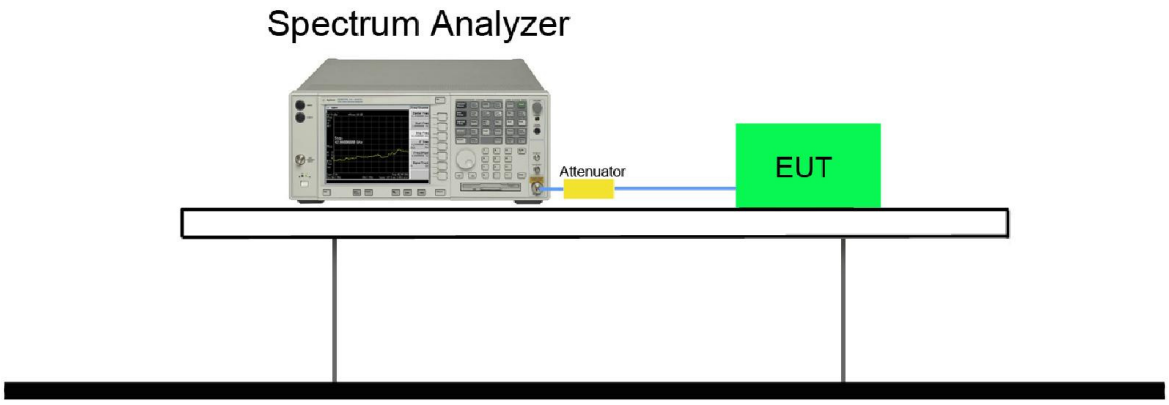
### 7.5.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.3

### 7.5.3. Test Settitng

1. Span = the frequency band of operation.
2. RBW ≥ 1 % of the span
3. VBW ≥ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

### 7.5.4. Test Setup

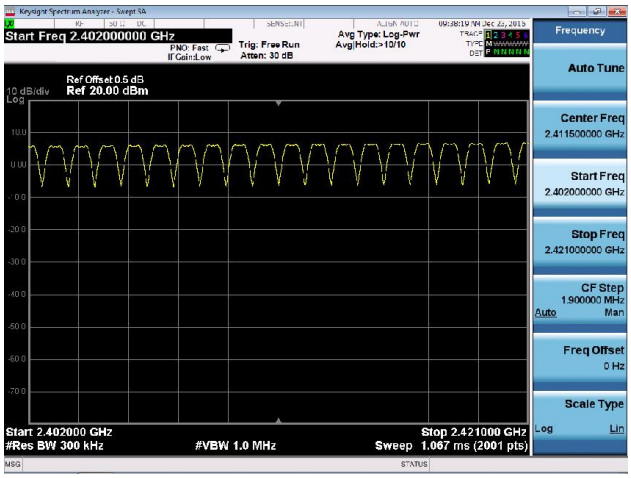


### 7.5.5. Test Result

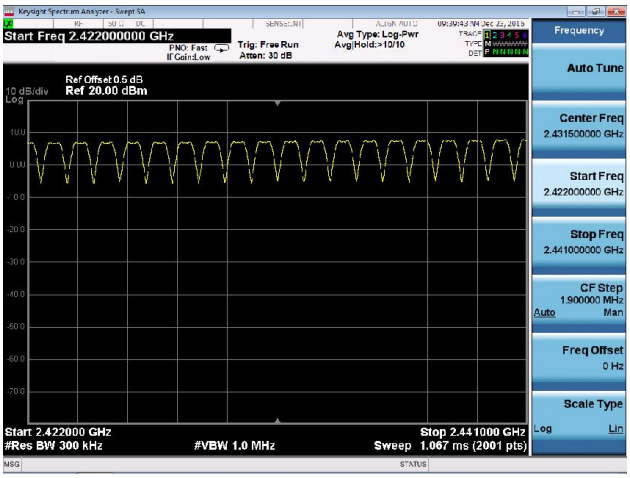
| Test Mode (Hopping) | Channel Numbers | Frequency (MHz) | Limit (Hopping Channels) | Result |
|---|---|---|---|---|
| DH5 | 79 | 2402~2480 | ≥ 15 | Pass |
| 2DH5 | 79 | 2402~2480 | ≥ 15 | Pass |
| 3DH5 | 79 | 2402~2480 | ≥ 15 | Pass |

**DH5 Number of Hopping Channels**

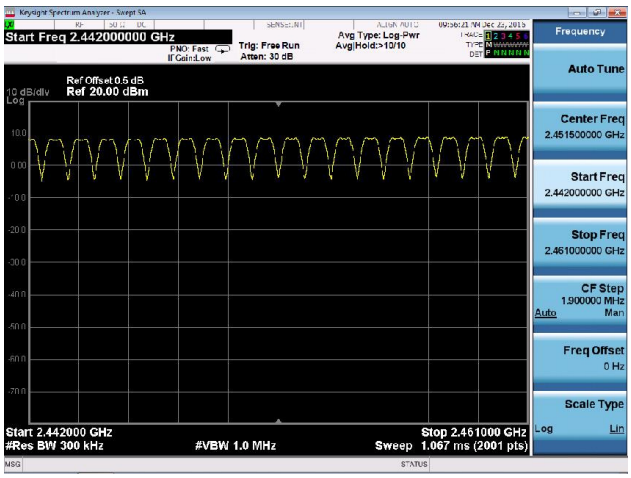
**2402 ~ 2421MHz**



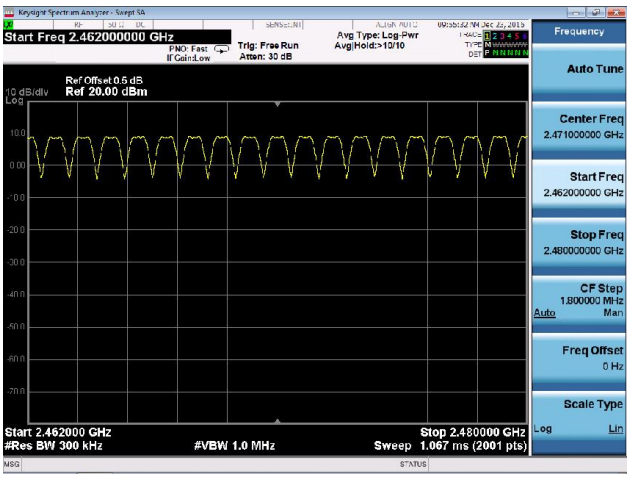

**2422 ~ 2441MHz**




**2442 ~ 2461MHz**

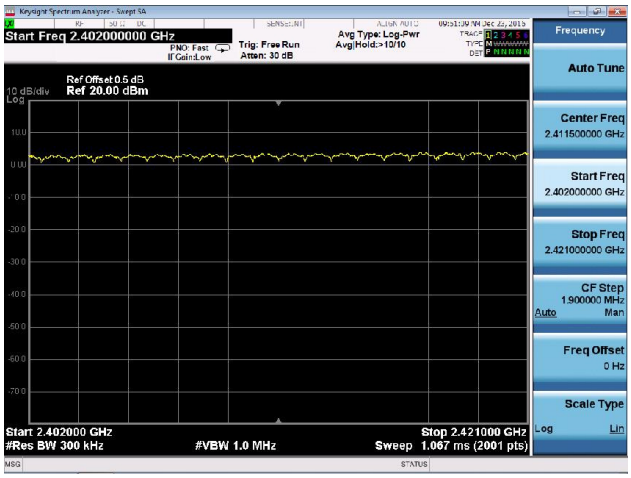



**2462 ~ 2480MHz**

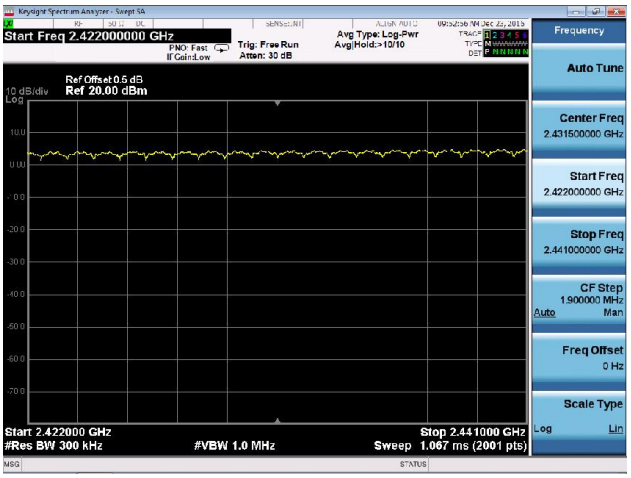


## 2DH5 Number of Hopping Channels

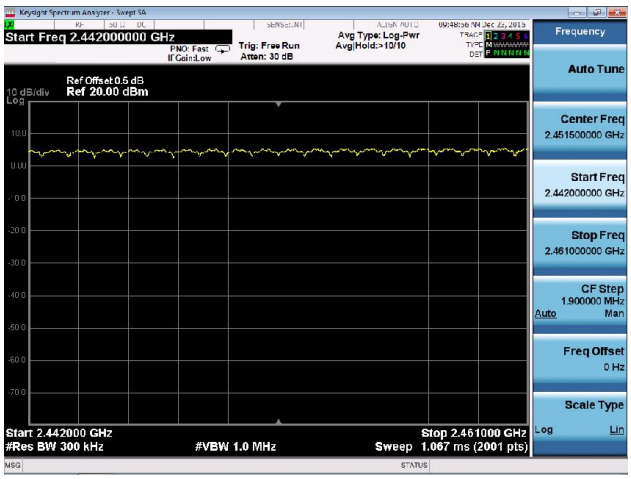
### 2402 ~ 2421MHz



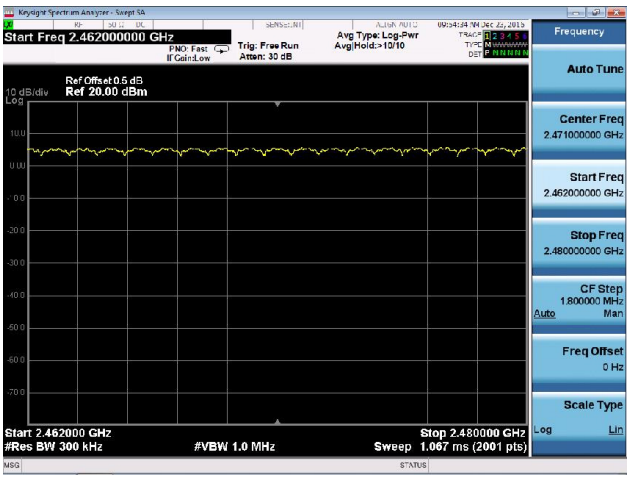

### 2422 ~ 2441MHz




### 2442 ~ 2461MHz

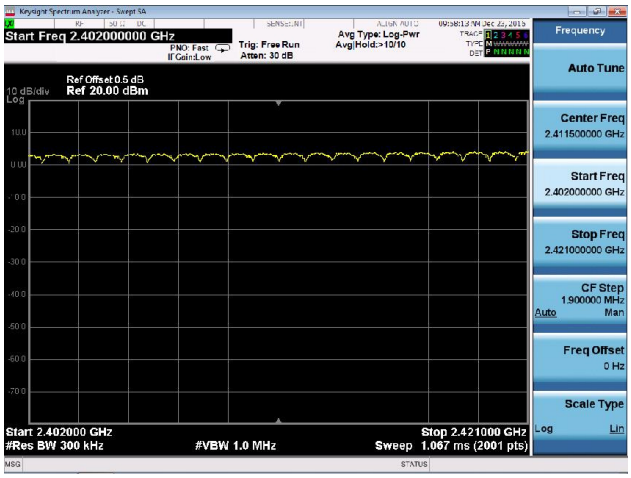



### 2462 ~ 2480MHz

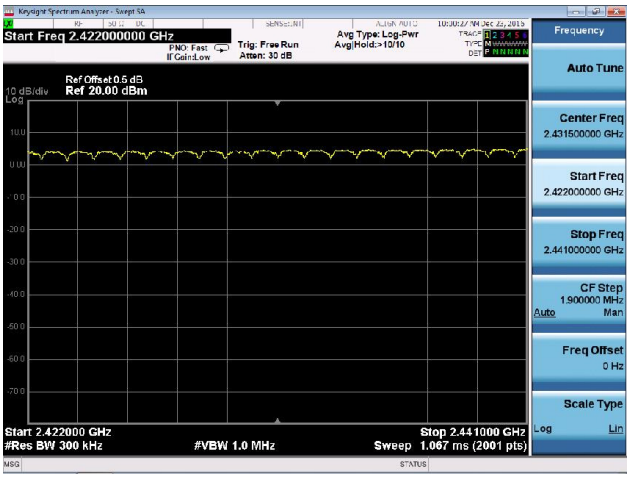


## 3DH5 Number of Hopping Channels

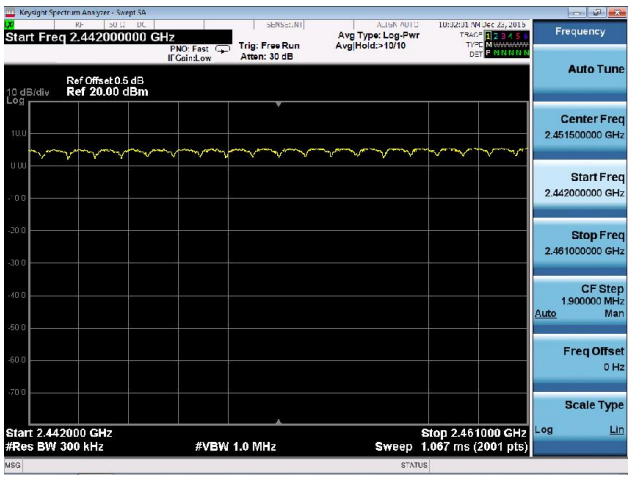
### 2402 ~ 2421MHz



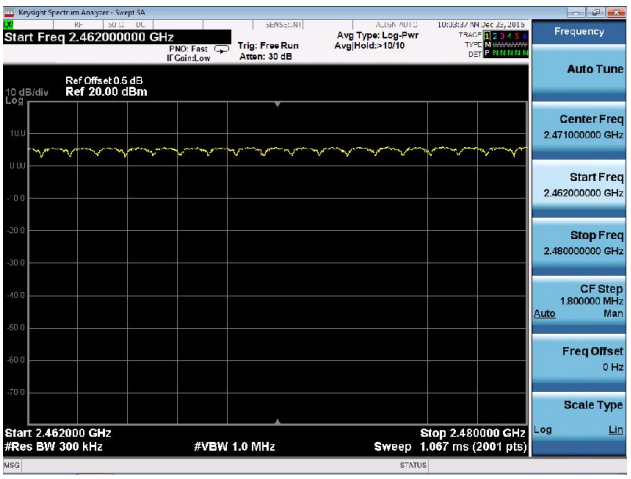

### 2422 ~ 2441MHz




### 2442 ~ 2461MHz




### 2462 ~ 2480MHz



## 7.6. Time of Occupancy Measurement

### 7.6.1. Test Limit

The maximum permissible time of occupancy is 400ms within a period of 400ms multiplied by the number of hopping channels employed.

### 7.6.2. Test Procedure Used

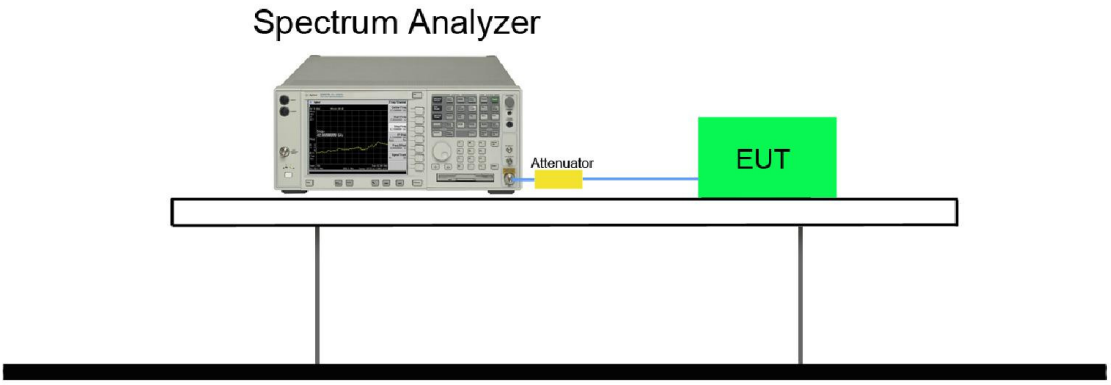
ANSI C63.10-2013 - Section 7.8.4

### 7.6.3. Test Settitng

1. Span = zero span, centered on a hopping channel.
2. RBW = 1MHz
3. VBW ≥ RBW
4. Sweep time = as necessary to capture the entire dwell time per hopping channel
5. Detector = Peak
6. Trace mode = max hold

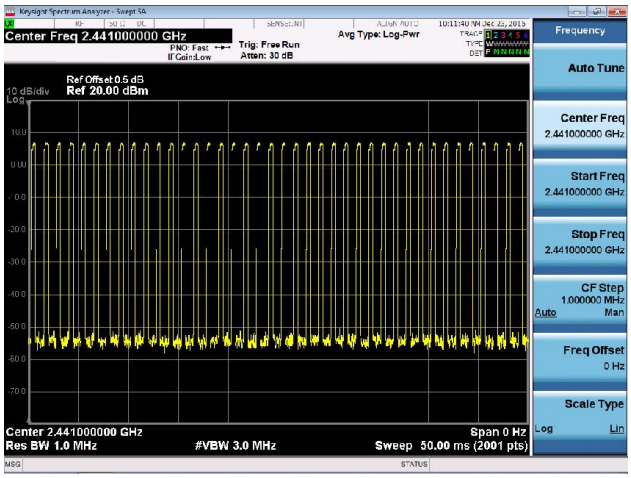
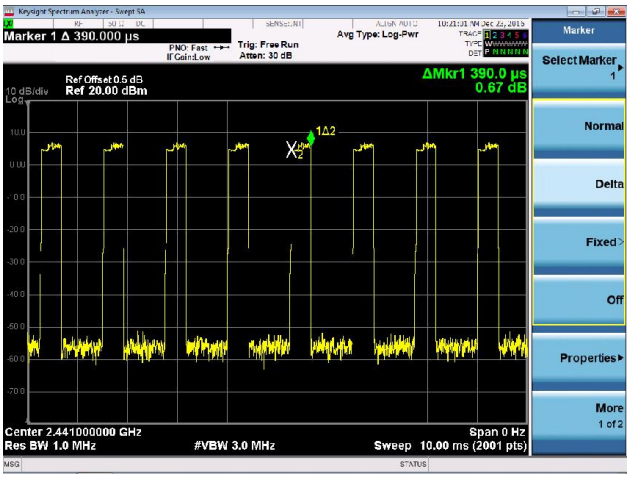
If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (data rate, modulation format, etc.), repeat this test for each variation. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

### 7.6.4. Test Setup



### 7.6.5. Test Result

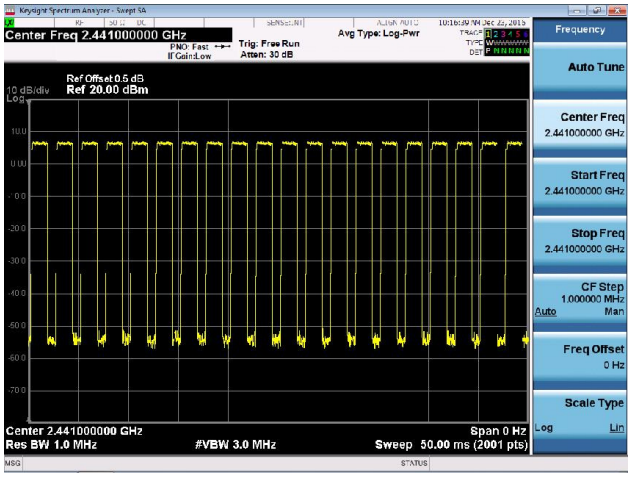
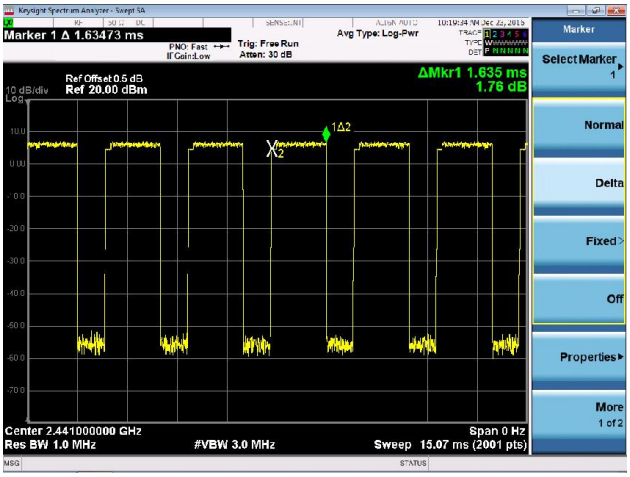
| Test Mode | Channel No. | Frequency (MHz) | Time of Occupancy (ms) | Limit (ms) | Result |
|---|---|---|---|---|---|
| 3DH1 | 39 | 2441 | 124.80 | < 400 | Pass |
| 3DH3 | 39 | 2441 | 262.40 | < 400 | Pass |
| 3DH5 | 39 | 2441 | 300.56 | < 400 | Pass |

| 3DH1 Time of Occupancy | |
|---|---|
| Channel 39(2441MHz) | Channel 39(2441MHz) |
|  |  |



Note: Test Time Period: 0.4*79=31.6sec, Hopping Times Within 1sec: 40/50msec=800 hops/sec.

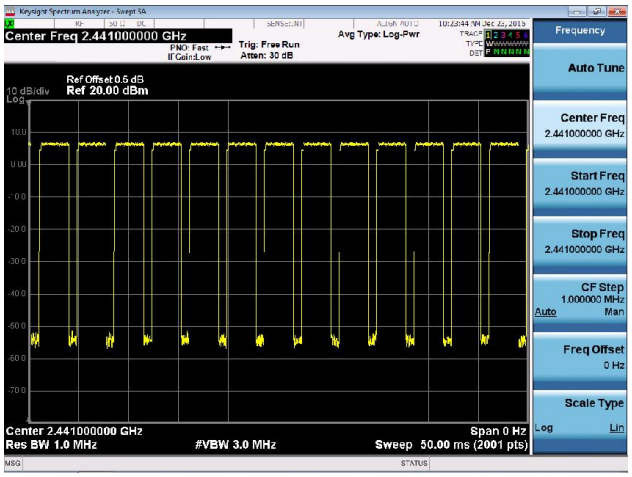
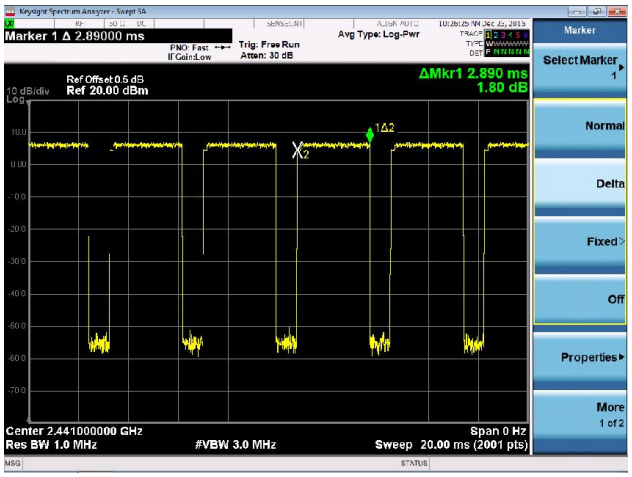
The Maximum Occupancy Time within 31.6sec: [(0.39ms*800)/79]*31.6 =124.80 msec.

| 3DH3 Time of Occupancy | |
|---|---|
| Channel 39(2441MHz) | Channel 39(2441MHz) |
|  |  |



Note: Test Time Period: 0.4*79=31.6sec, Hopping Times Within 1sec: 20/50msec=400hops/sec.

The Maximum Occupancy Time within 31.6sec: [(1.64ms*400)/79]*31.6 =262.40msec.

| 3DH5 Time of Occupancy | |
|---|---|
| **Channel 39(2441MHz)** | **Channel 39(2441MHz)** |
|  |  |





Note: Test Time Period: 0.4*79=31.6sec, Hopping Times Within 1sec: 13/50msec=260 hops/sec.

The Maximum Occupancy Time within 31.6sec: [(2.89ms*260)/79]*31.6 =300.56 msec.

## 7.7. Band-edge Compliance Measurement

### 7.7.1. Test Limit

The maximum permissible emission level is 20dBc. Any emissions were lying outside of the emission bandwidth and in authorized band edges to a field strength limit specified in Section 15.209 of the Title 47 CFR.

### 7.7.2. Test Procedure Used

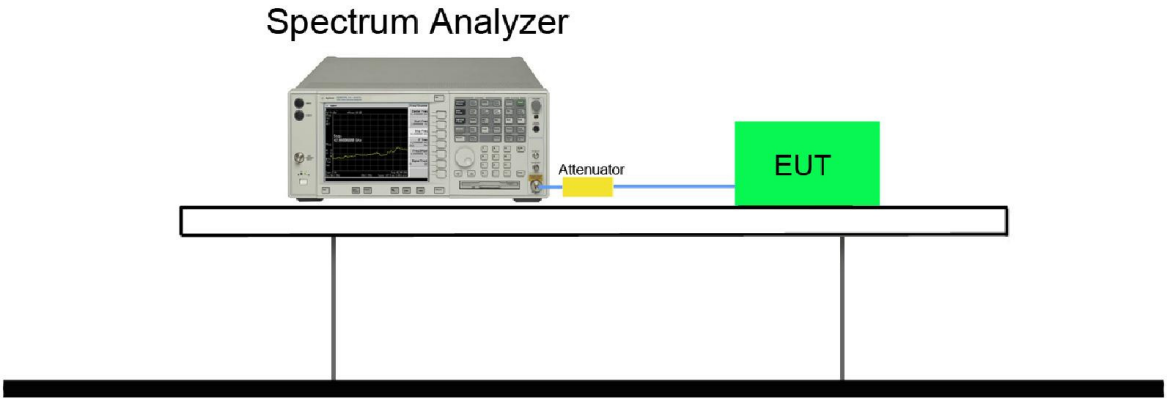
ANSI C63.10-2013 - Section 6.10.4

### 7.7.3. Test Setting

1. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
2. RBW ≥ 1% of spectrum analyzer display span
3. VBW ≥ RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, than use the marker-to-peak function to move the marker to the peak of the in-band emission.

### 7.7.4. Test Setup



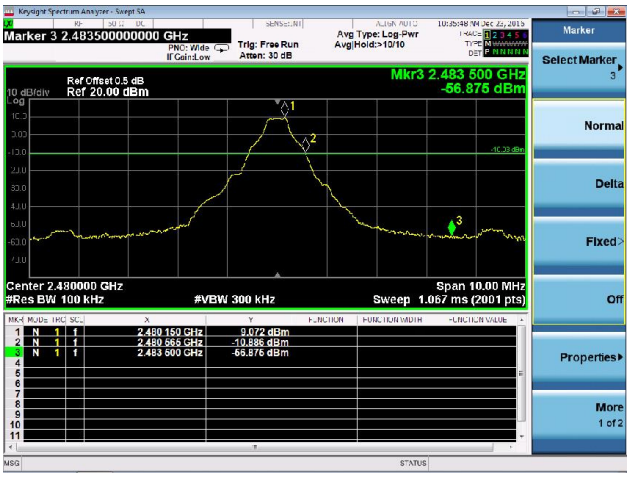
### 7.7.5. Test Result

| Test Mode | Channel No. | Frequency (MHz) | Limit | Result |
|---|---|---|---|---|
| DH5 | 00 | 2402 | 20dBc | Pass |
| DH5 | 78 | 2480 | 20dBc | Pass |
| 2DH5 | 00 | 2402 | 20dBc | Pass |
| 2DH5 | 78 | 2480 | 20dBc | Pass |
| 3DH5 | 00 | 2402 | 20dBc | Pass |
| 3DH5 | 78 | 2480 | 20dBc | Pass |

**DH5 Band-edge Compliance**

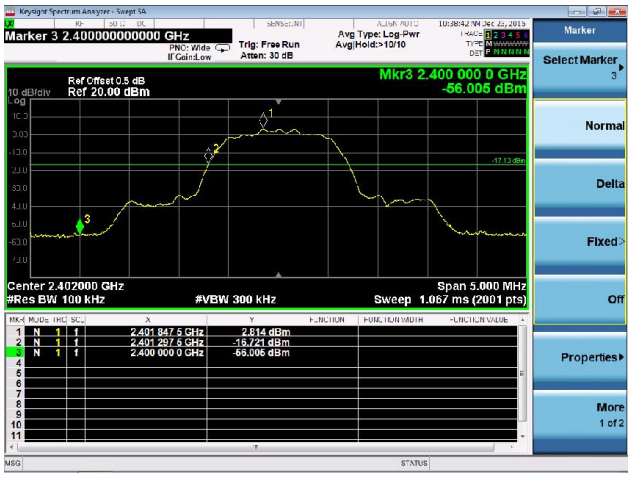
**Channel 00 (2402MHz)**

**Channel 78 (2480MHz)**

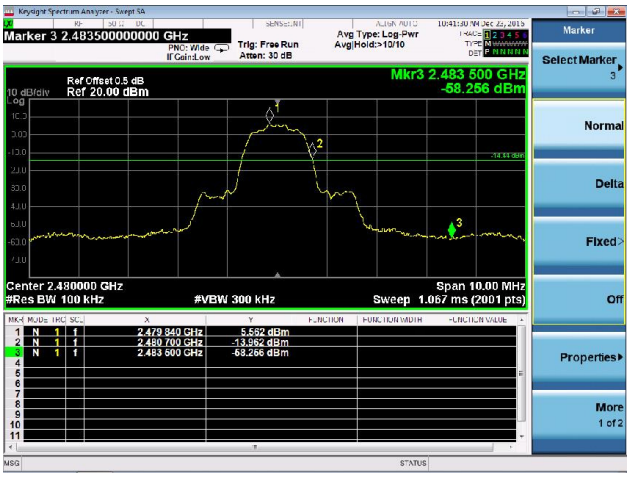



**2DH5 Band-edge Compliance**

**Channel 00 (2402MHz)**



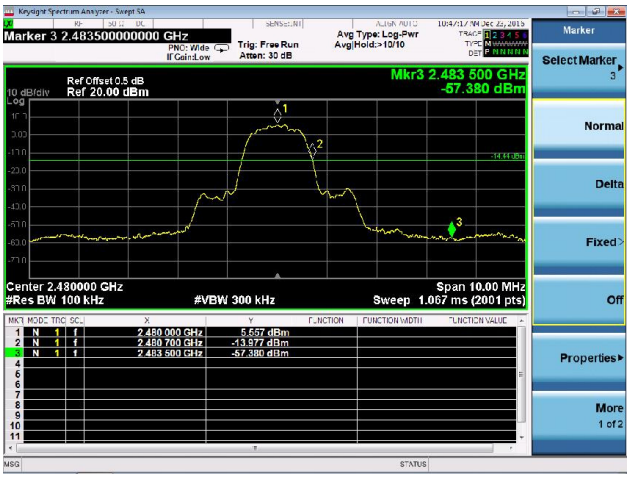

**Channel 78 (2480MHz)**



## 3DH5 Band-edge Compliance

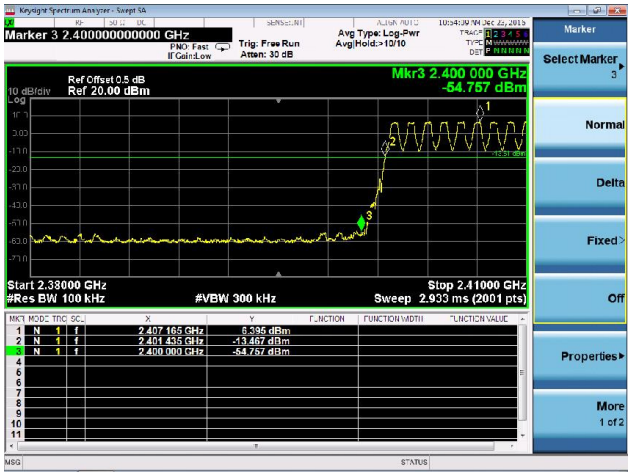
### Channel 00 (2402MHz)

### Channel 78 (2480MHz)

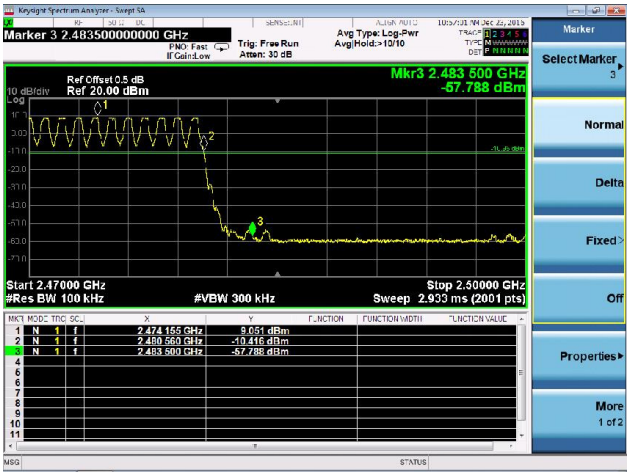



## DH5 Operation Frequency Range of 20dB Bandwidth within Hopping Mode

### Channel 00 (2402MHz)

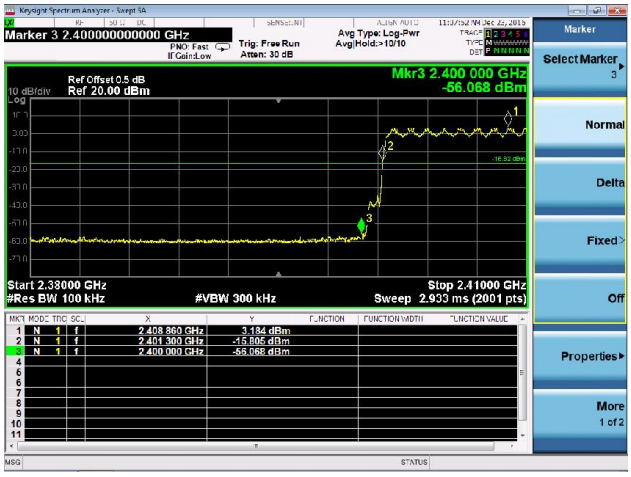



### Channel 78 (2480MHz)

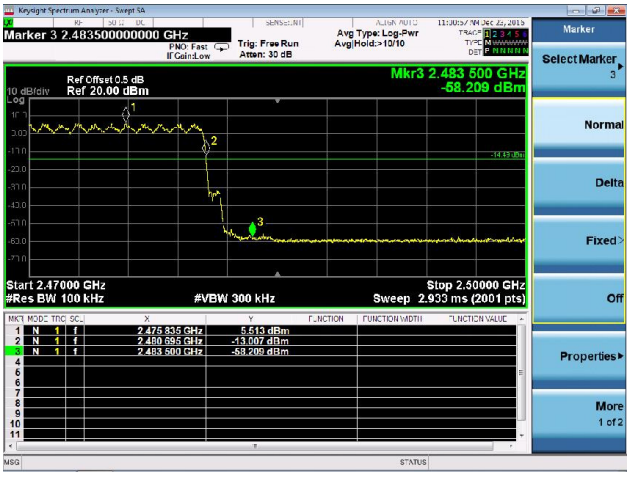


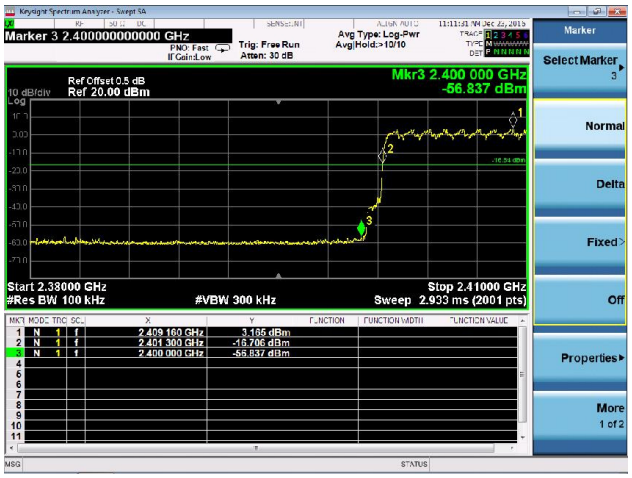
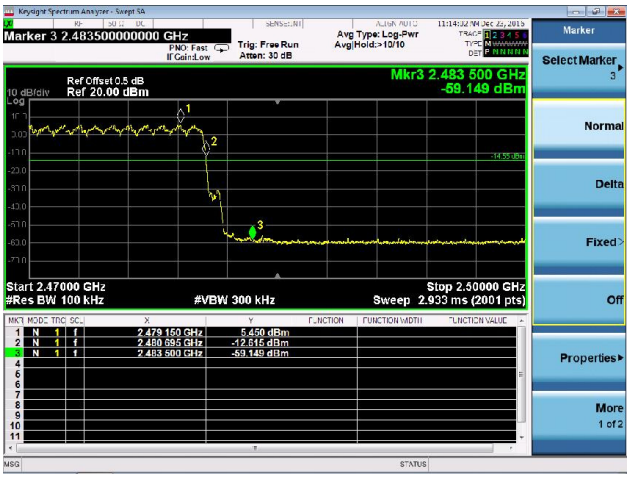

## 2DH5 Operation Frequency Range of 20dB Bandwidth within Hopping Mode

### Channel 00 (2402MHz)




### Channel 78 (2480MHz)



| 3DH5 Operation Frequency Range of 20dB Bandwidth within Hopping Mode | |
|---|---|
| **Channel 00 (2402MHz)** | **Channel 78 (2480MHz)** |
|  |  |

## 7.8. Conducted Spurious Emissions Measurement

### 7.8.1. Test Limit

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 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

### 7.8.2. Test Procedure Used

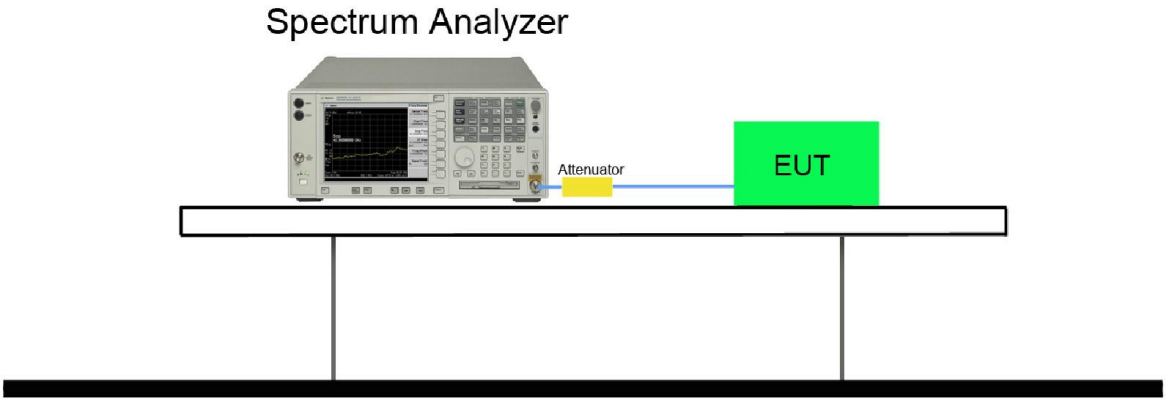
ANSI C63.10-2013 - Section 7.8.8

### 7.8.3. Test Setting

1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10$^{th}$ harmonic. Typically, several plots are required to cover this entire span.
2. RBW = 100 KHz
3. VBW ≥ RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

### 7.8.4. Test Setup

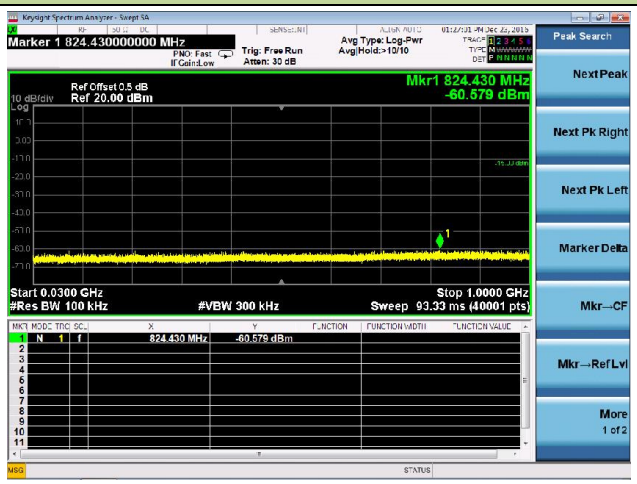


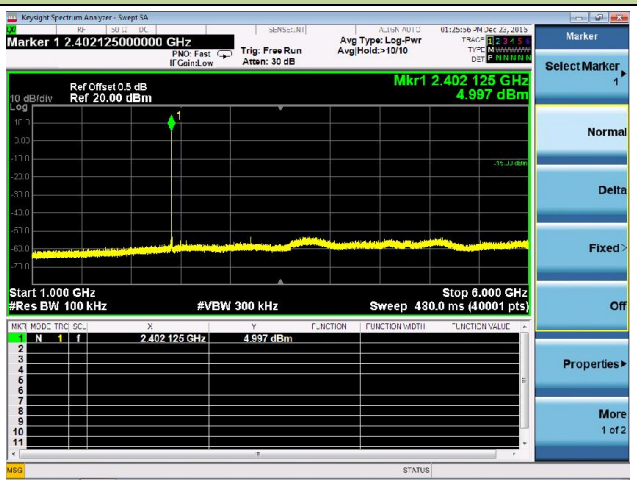
### 7.8.5. Test Result

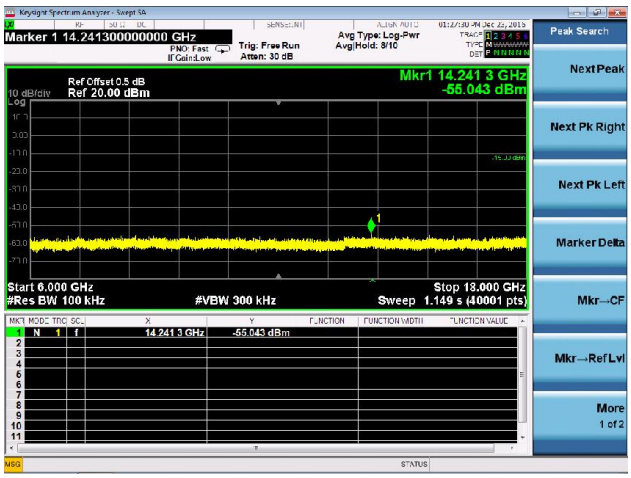
| Test Mode | Channel No. | Frequency (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|
| DH5 | 00 | 2402 | 20dBc | Pass |
| DH5 | 39 | 2441 | 20dBc | Pass |
| DH5 | 78 | 2480 | 20dBc | Pass |
| 2DH5 | 00 | 2402 | 20dBc | Pass |
| 2DH5 | 39 | 2441 | 20dBc | Pass |
| 2DH5 | 78 | 2480 | 20dBc | Pass |
| 3DH5 | 00 | 2402 | 20dBc | Pass |
| 3DH5 | 39 | 2441 | 20dBc | Pass |
| 3DH5 | 78 | 2480 | 20dBc | Pass |

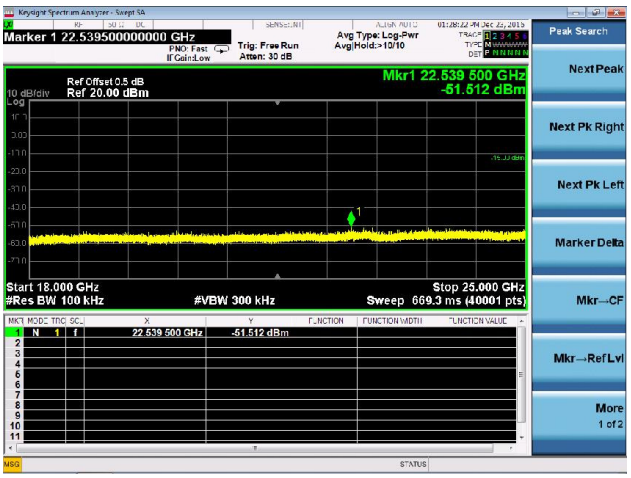
**DH5 Conducted Spurious Emissions**

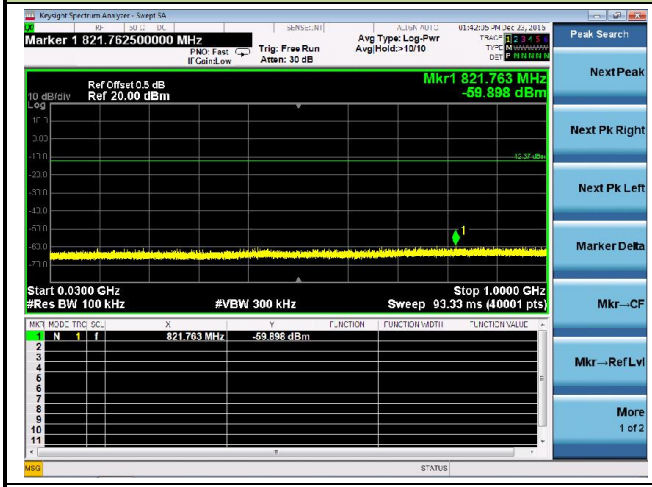
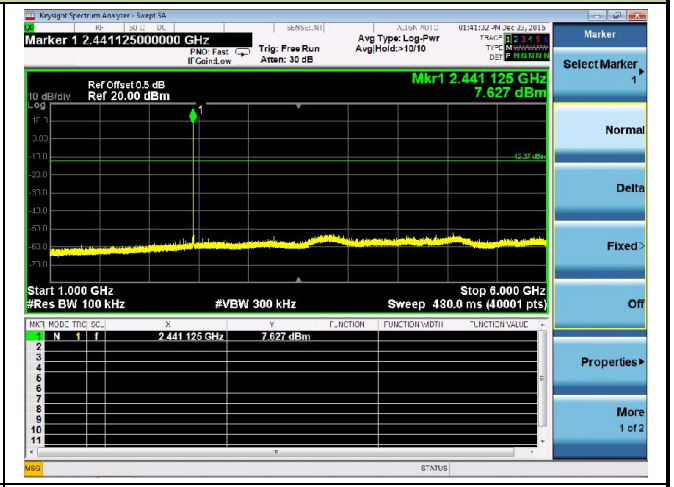
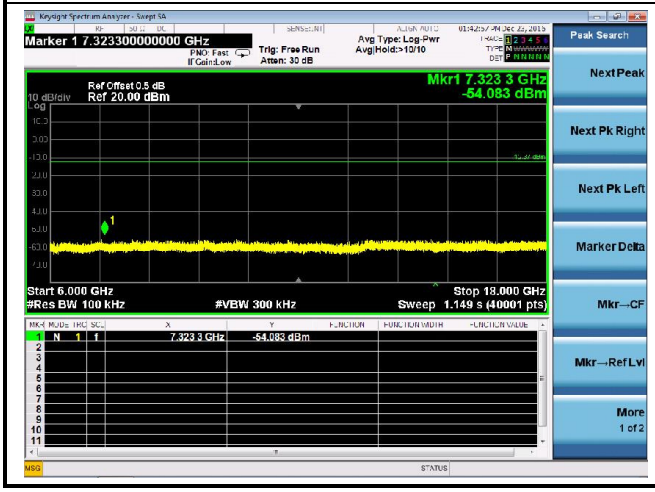
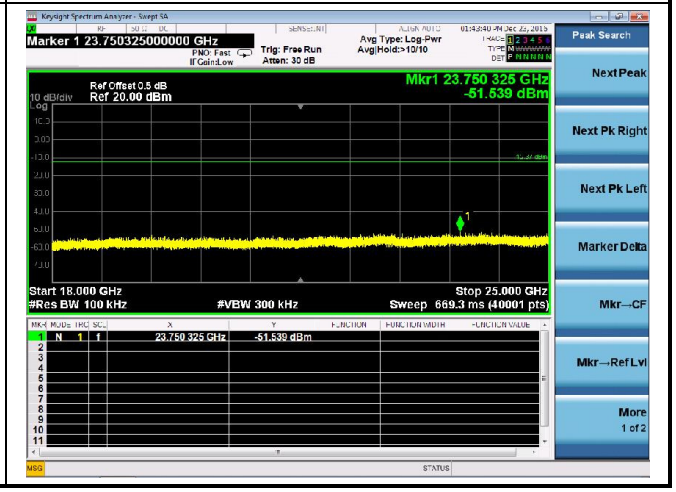
**Channel 00 (2402MHz)**



## DH5 Conducted Spurious Emissions

### Channel 39 (2441MHz)