**FCC 47 CFR PART 15 SUBPART C**

**CERTIFICATION TEST REPORT**

**FOR**

**PORTABLE COMPUTING DEVICE**

**MODEL NUMBER: 1724**

**FCC ID: C3K1724B**

**REPORT NUMBER: R10880568-E3AV2**

**ISSUE DATE: 2015-10-08**

*Prepared for*
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## Revision History

| Ver. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| 1 | 2015-09-25 | Initial Issue. | Jeff Moser |
| 2 | 2015-10-08 | Updated with declared AFH channels | F. de Anda |


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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** MICROSOFT CORPORATION
ONE MICROSOFT WAY
REDMOND, WA 98052, U.S.A.

**EUT DESCRIPTION:** PORTABLE COMPUTING DEVICE

**MODEL:** 1724

**SERIAL NUMBER:** 012760552253 (RF4)

**DATE TESTED:** August 03-17, 2015

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | PASS |

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

| Approved & Released For UL LLC By: | Reviewed By: | Prepared By: |
|---|---|---|
| Francisco de Anda<br>Project Lead<br>UL Verification Services Inc. | Jeff Moser<br>EMC Program Manager<br>UL – Consumer Technology Division | Mark Nolting<br>EMC Engineer<br>UL – Consumer Technology Division |


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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15 and DA 00-705 Rel. March 30, 2000.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Suite B Perimeter Park Dr., Morrisville, NC 27560.

| 12 Laboratory Dr., RTP, NC 27709 |
|---|
| ☐ Chamber A |
| ☐ Chamber C |

| 2800 Suite B Perimeter Park Dr., Morrisville, NC 27560 |
|---|
| ☒ Chamber NORTH |
| ☐ Chamber SOUTH |

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://www.nist.gov/nvlap/.

# 4. CALIBRATION AND UNCERTAINTY

## 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m


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## 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | UNCERTAINTY |
|---|---|
| Total RF power, conducted | ±0.45 dB |
| RF power density, conducted | ±1.5 dB |
| Spurious emissions, conducted | ±1.46 dB |
| Radiated Emissions (30-1000 MHz) | +/- 6.04 dB (3m) |
| Radiated Emissions (1-6 GHz) | +/- 5.96 dB |
| Radiated Emissions (6-18 GHz) | +/- 6.10 dB |
| Radiated Emissions (18-26 GHz) | +/- 6.81 dB |
| Temperature | ±0.07°C |
| Humidity | ±2.26% RH |
| DC and low frequency voltages | ±1.27% |

Uncertainty figures are valid to a confidence level of 95%.


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# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is a handheld computing device with 802.11 2x2, a/b/g/n/ac WLAN, Bluetooth, Bluetooth LE. This report covers the Bluetooth. All other technologies are covered by separate reports.

## 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode | Output Peak Power (dBm) | Output Peak Power (mW) |
|---|---|---|---|
| 2402 - 2480 | Basic GFSK | 3.41 | 2.19 |
| 2402 - 2480 | DQPSK | 5.83 | 3.83 |
| 2402 - 2480 | Enhanced 8PSK | 6.11 | 4.08 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integrated antenna, with a maximum gain of 1.7 dBi.

## 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Mte OS 1.416.0.

The test utility software used during testing was WiFi tool v2.7.4.


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## 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z and an additional one employing its kickstand, it was determined that the Y orientation was the worst-case orientation; therefore, all final radiated testing was performed with the EUT in the Y orientation.

For Enhanced Data rate modes, 8DPSK is considered worst-case and only select tests were performed for the DQPSK mode. Additionally, unless noted in the test report, all tests were performed with the DH5 packet size as this was considered worst-case.


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## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Support Equipment List | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Serial Number** | **FCC ID** |
| Laptop | Lenovo | E545 | MP-06P9HP | DoC |
| Laptop AC/DC adapter | Lenovo | 42T4430 | 11S42T4430Z1ZGWE25Y1ET | DoC |
| Ethernet to USB Adapter | Linksys | USB300M | C8D719E76E21 | N/A |
| EUT AC/DC adapter | Microsoft | 1625 | 0D130C07VLN51 | DoC |
| Ear buds | - | Generic | - | N/A |

**I/O CABLES**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| **Cable No** | **Port** | **# of identical ports** | **Connector Type** | **Cable Type** | **Cable Length (m)** | **Remarks** |
| 1 | Antenna | 1 | SMA | Un-Shielded | 0.3 | To spectrum Analyzer |
| 2 | USB | 1 | USB | Shielded | 0.2 | To EUT |
| 3 | DC | 1 | DC | Un-shielded | 1.8 | N/A |
| 4 | Ether cable | 1 | RJ45- USB | Un-shielded | 1 | To laptop |
| 5 | DC | 1 | DC | Un-shielded | 0.8 | N/A |
| 6 | AC | 1 | 2-Prong | Un-shielded | 1.5 | N/A |
| 7 | AC | 1 | 2-Prong | Un-Shielded | 0.5 | N/A |
| 8 | Audio | 1 | 3.5mm stereo | Un-Shielded | 1.1 | N/A |


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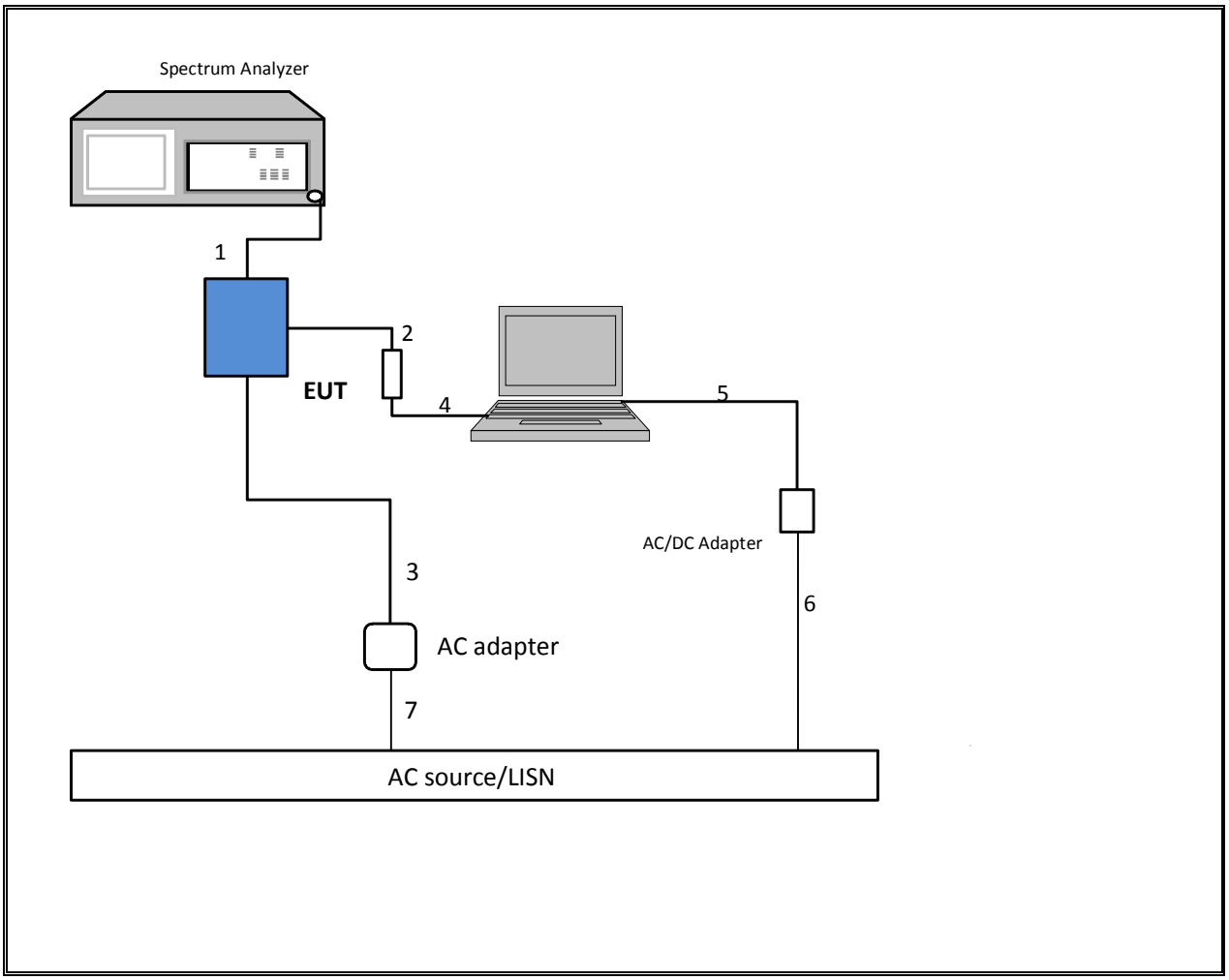
**TEST SETUP- CONDUCTED PORT**

The EUT was tested connected to a host Laptop via RJ45/USB cable and spectrum analyzer to antenna port. Test software exercised the EUT.

**SETUP DIAGRAM**





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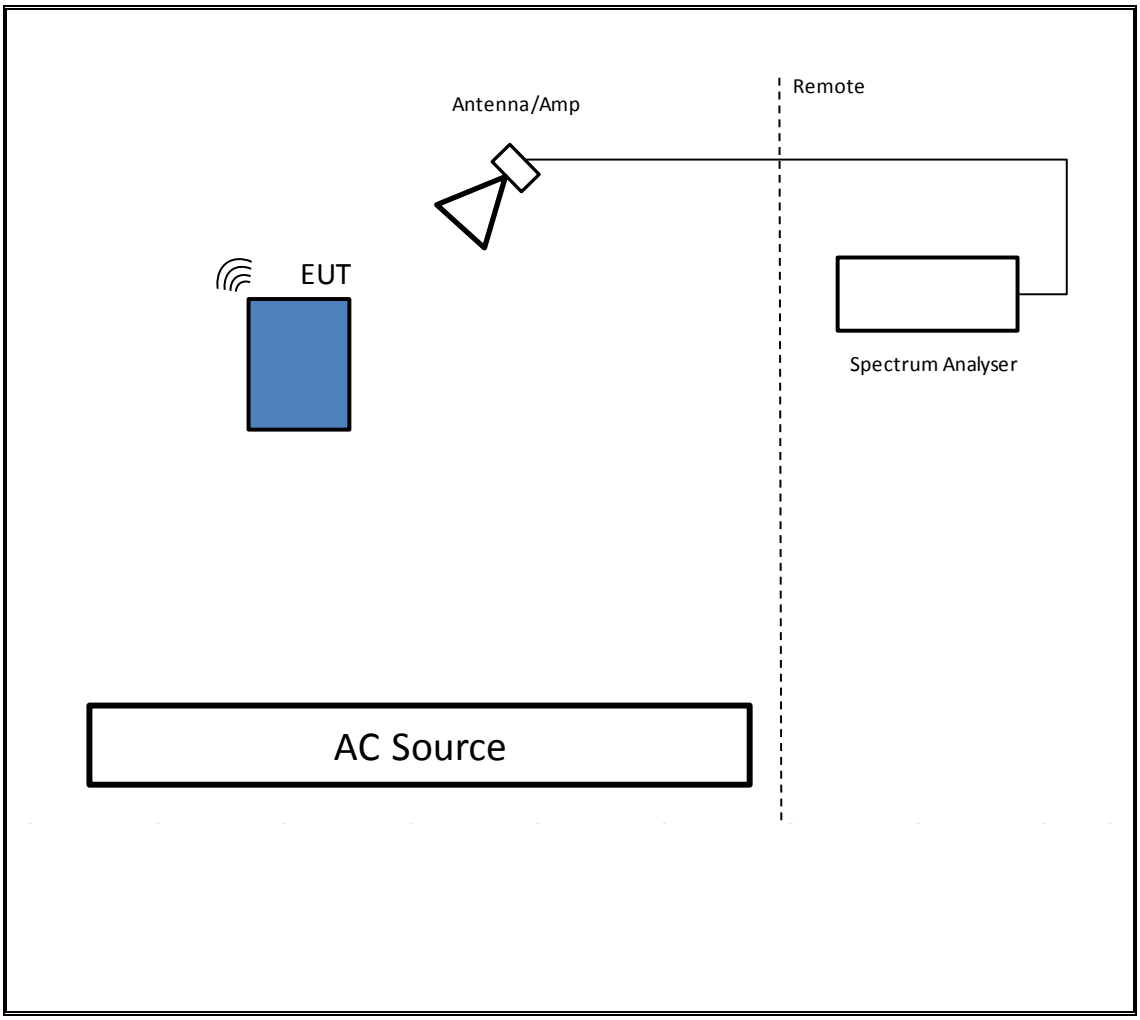
**TEST SETUP- RADIATED-ABOVE 1 GHZ**

The EUT was tested battery powered. Test software exercised the EUT.

**SETUP DIAGRAM**





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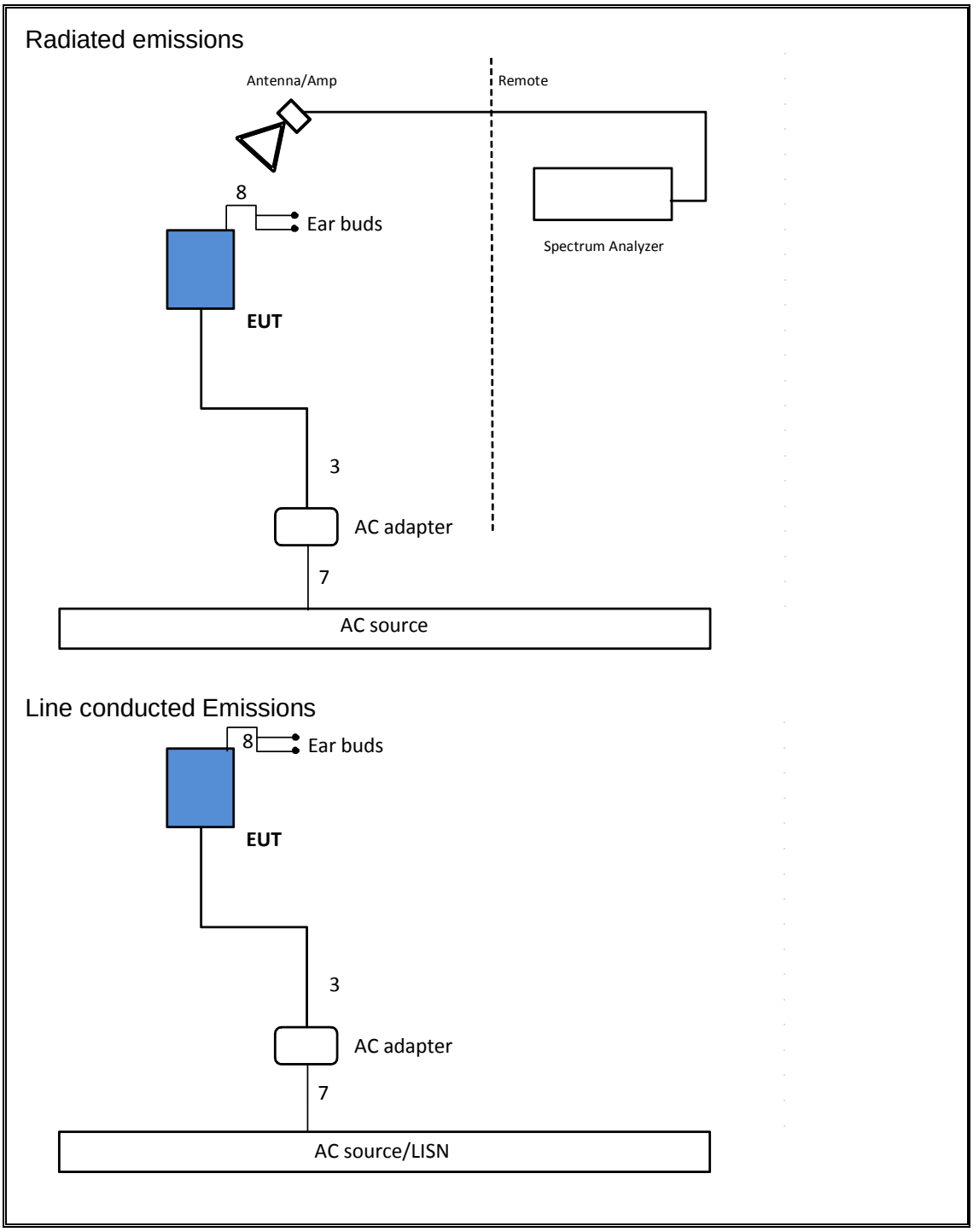
**TEST SETUP - BELOW 1GHZ & AC LINE CONDUCTED TESTS**

**SETUP DIAGRAM**





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# 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

| Equip. ID | Description | Manufacturer | Model Number | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| AT0073 | Hybrid Broadband Antenna, 30-1000MHz | Sunol Sciences Corp. | JB3 | 2015-06-10 | 2016-06-30 |
| AT0072 | Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz | ETS Lindgren | 3117 | 2015-02-17 | 2016-02-29 |
| SAC_N_Hybrid (30-1000MHz) | Gain-Loss string for Hybrid antenna | Various | Various | 2015-06-25 | 2016-06-30 |
| SAC_N_Horn (1-18GHz) | Gain-Loss string for Horn antenna | Various | Various | 2015-06-25 | 2016-06-30 |
| AT0053 | Horn Antenna, 18-26.5GHz | ARA | SWH-28 (S/N 1004) | 2015-07-28 | 2016-07-31 |
| | Amplifier (S/Ns 859993, 860112, 859864) | Miteq | JSD42-1800400-30-5A | | |
| | Cable (S/N 204158-001) | Micro-coax | UFA147A-0-1181-200200 | | |
| SA0026 | Spectrum Analyzer | Agilent | N9030A | 2015-03-27 | 2016-03-31 |
| SOFTEMI | EMI Software | UL | Version 9.5 | NA | NA |
| 43733 | Temp/Humid/Pressure Meter | Cole Parmer | 99760-00 | 2014-03-24 | 2016-03-24 |


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Antenna-port Test Measurement Equipment

| Equipment ID | Description | Manufacturer | Model Number | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| | **Common Equipment** | | | | |
| T189 | Spectrum Analyzer | Agilent Technologies | E4440A | 2015-05-13 | 2016-05-31 |
| PWM002 | RF Power Meter | Keysight Technologies | N1911A | 2015-06-08 | 2017-06-08 |
| PWS004 | Power Sensor, 50MHz to 6 GHz | Keysight Technologies | E9323A | 2015-06-05 | 2016-06-05 |
| 43733 | Temp/Humid/Pressure Meter | Cole Parmer | 99760-00 | 2014-03-24 | 2016-03-24 |

Line Conducted Test Equipment

| Equipment ID | Description | Manufacturer | Model Number | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| SA0021 | EMI Test Receiver 9kHz-3.6GHz | Rohde & Schwarz | ESR3 | 2015-07-08 | 2-16-07-31 |
| ATA508 | Transient Limiter, 0.009 to 100 MHz | Electro-Metrics | EM 7600 | 2015-08-03 | 2016-08-31 |
| ATA509 | Coaxial cable, 20 ft., BNC - male to BNC-male | UL | RG-223 | 2015-08-03 | 2016-08-31 |
| HI0069 | Temp/Humid/Pressure Meter | Cole-Parmer | 99760-00 | 2015-07-01 | 2016-07-31 |
| SOFTEMI | EMI Software | UL | Version 9.5 | NA | NA |
| LISN002 | LISN, 50-ohm/50-uH, 2-conductor, 25A | Fischer Custom Com. | FCC-LISN-50-25-2-01-550V | 2014-09-04 | 2015-09-30 |


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# 7. ANTENNA PORT TEST RESULTS

# 8. ON TIME AND DUTY CYCLE

**LIMITS**

None; for reporting purposes only.

**PROCEDURE**

KDB 558074 Zero-Span Spectrum Analyzer Method.

## 8.1. ON TIME AND DUTY CYCLE RESULTS

| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW (kHz) |
|---|---|---|---|---|---|---|
| **2.4 GHz band (Hopping OFF)** | | | | | | |
| Bluetooth GFSK | 2.897 | 3.748 | 0.773 | 77.29% | 1.12 | 0.345 |
| Bluetooth 8PSK | 2.897 | 3.748 | 0.773 | 77.29% | 1.12 | 0.345 |


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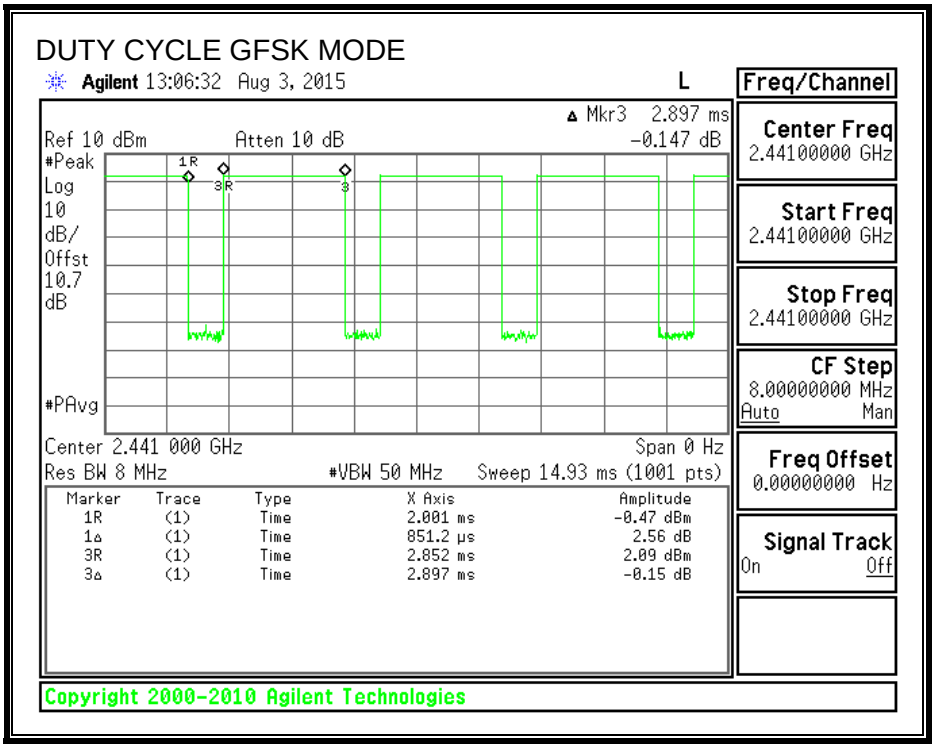
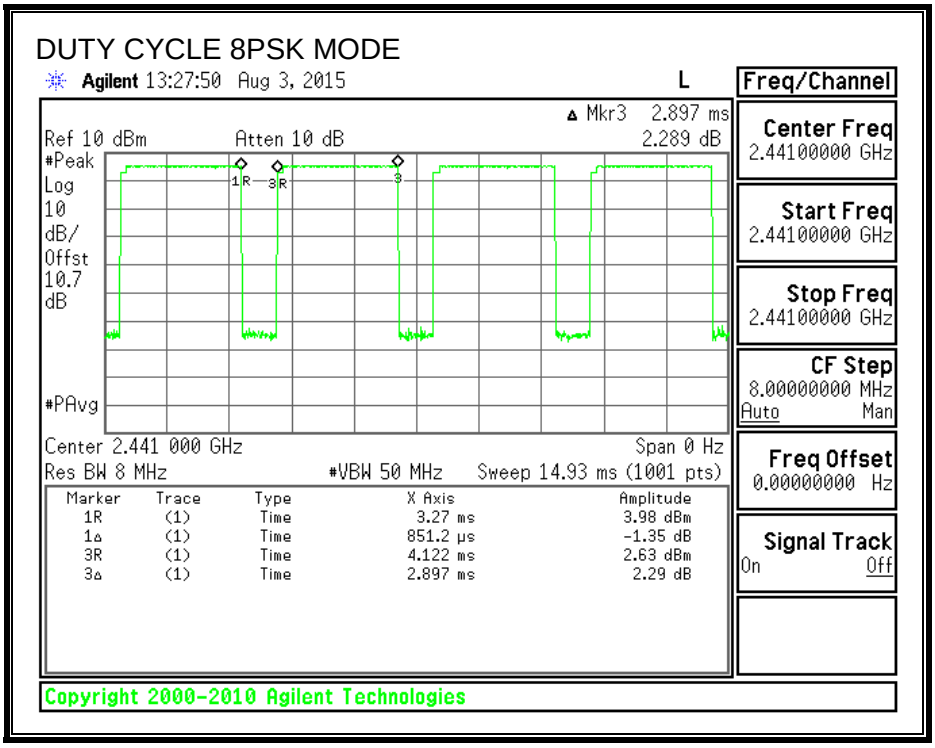
## 8.2. DUTY CYCLE PLOTS

**HOPPING OFF**





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## 8.3. BASIC DATA RATE GFSK MODULATION

### 8.3.1. 20 dB AND 99% BANDWIDTH

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 99% OBW. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 20 dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|---|---|---|---|
| Low | 2402 | 940 | 869.8070 |
| Middle | 2441 | 936 | 883.7112 |
| High | 2480 | 940 | 882.0087 |


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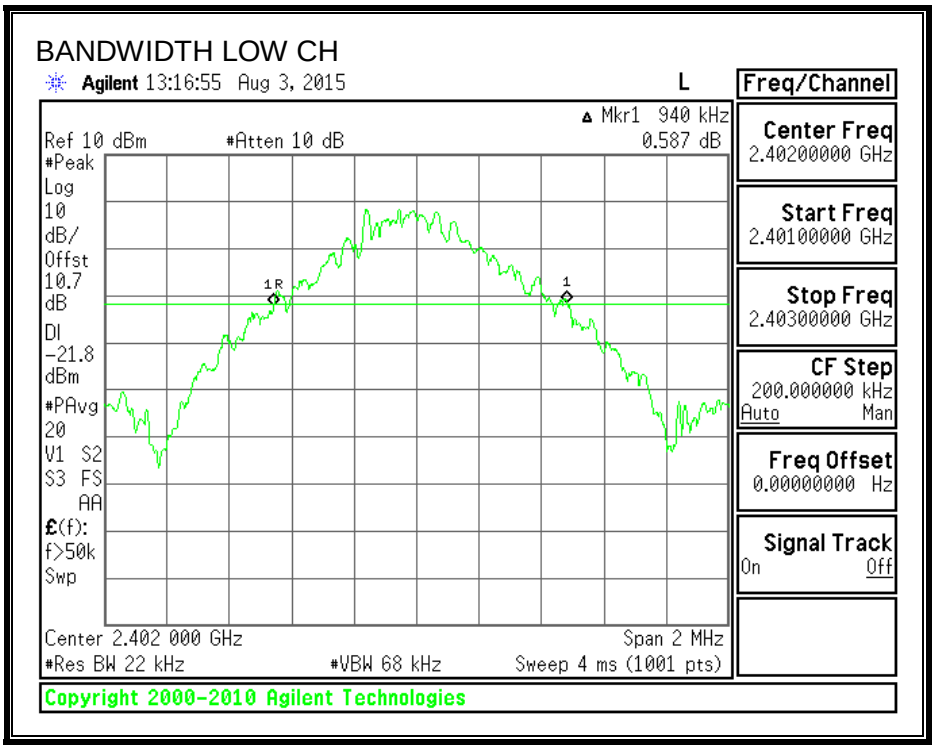
**20 dB BANDWIDTH**





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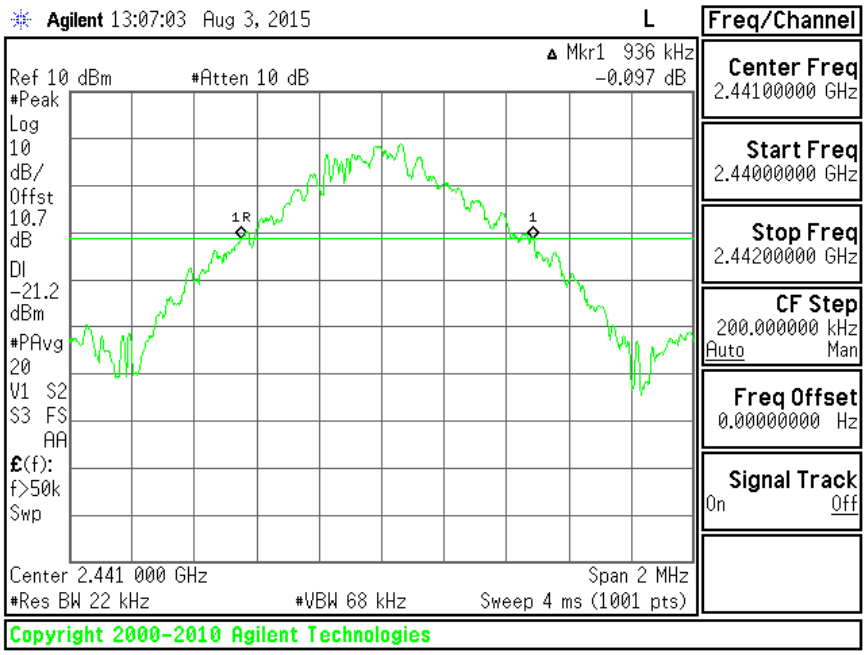
BANDWIDTH MID CH





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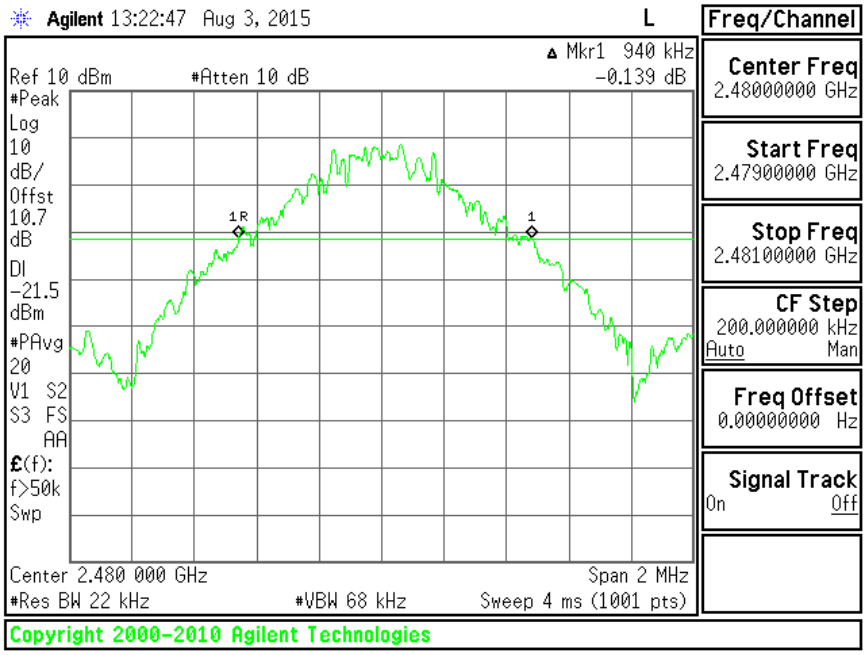
BANDWIDTH HIGH CH





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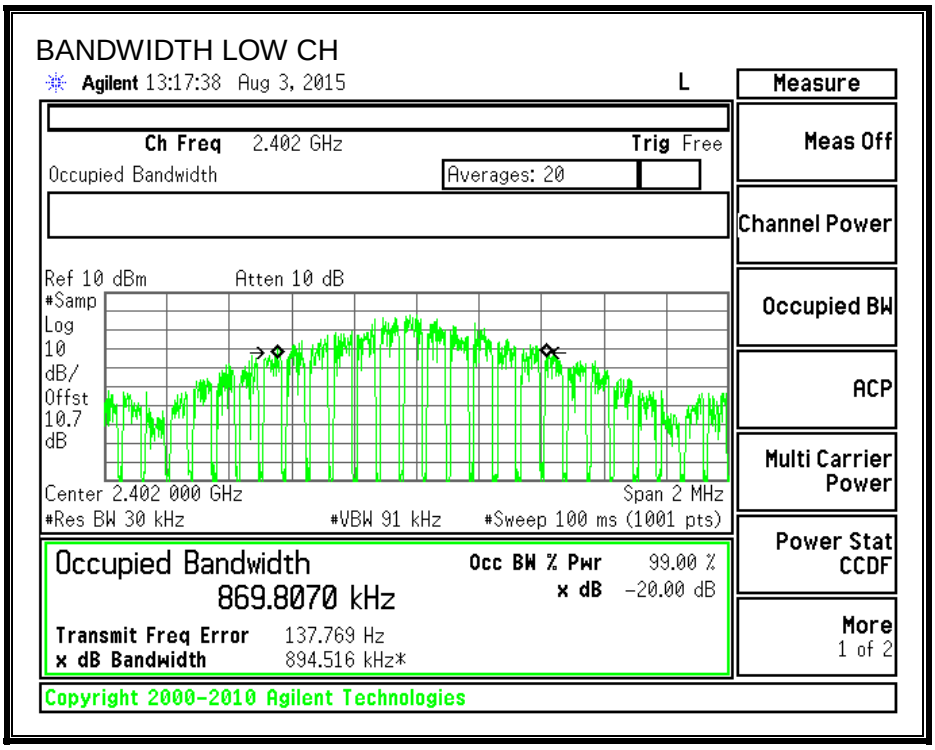
**99% BANDWIDTH**





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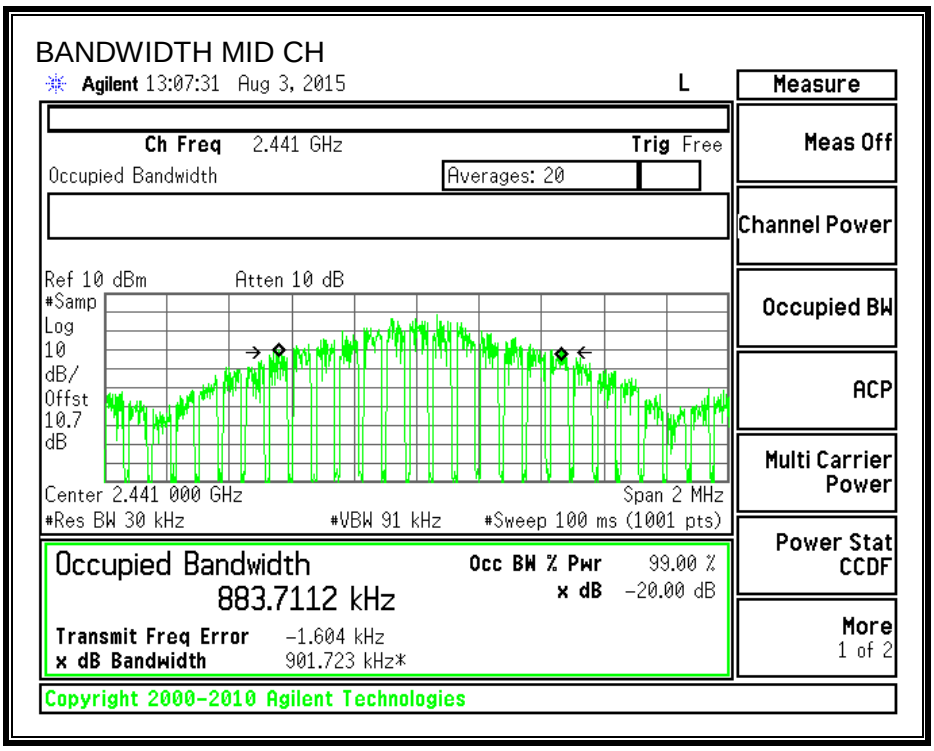



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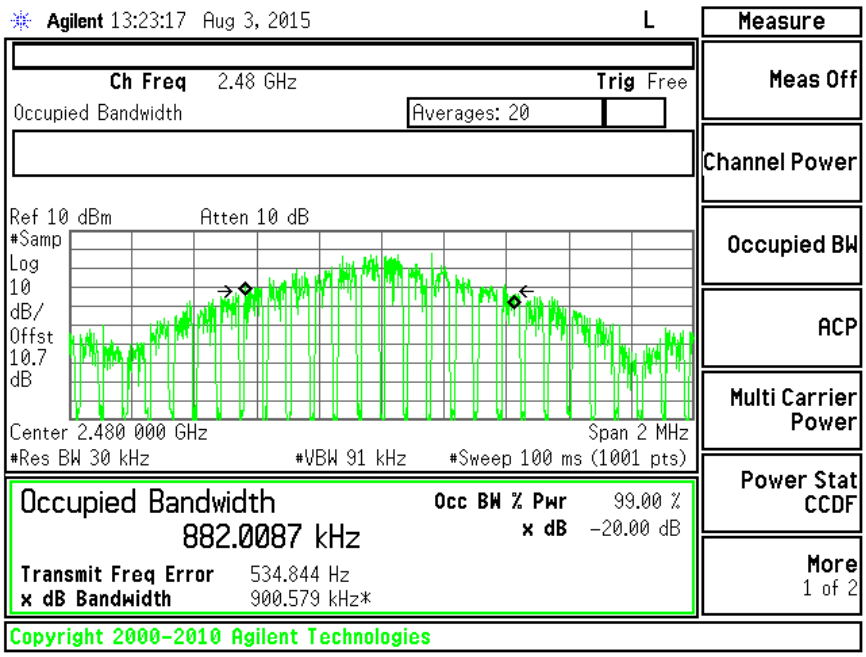
BANDWIDTH HIGH CH





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## 8.3.2. HOPPING FREQUENCY SEPARATION

**LIMIT**

FCC §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 hoping 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 PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the span and the VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

Note – The EUT's channel separation (1MHz) is greater than the 20 dB BW (940 kHz).


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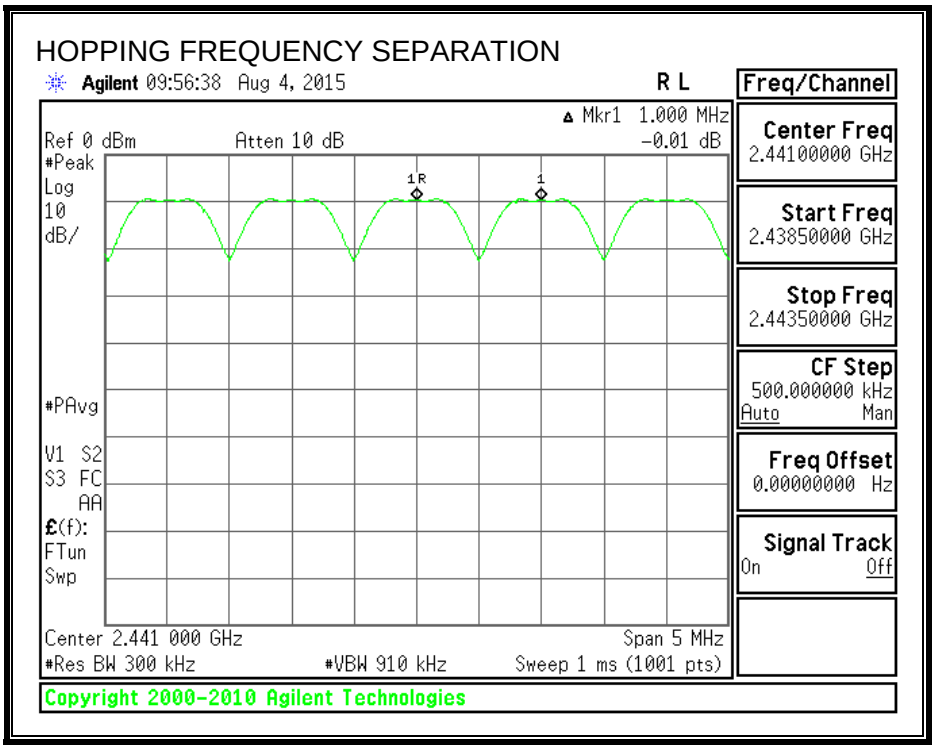
**HOPPING FREQUENCY SEPARATION**





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## 8.3.3. NUMBER OF HOPPING CHANNELS

**LIMIT**

FCC §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

**RESULTS**

Normal Mode: 79 Channels observed.

AFH Mode: 20 Channels declared.


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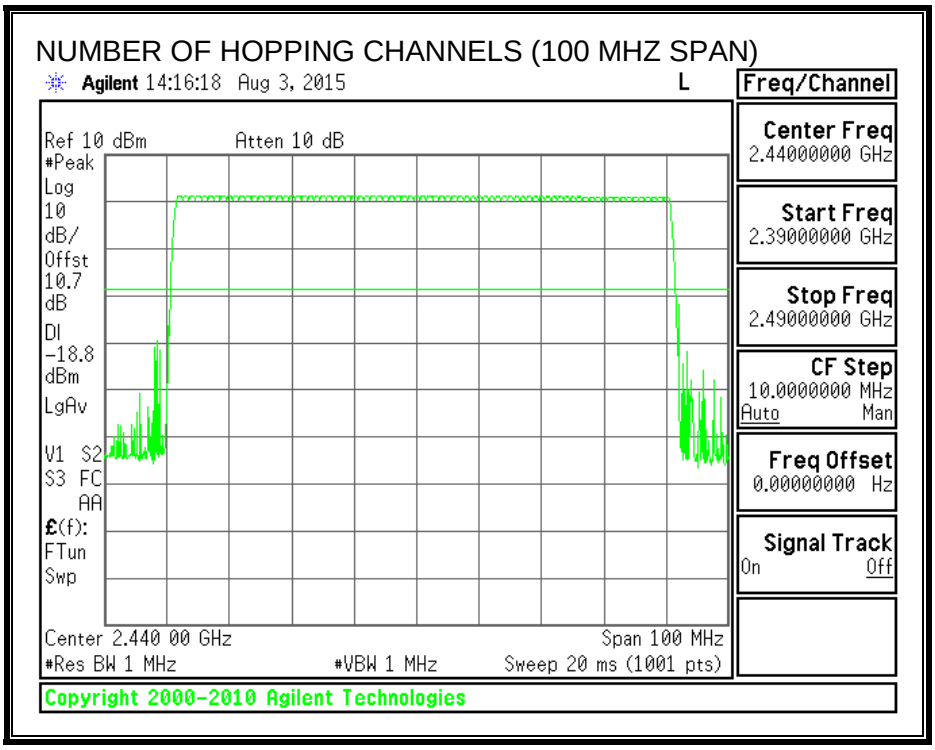
**NUMBER OF HOPPING CHANNELS**





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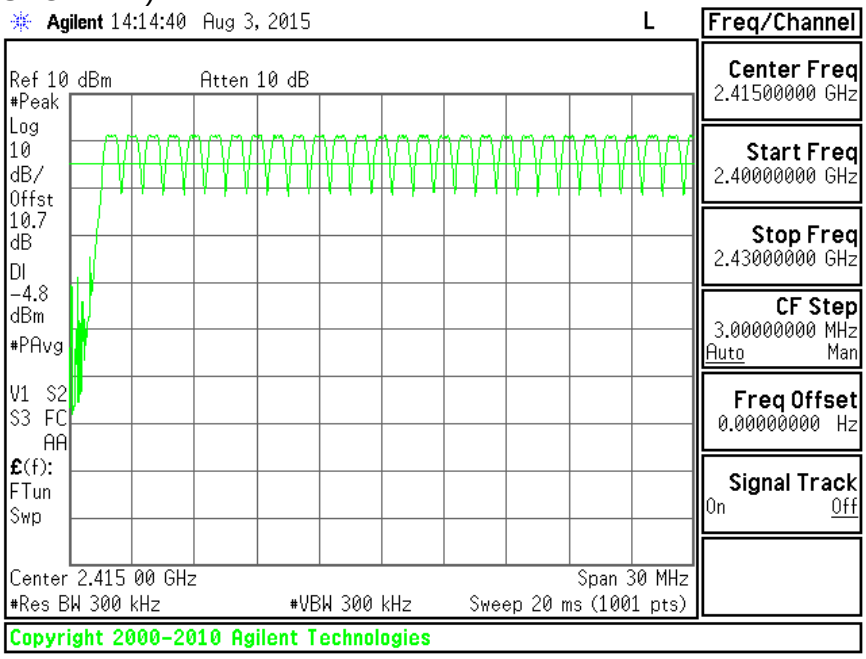
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)





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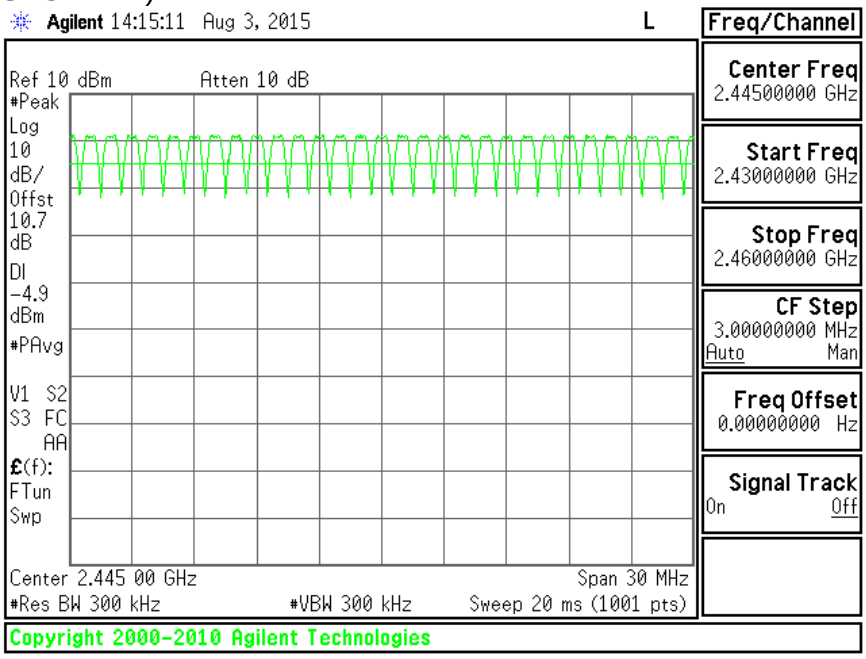
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)





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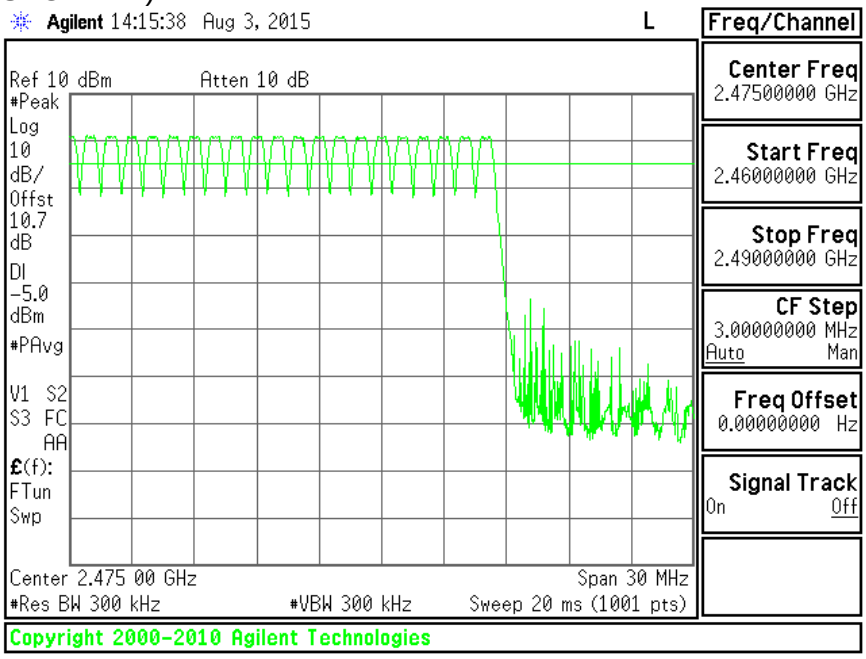
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)





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## 8.3.4. AVERAGE TIME OF OCCUPANCY

**LIMIT**

FCC §15.247 (a) (1) (iii)

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.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

**RESULTS**

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| GFSK Normal Mode | | | | | |
| DH1 | 0.388 | 31 | 0.120 | 0.4 | -0.280 |
| DH3 | 1.644 | 20 | 0.329 | 0.4 | -0.071 |
| DH5 | 2.88 | 13 | 0.374 | 0.4 | -0.026 |
| | | | | | |
| DH Packet | Pulse Width (msec) | Number of Pulses in 0.8 | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
| GFSK AFH Mode | | | | | |
| DH1 | 0.388 | 7.75 | 0.030 | 0.4 | -0.370 |
| DH3 | 1.644 | 5 | 0.082 | 0.4 | -0.318 |
| DH5 | 2.88 | 3.25 | 0.094 | 0.4 | -0.306 |


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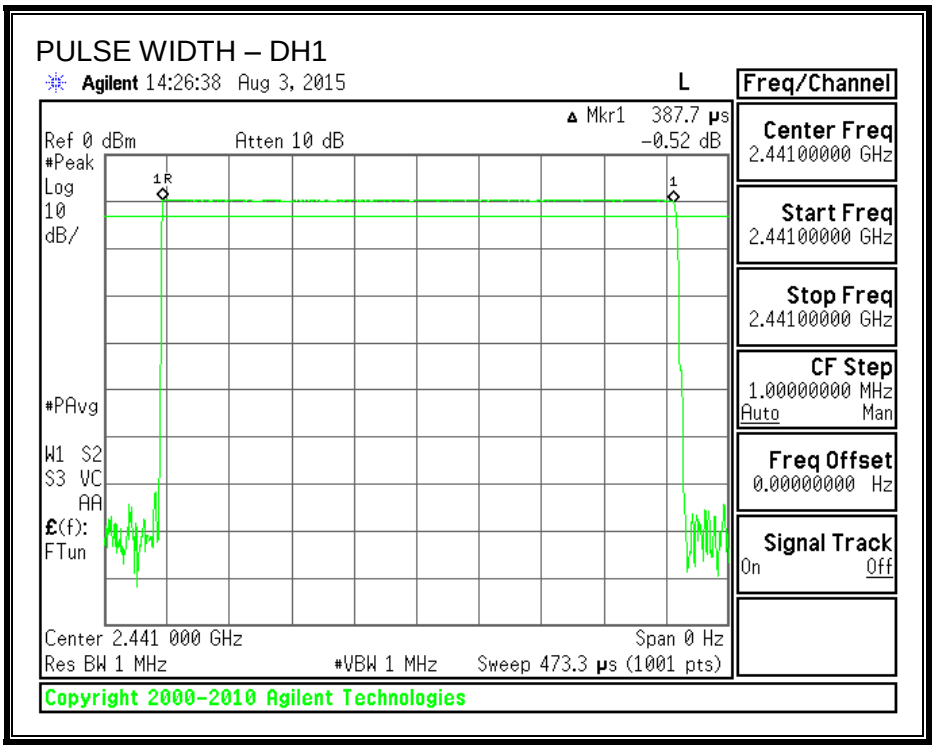
**PULSE WIDTH - DH1**





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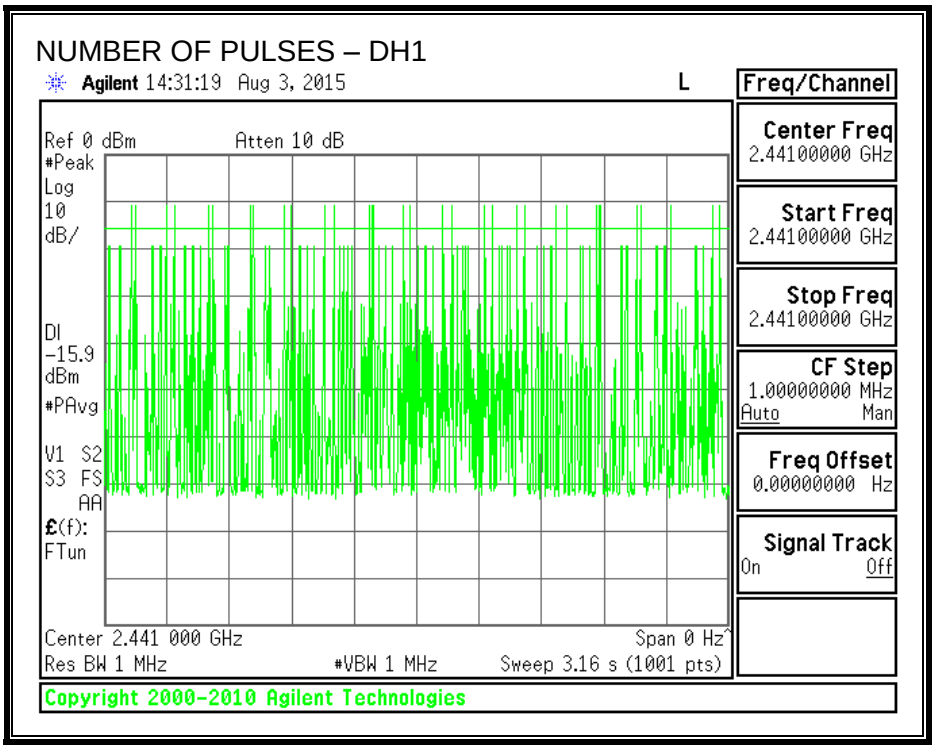
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1**





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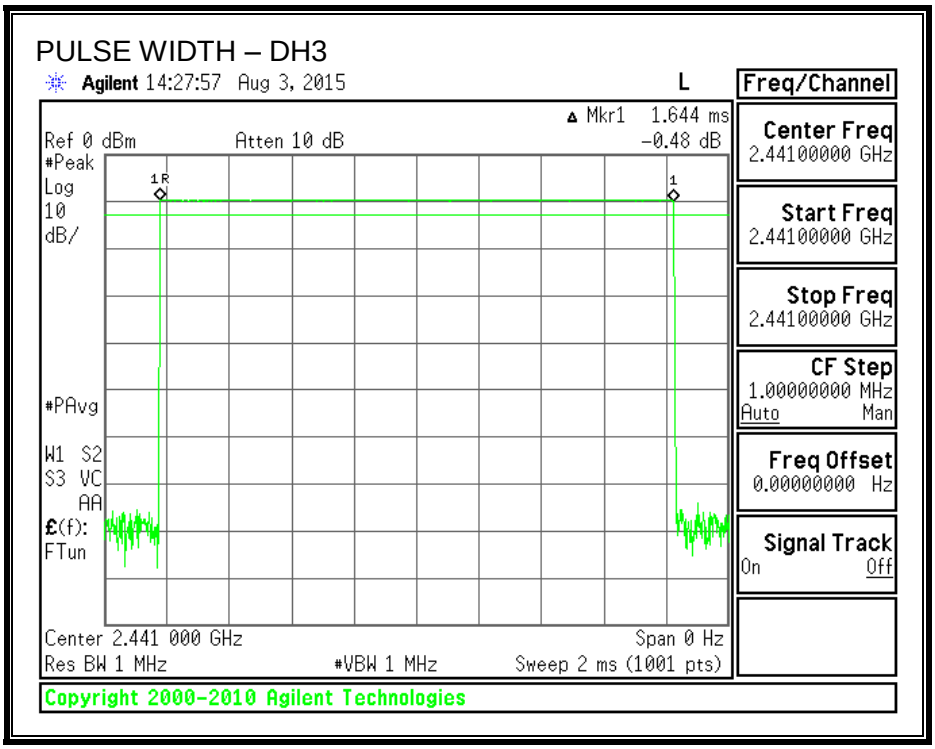
**PULSE WIDTH – DH3**





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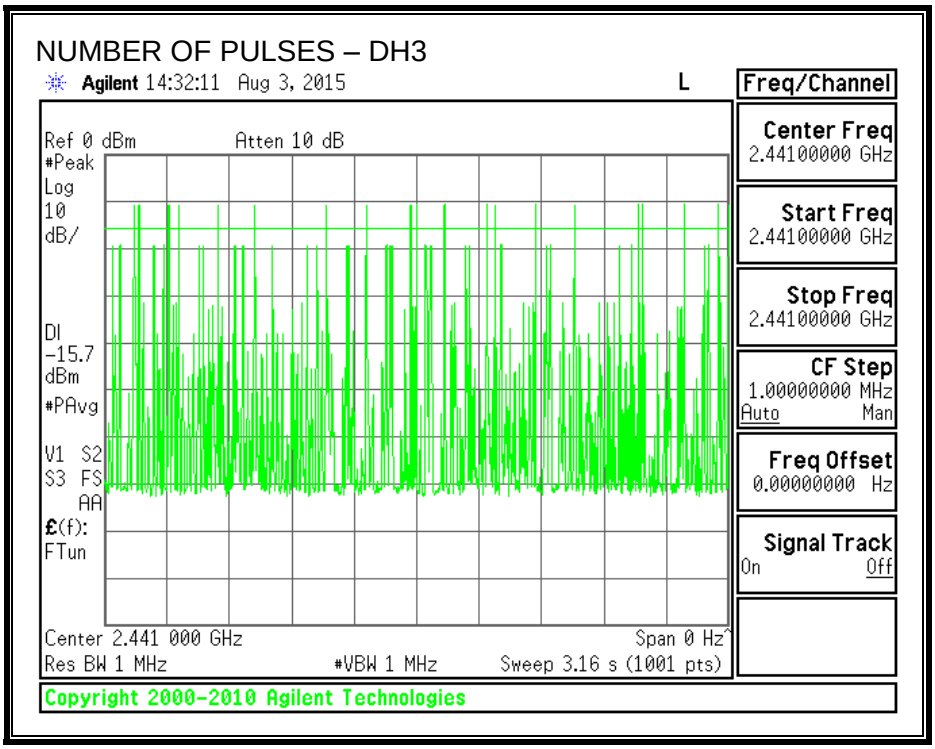
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**





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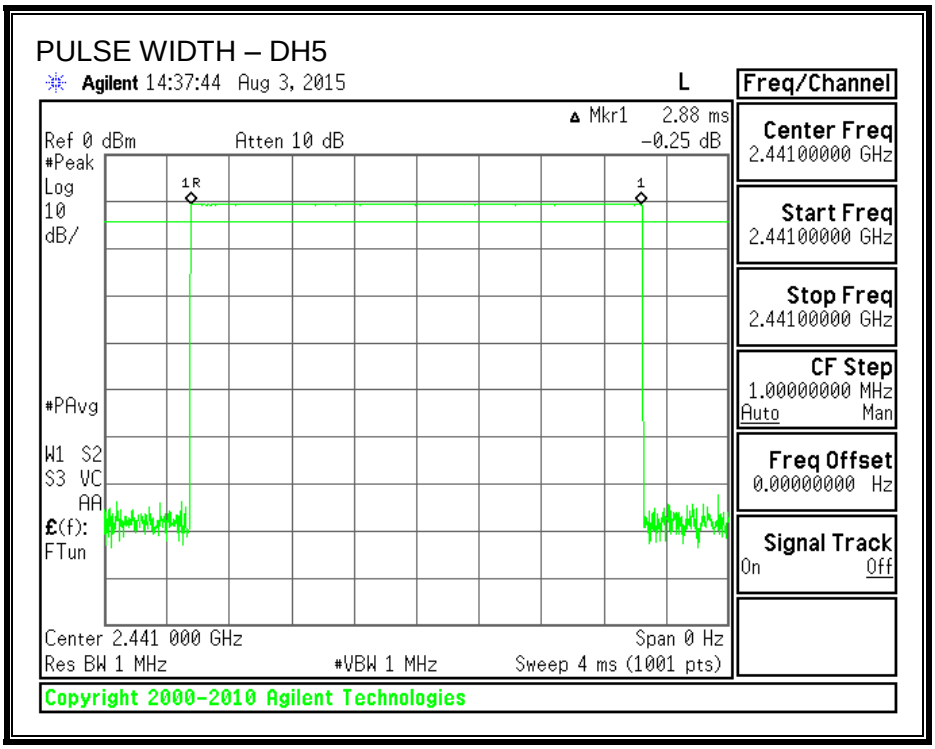
**PULSE WIDTH – DH5**





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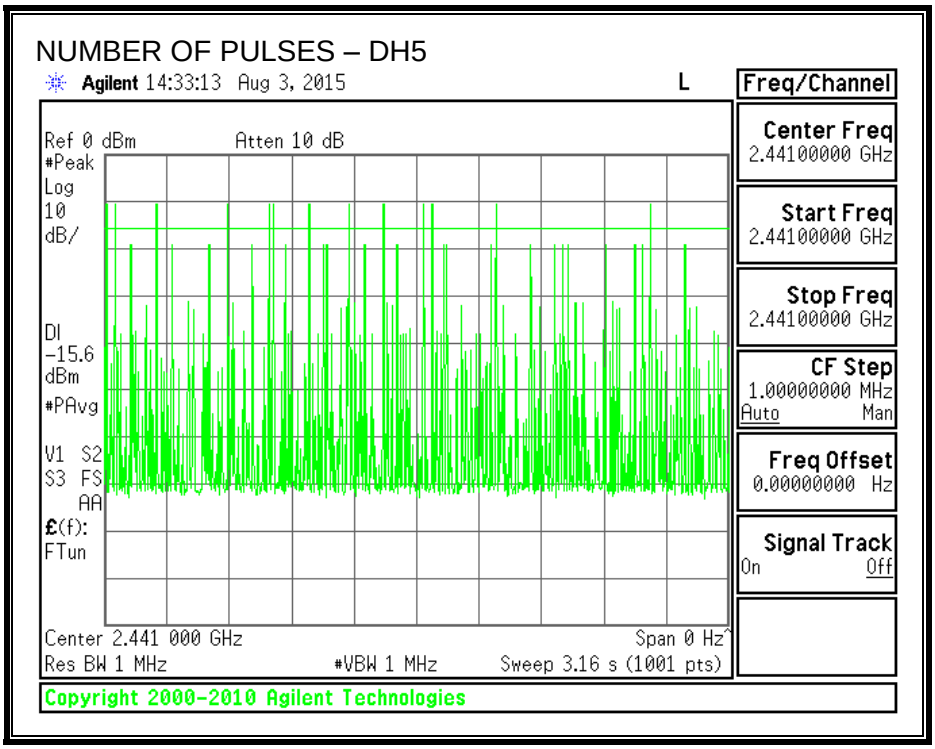
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**





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## 8.3.5. OUTPUT POWER

**LIMIT**

§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.

**TEST PROCEDURE**

The transmitter output is connected to a peak power meter.

**RESULTS**

For 75 or more hopping channels

| Channel | Frequency (MHz) | Output Power (dBm) | Directional Gain (dBi) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | 2402 | 3.41 | 1.70 | 30 | -26.59 |
| Middle | 2441 | 3.27 | 1.70 | 30 | -26.73 |
| High | 2480 | 3.22 | 1.70 | 30 | -26.78 |


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### 8.3.6. AVERAGE POWER

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

**RESULTS**

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Average Power (dBm) |
|---|---|---|
| Low | 2402 | 2.94 |
| Middle | 2441 | 2.81 |
| High | 2480 | 2.59 |


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## 8.3.7. CONDUCTED SPURIOUS EMISSIONS

**LIMITS**

FCC §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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set with hopping off and to the normal hopping mode.


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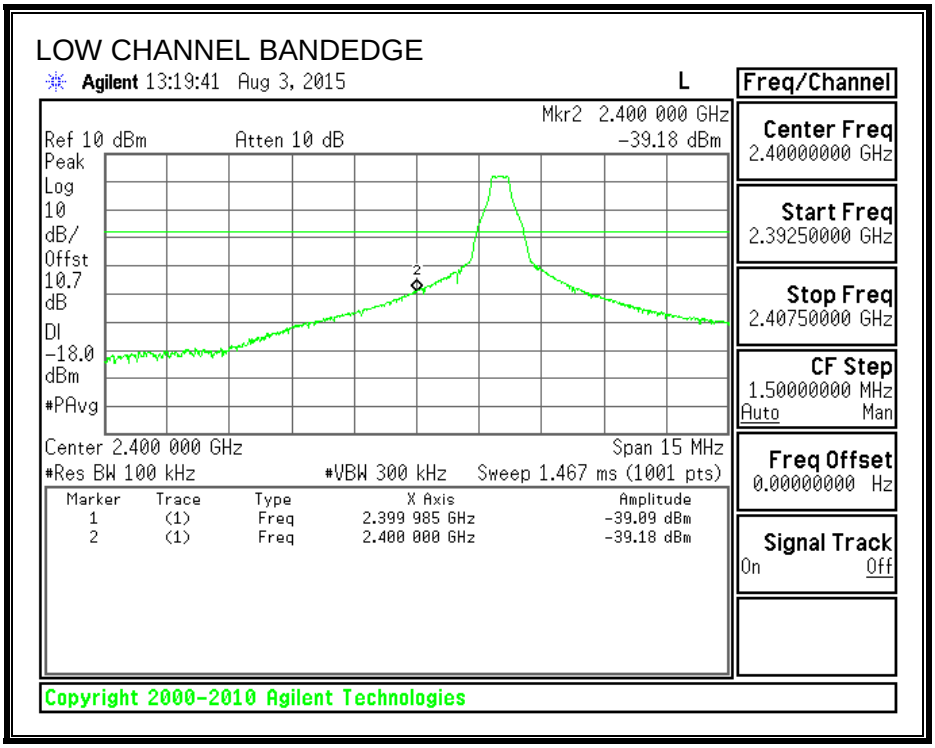
**RESULTS**

**SPURIOUS EMISSIONS, LOW CHANNEL**





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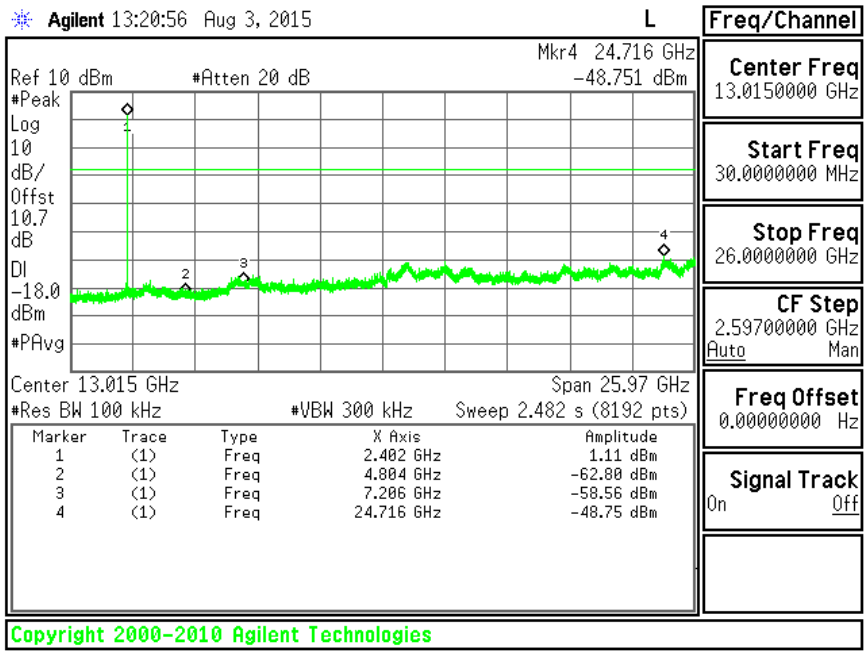
LOW CHANNEL SPURIOUS





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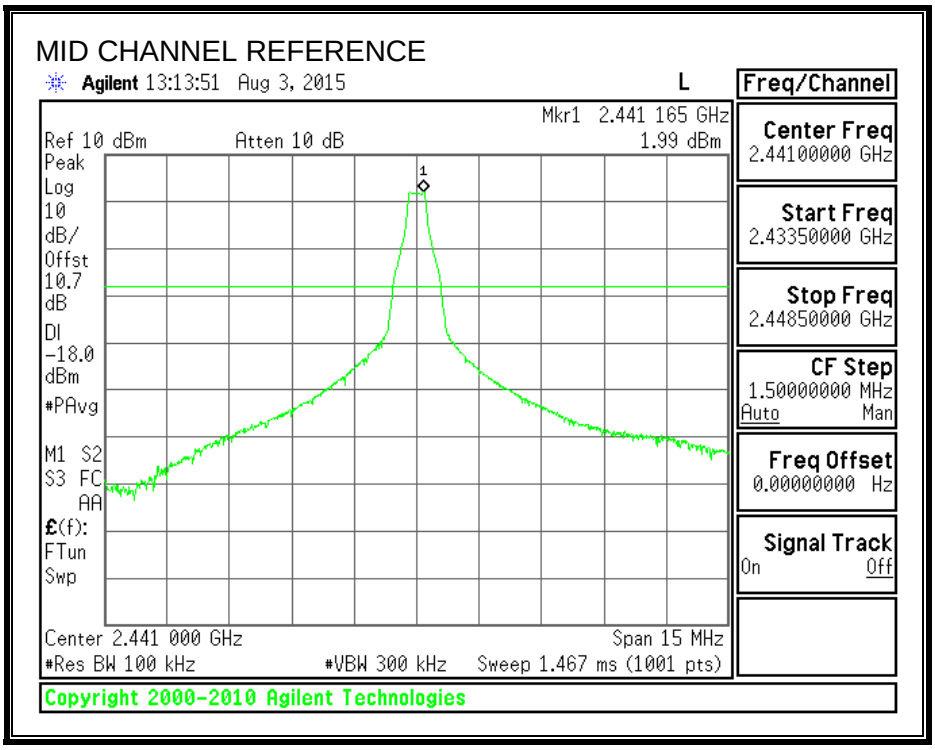
**SPURIOUS EMISSIONS, MID CHANNEL**





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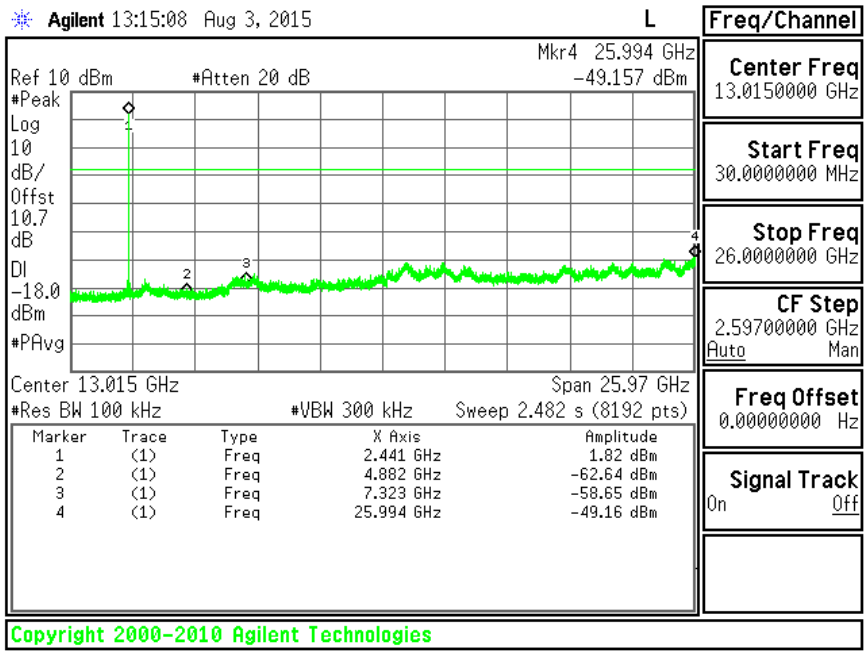
MID CHANNEL SPURIOUS





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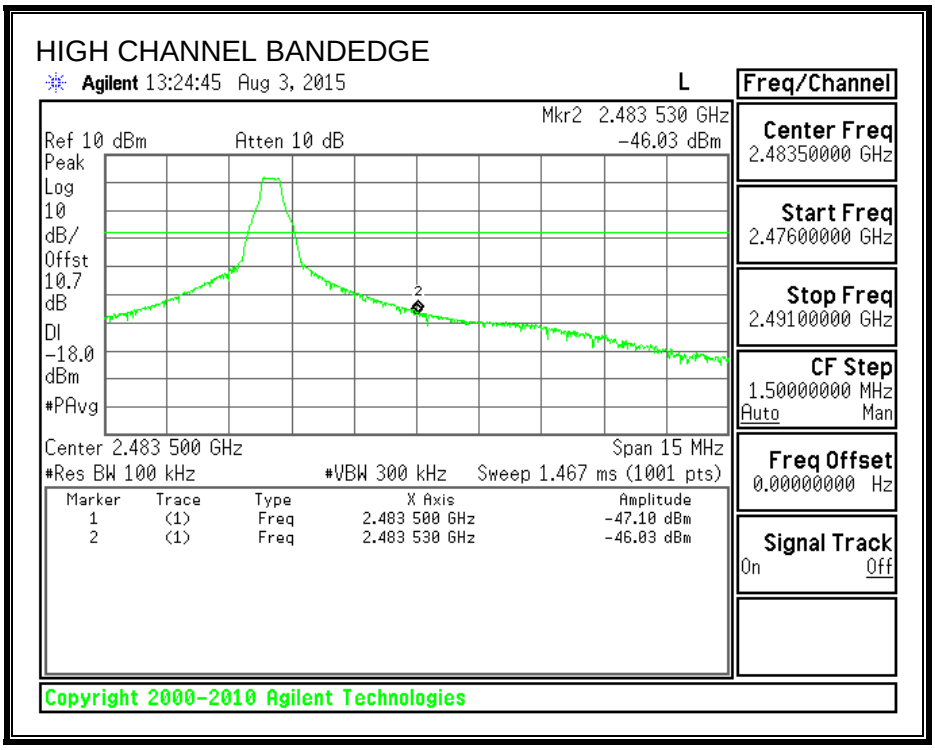
**SPURIOUS EMISSIONS, HIGH CHANNEL**





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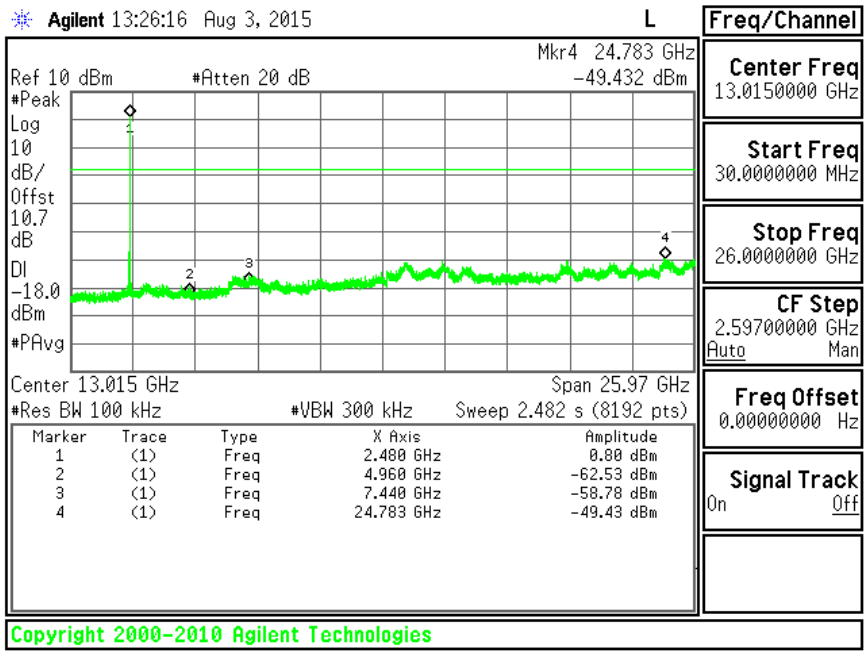
HIGH CHANNEL SPURIOUS





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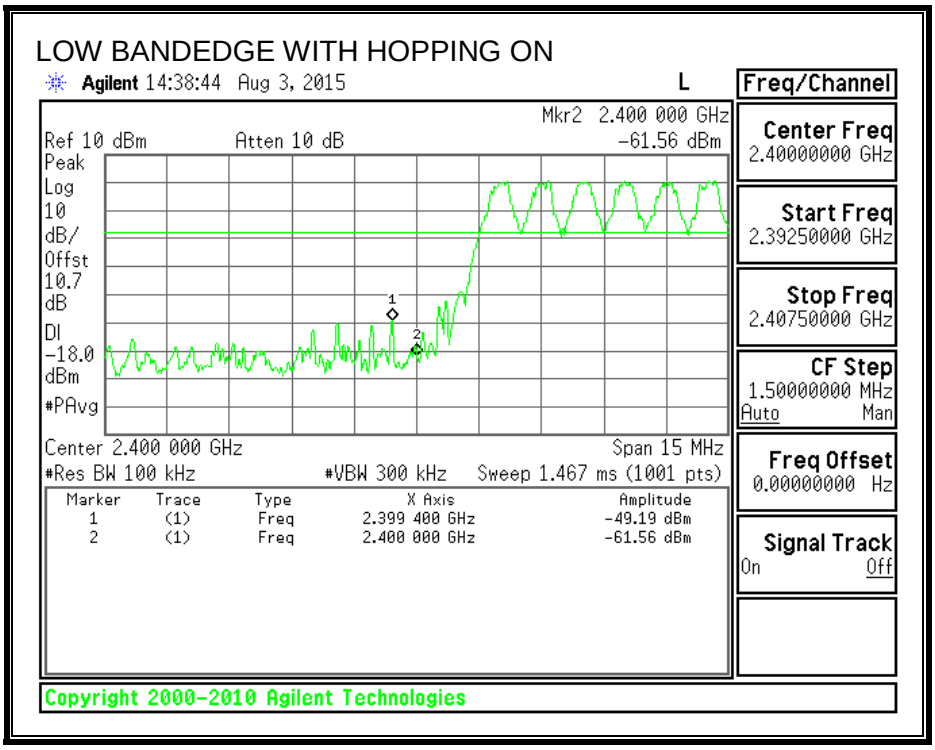
**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**





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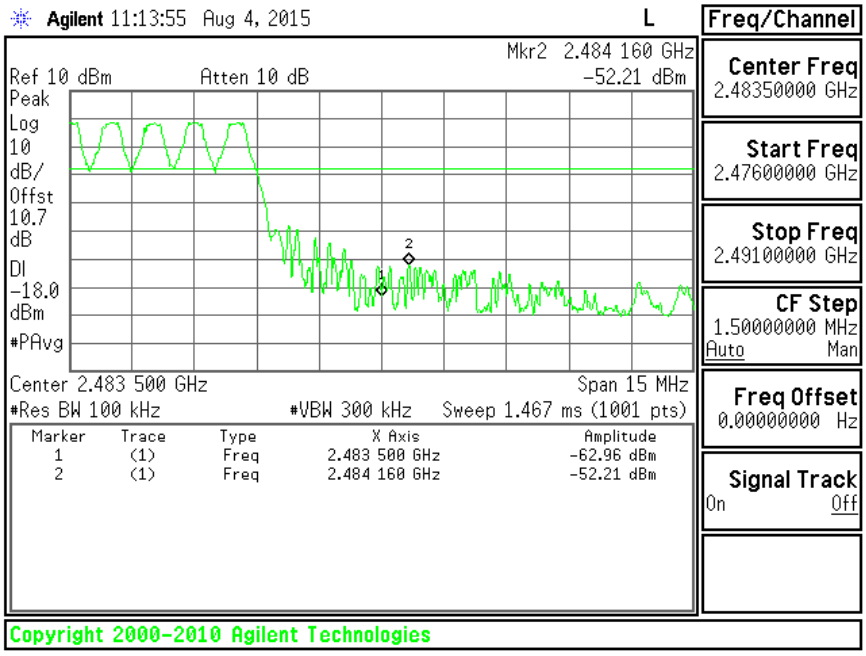
HIGH BANDEDGE WITH HOPPING ON





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## 8.4. ENHANCED DATA RATE QPSK MODULATION

### 8.4.1. 20 dB AND 99% BANDWIDTH

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 99% OBW. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 20 dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|---|---|---|---|
| Low | 2402 | 1323 | 1176.1 |
| Middle | 2441 | 1311 | 1174.3 |
| High | 2480 | 1305 | 1158.1 |


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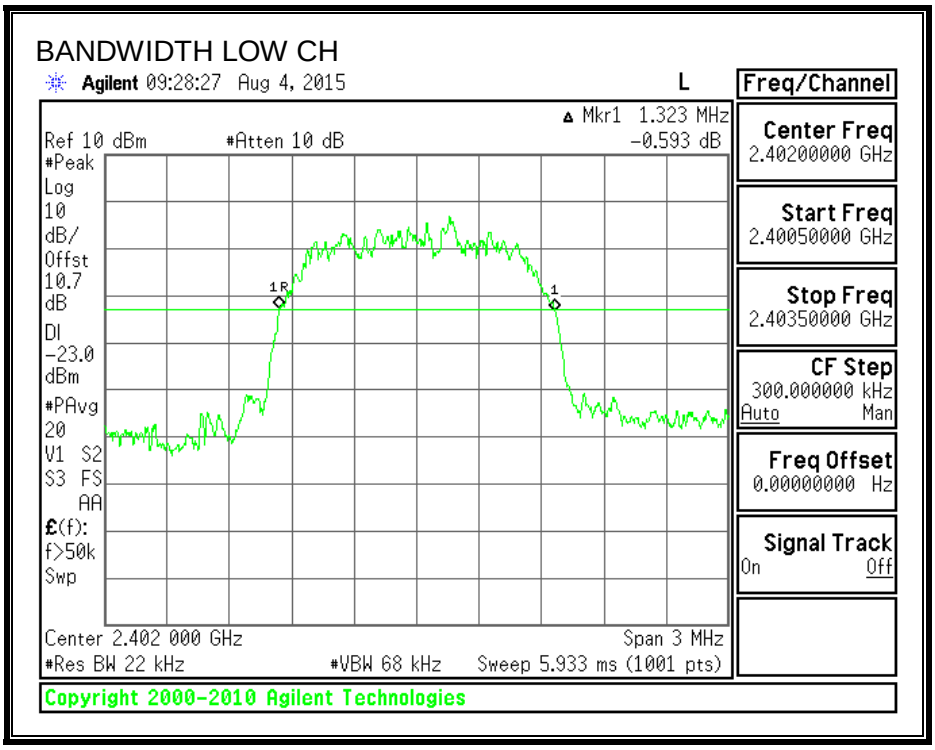
**20 dB BANDWIDTH**





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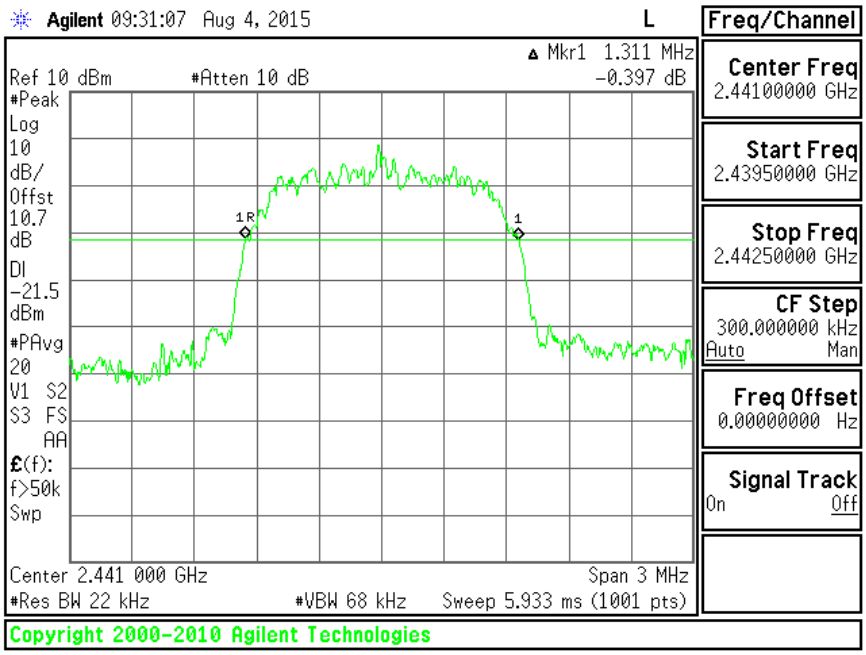
BANDWIDTH MID CH





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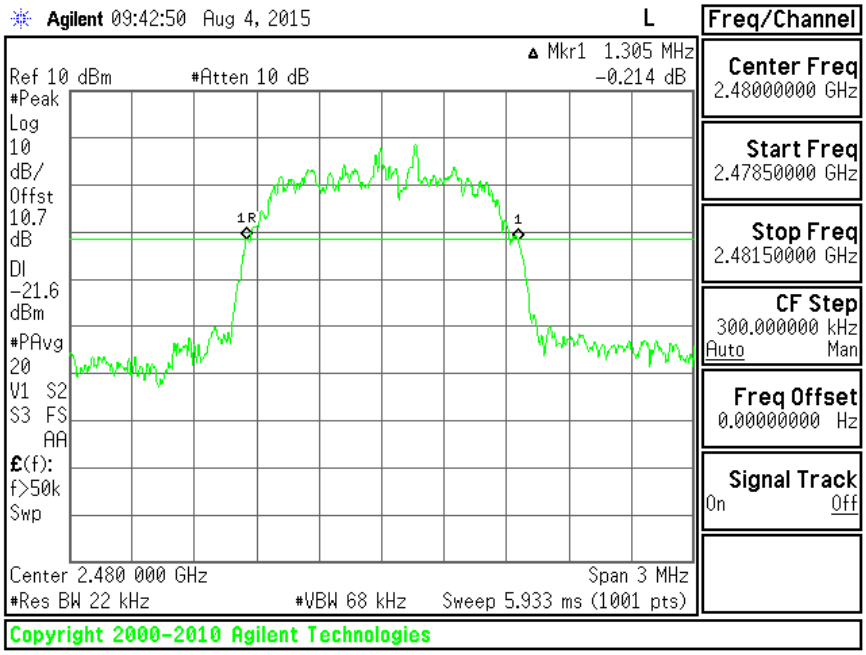
BANDWIDTH HIGH CH





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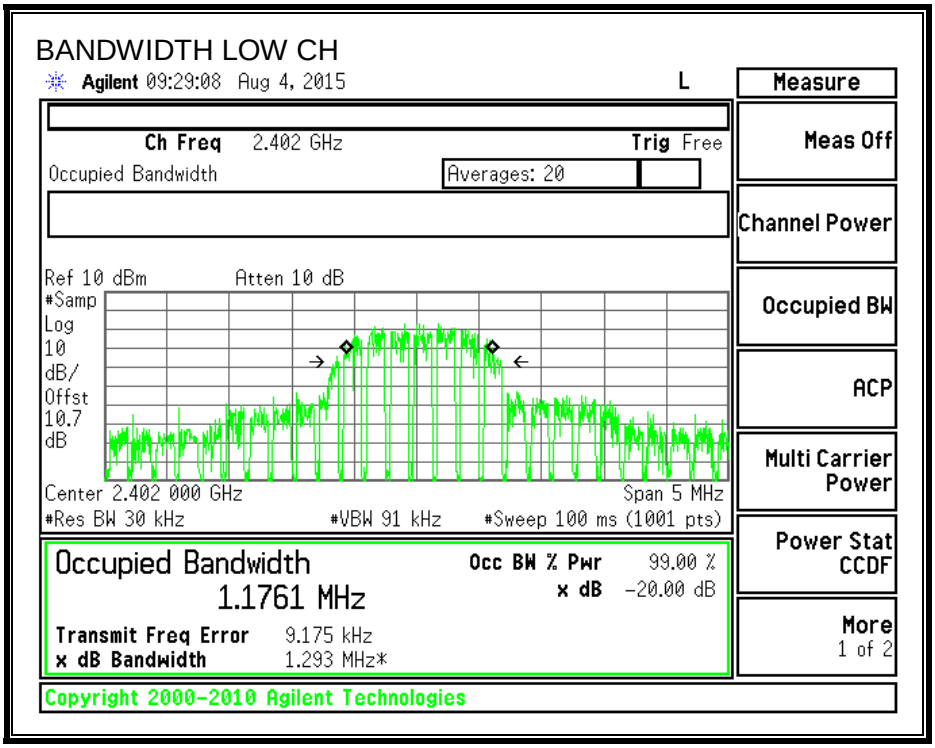
## 99% BANDWIDTH





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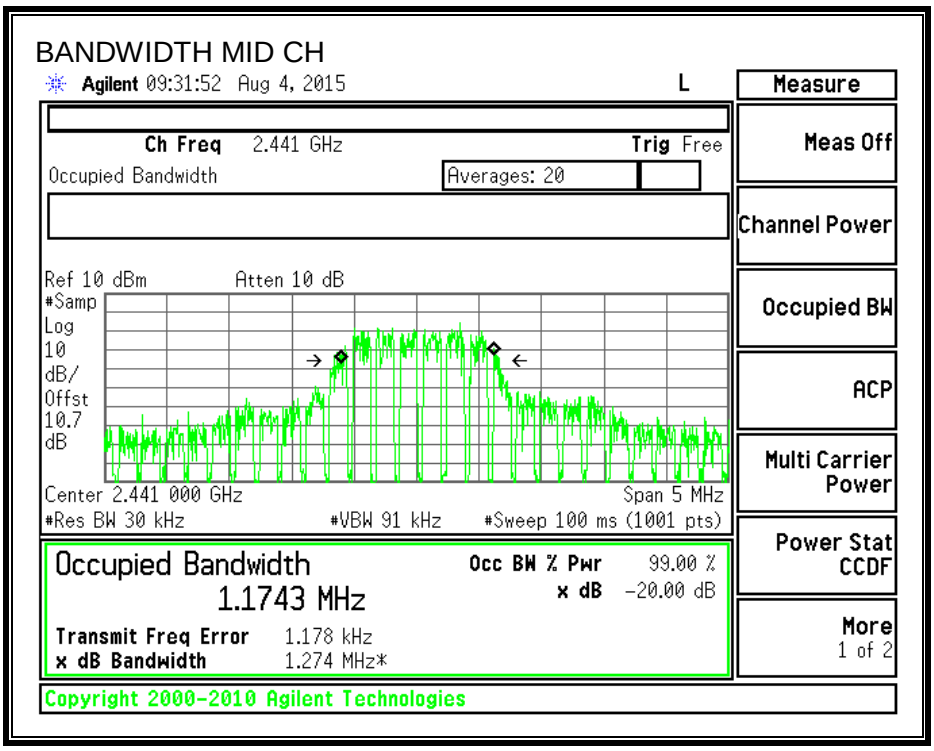



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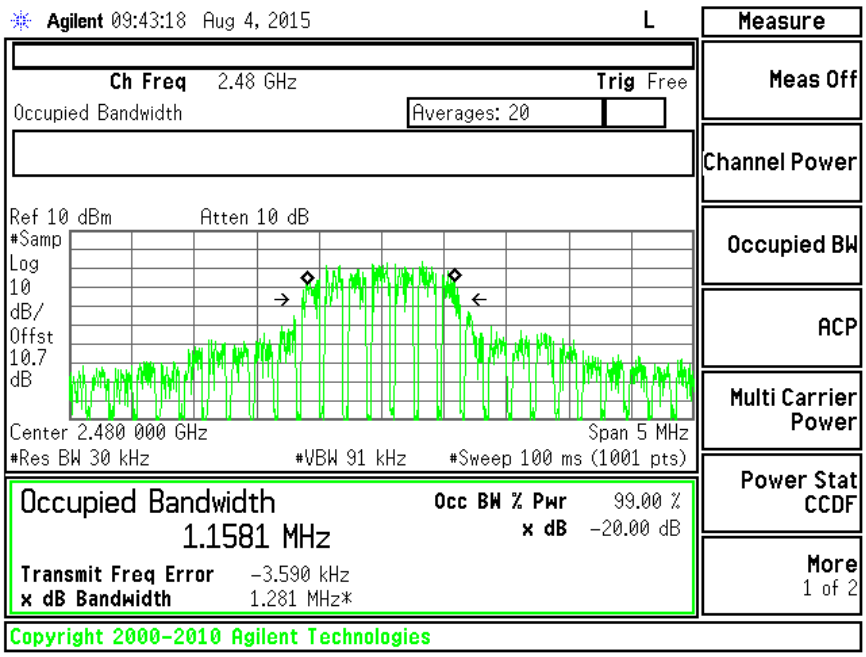
BANDWIDTH HIGH CH





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## 8.4.2. AVERAGE TIME OF OCCUPANCY

**LIMIT**

FCC §15.247 (a) (1) (iii)

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.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

**RESULTS**

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

DQPSK Mode

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| DH1 | 0.390 | 28 | 0.109 | 0.4 | -0.291 |
| DH3 | 1.642 | 20 | 0.328 | 0.4 | -0.072 |
| DH5 | 2.889 | 7 | 0.202 | 0.4 | -0.198 |


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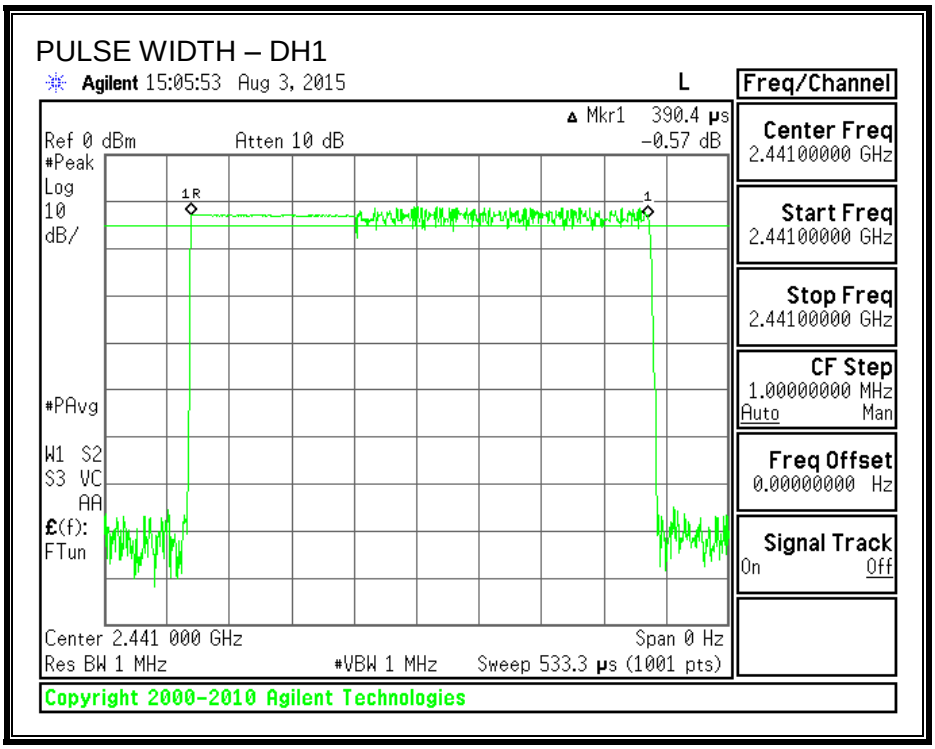
**PULSE WIDTH - DH1**





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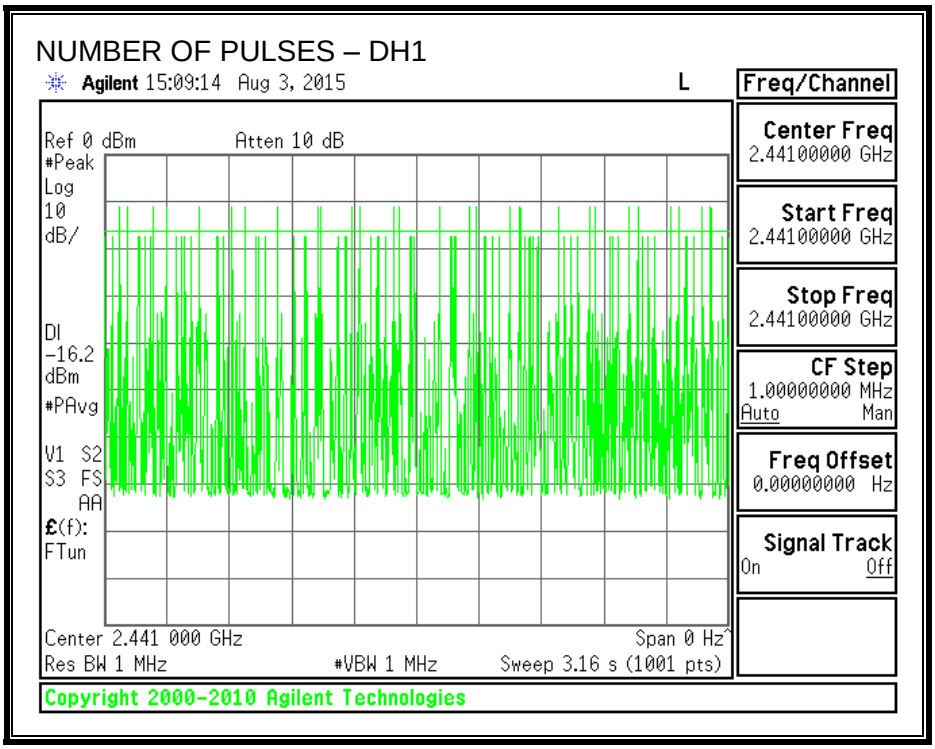
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1**





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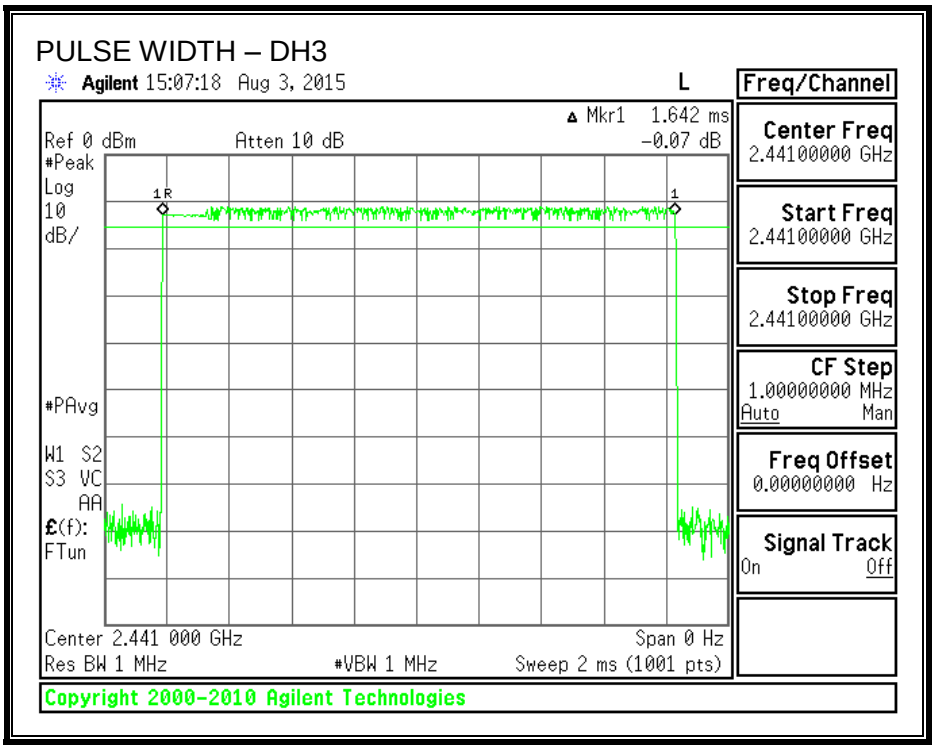
**PULSE WIDTH – DH3**





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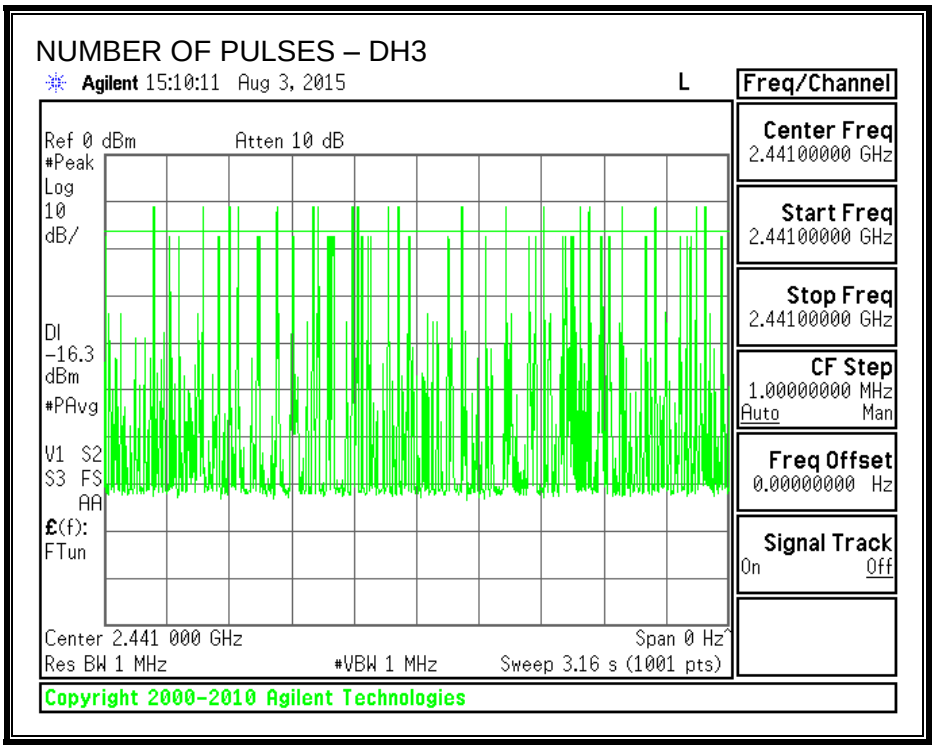
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**





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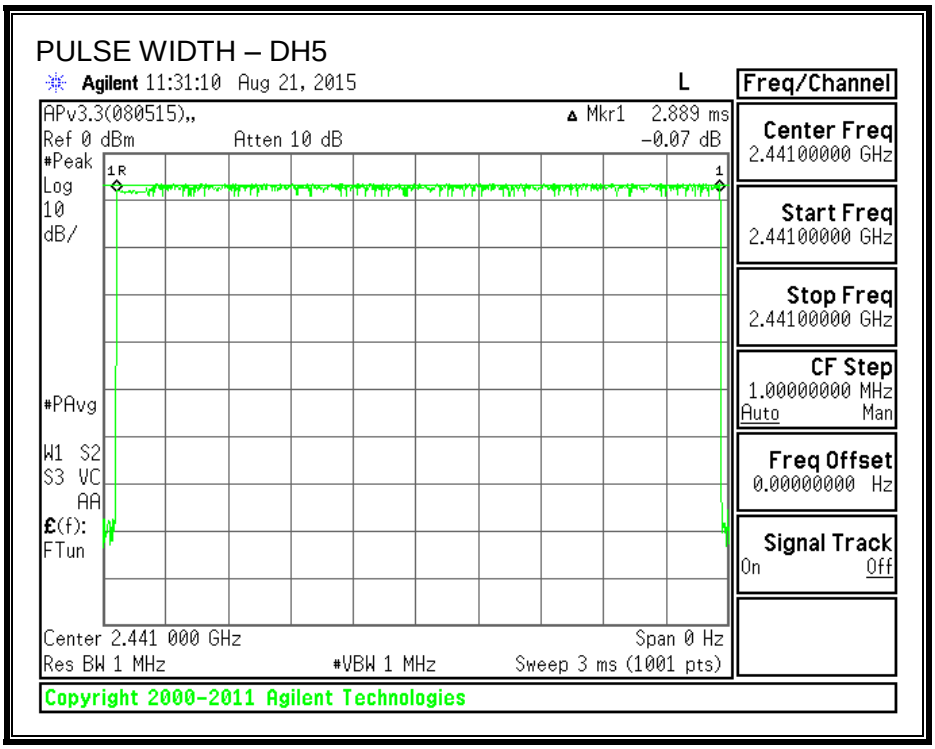
**PULSE WIDTH – DH5**





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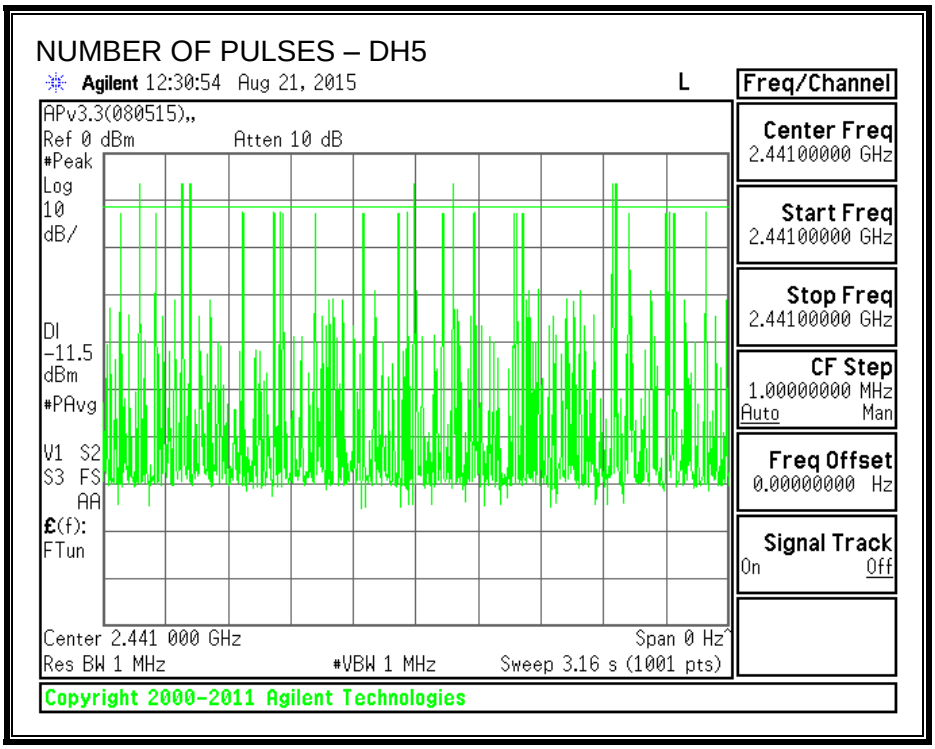
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**





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### 8.4.3. OUTPUT POWER

**LIMIT**

§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.

**TEST PROCEDURE**

The transmitter output is connected to a peak power meter.

**RESULTS**

For 75 or more hopping channels

| Channel | Frequency (MHz) | Output Power (dBm) | Directional Gain (dBi) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | 2402 | 5.83 | 1.70 | 30 | -24.17 |
| Middle | 2441 | 5.70 | 1.70 | 30 | -24.30 |
| High | 2480 | 5.46 | 1.70 | 30 | -24.54 |


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### 8.4.4. AVERAGE POWER

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

**RESULTS**

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Average Power (dBm) |
|---|---|---|
| Low | 2402 | 3.05 |
| Middle | 2441 | 2.92 |
| High | 2480 | 2.63 |


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## 8.5. ENHANCED DATA RATE 8PSK MODULATION

### 8.5.1. 20 dB AND 99% BANDWIDTH

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 99% OBW. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 20 dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|---|---|---|---|
| Low | 2402 | 1329 | 1178.2 |
| Middle | 2441 | 1338 | 1184.6 |
| High | 2480 | 1290 | 1187.4 |


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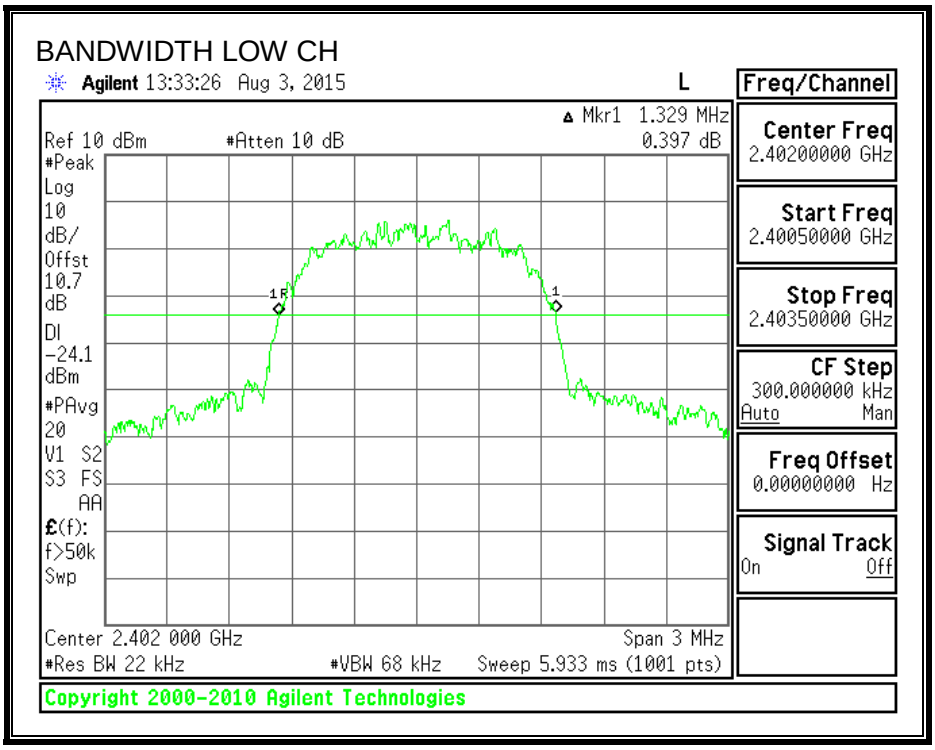
**20 dB BANDWIDTH**





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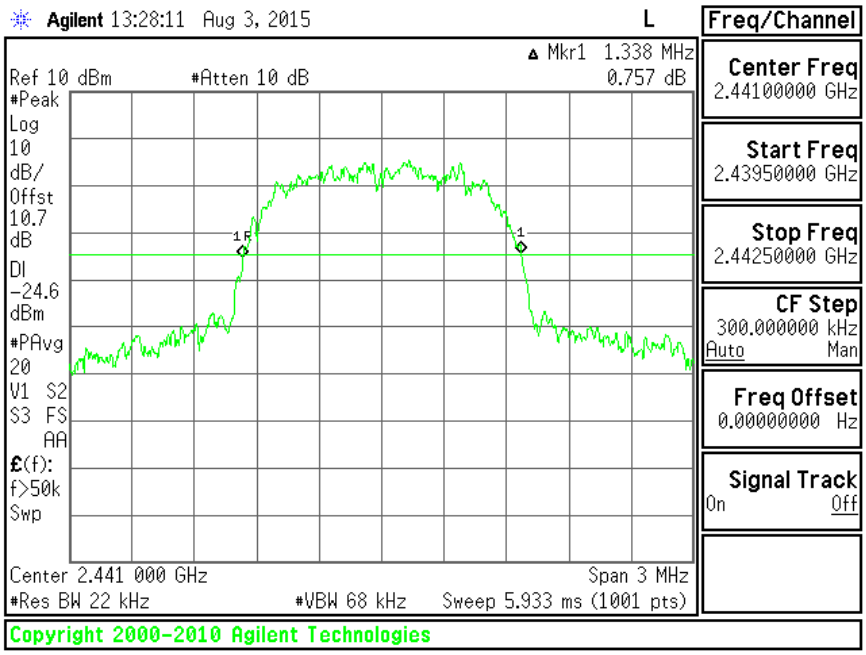
BANDWIDTH MID CH





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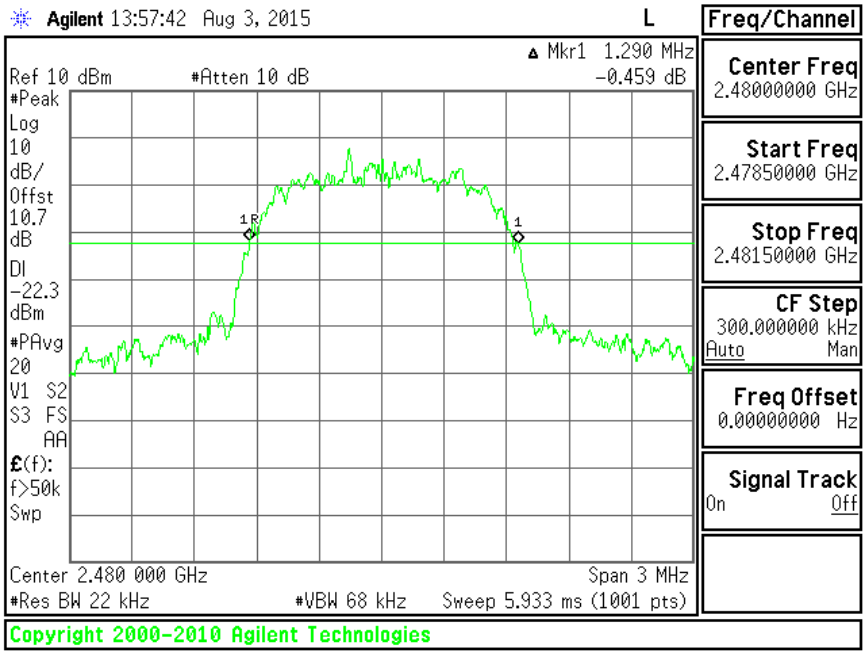
BANDWIDTH HIGH CH





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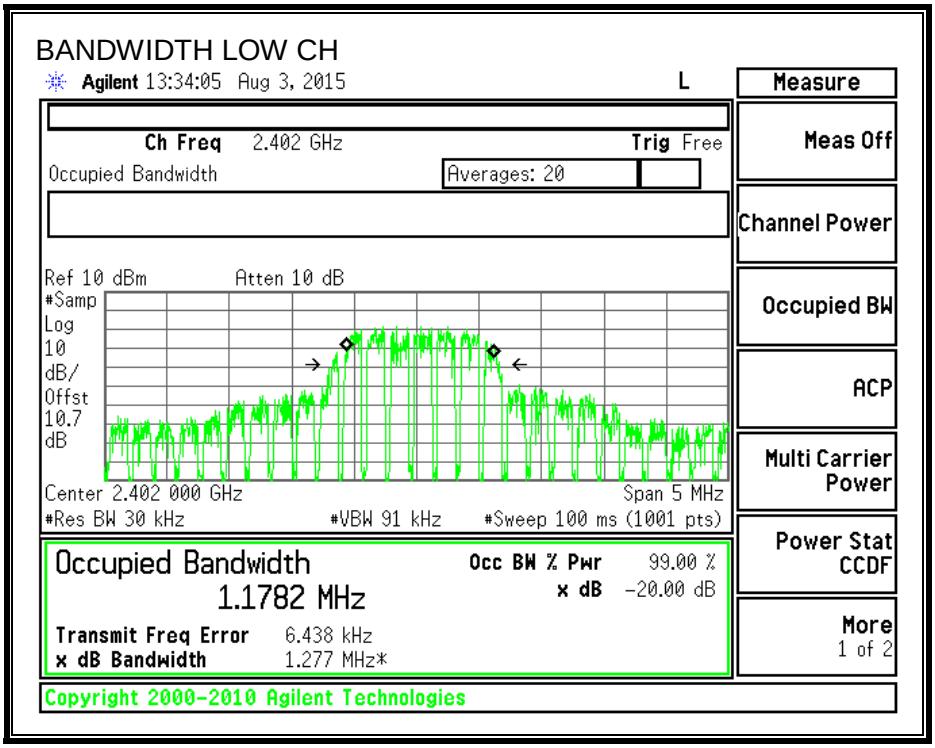
## 99% BANDWIDTH





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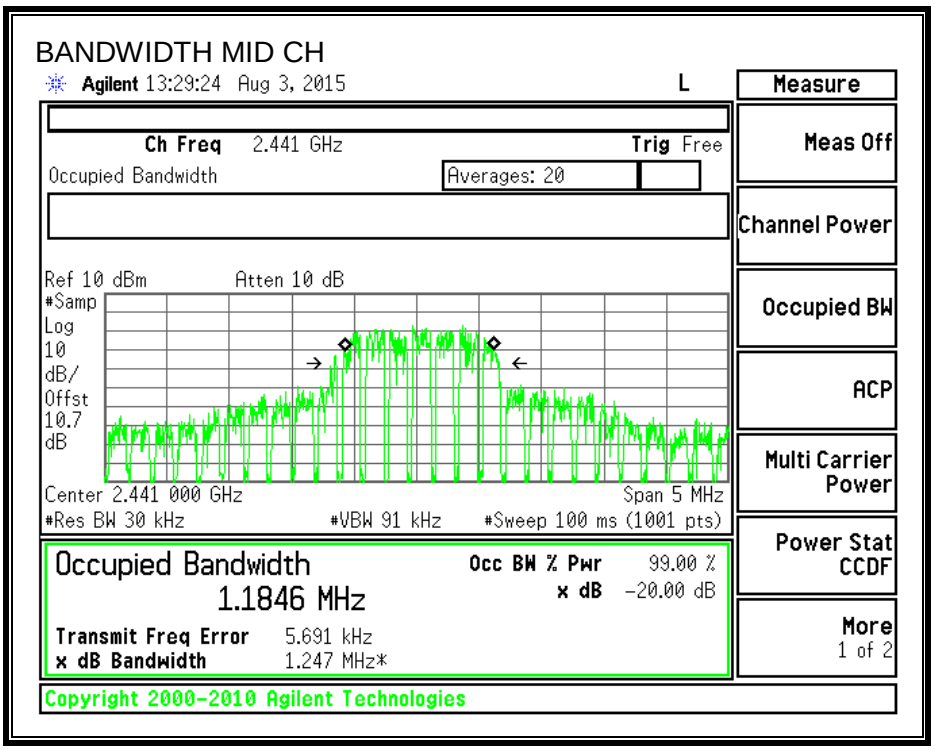
BANDWIDTH MID CH





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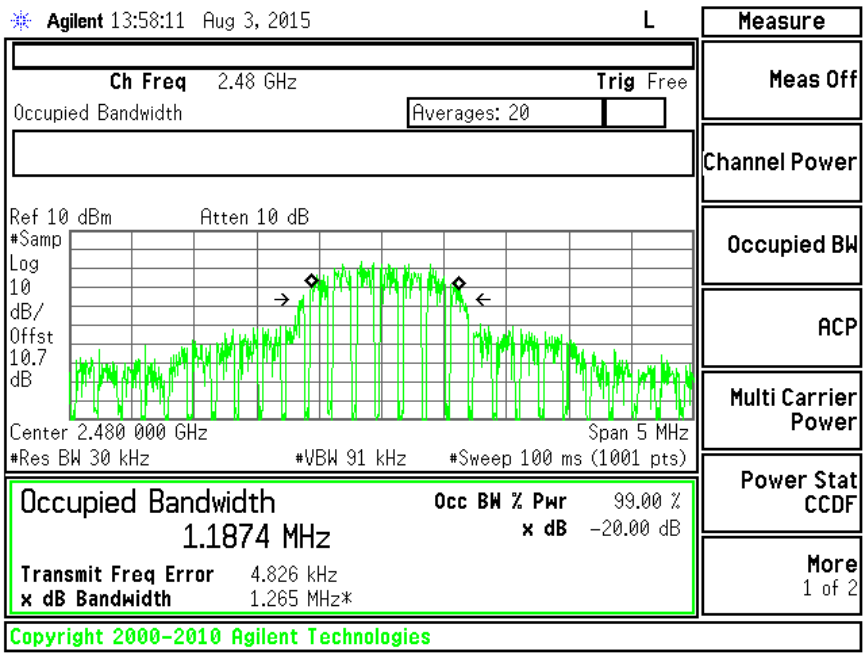
BANDWIDTH HIGH CH





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## 8.5.2. HOPPING FREQUENCY SEPARATION

**LIMIT**

FCC §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 hoping 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 PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% span and the VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

Note – The EUT's channel separation (1MHz) is less than the 20 dB BW (1.338 MHz). However, the EUT's power is less than 1W and the channel separation is allowed to be 2/3's the 20 dB BW or 892 kHz.


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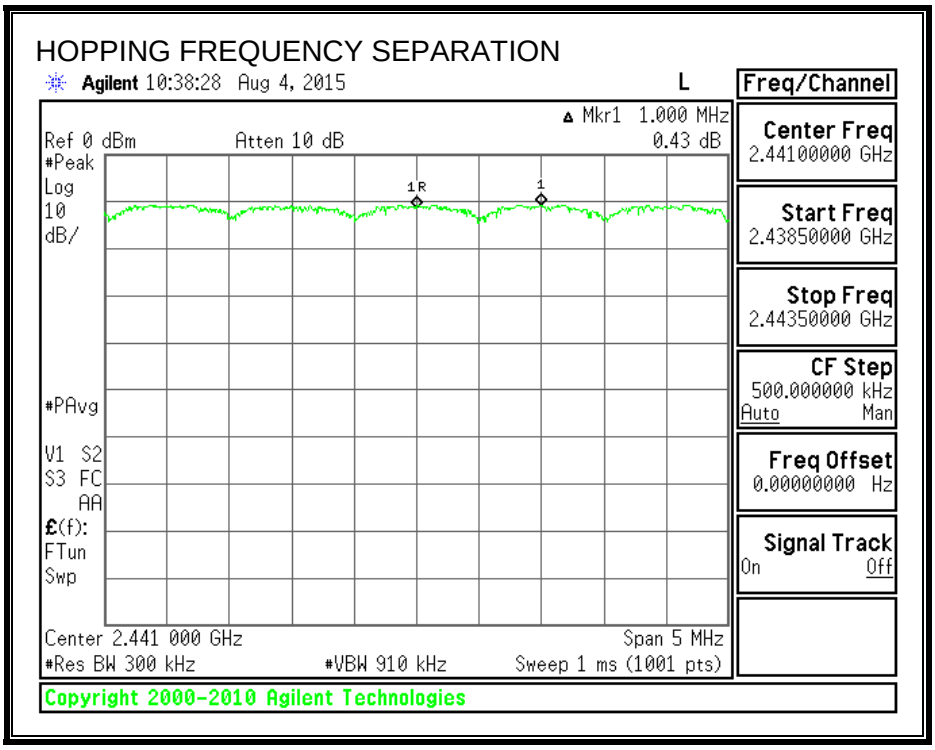
**HOPPING FREQUENCY SEPARATION**





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### 8.5.3. NUMBER OF HOPPING CHANNELS

**LIMIT**

FCC §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

**RESULTS**

Normal Mode: 79 Channels observed.

AFH Mode: 20 Channels declared.


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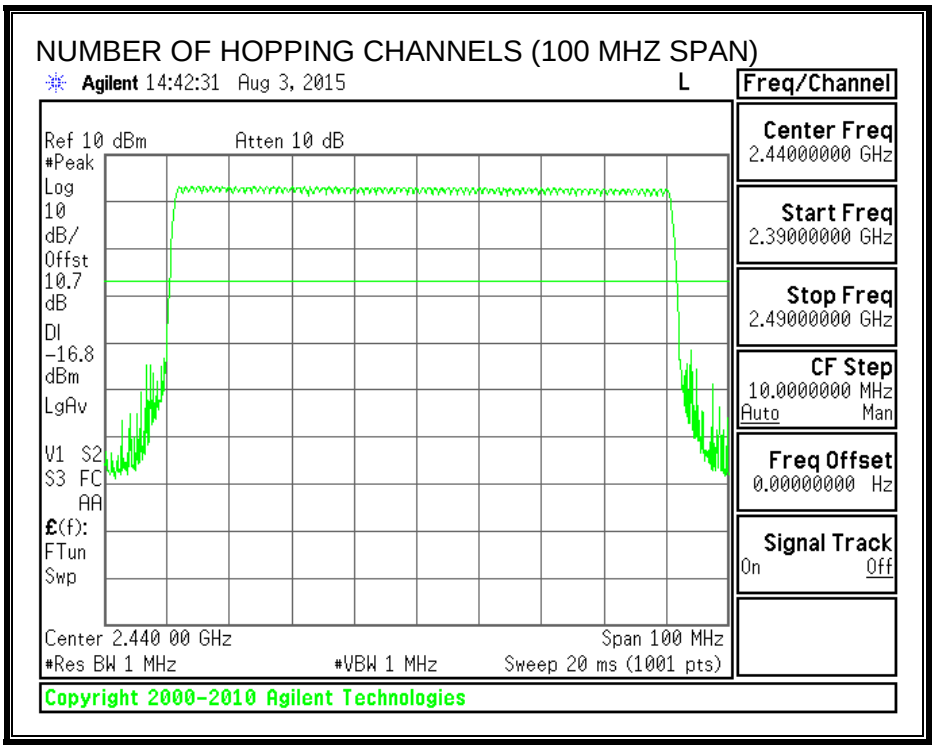
**NUMBER OF HOPPING CHANNELS**





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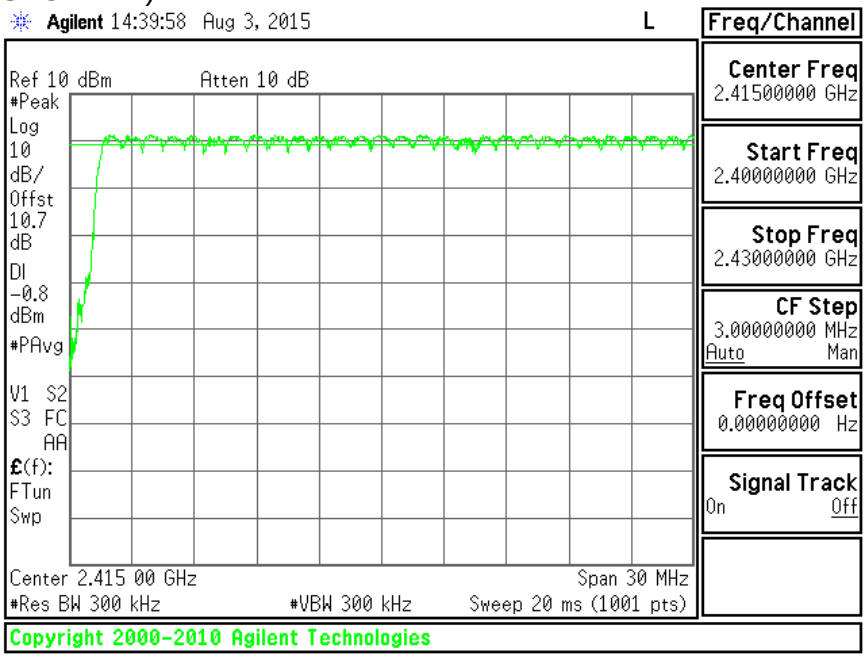
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)





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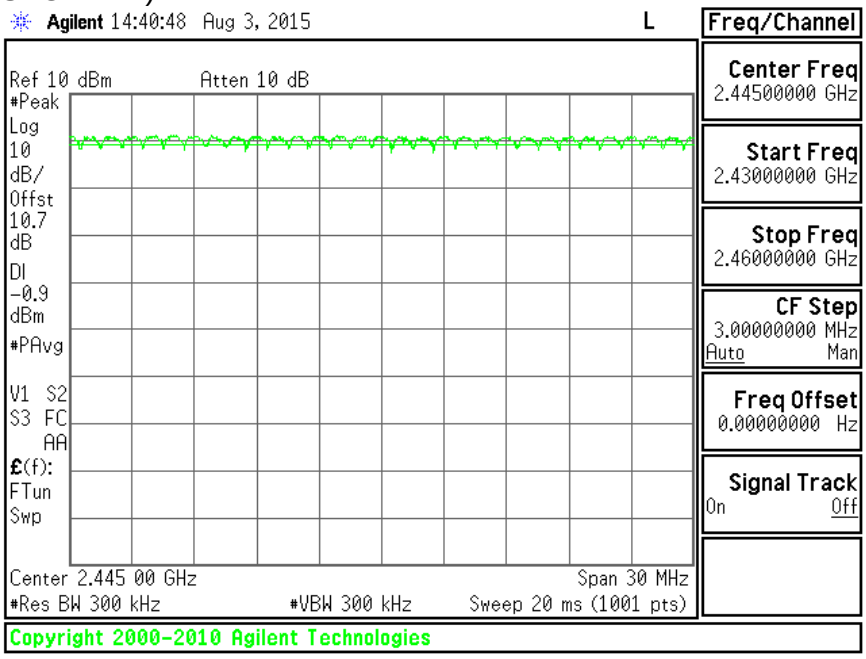
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)





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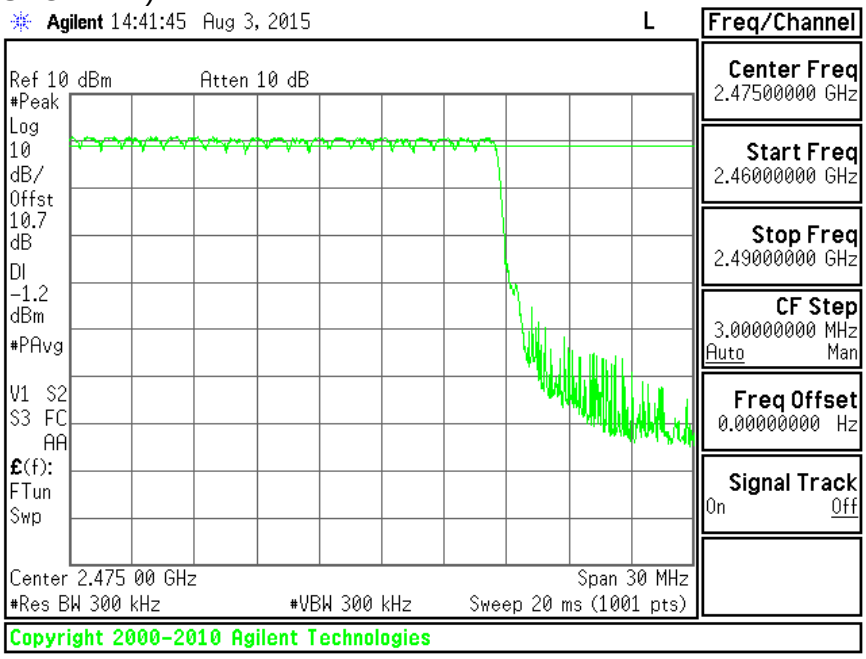
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)





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## 8.5.4. AVERAGE TIME OF OCCUPANCY

**LIMIT**

FCC §15.247 (a) (1) (iii)

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.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

**RESULTS**

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

8PSK (EDR) Mode

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| DH1 | 0.390 | 31 | 0.121 | 0.4 | -0.279 |
| DH3 | 1.638 | 12 | 0.197 | 0.4 | -0.203 |
| DH5 | 2.889 | 13 | 0.376 | 0.4 | -0.024 |

**Note:** for AFH (8PSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 32 demonstrates compliance with channel occupancy when AFH is employed.


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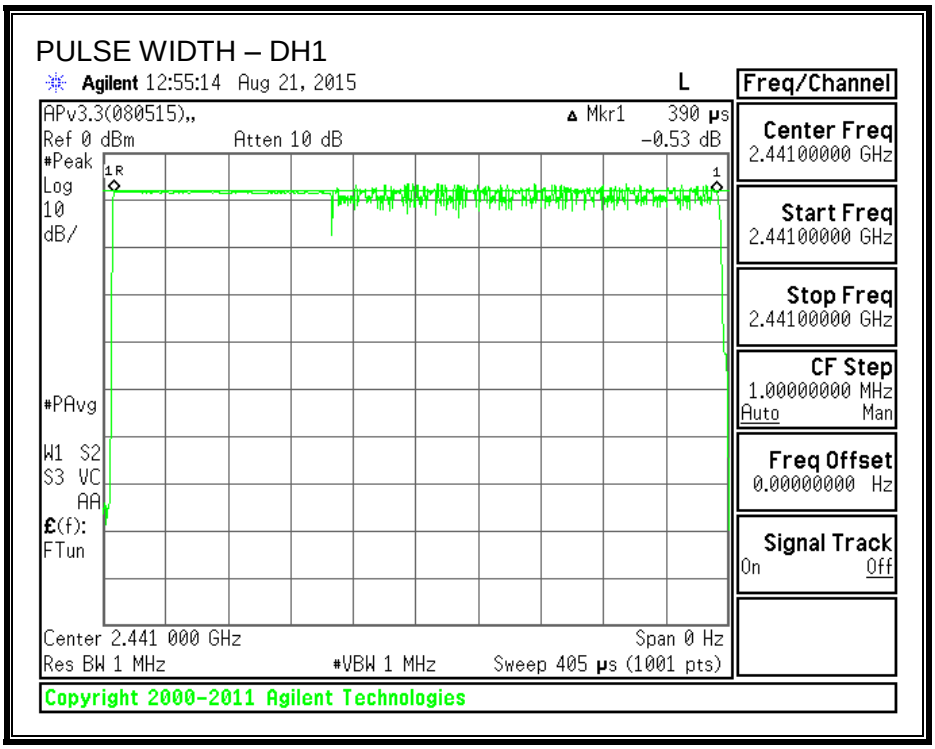
**PULSE WIDTH - DH1**





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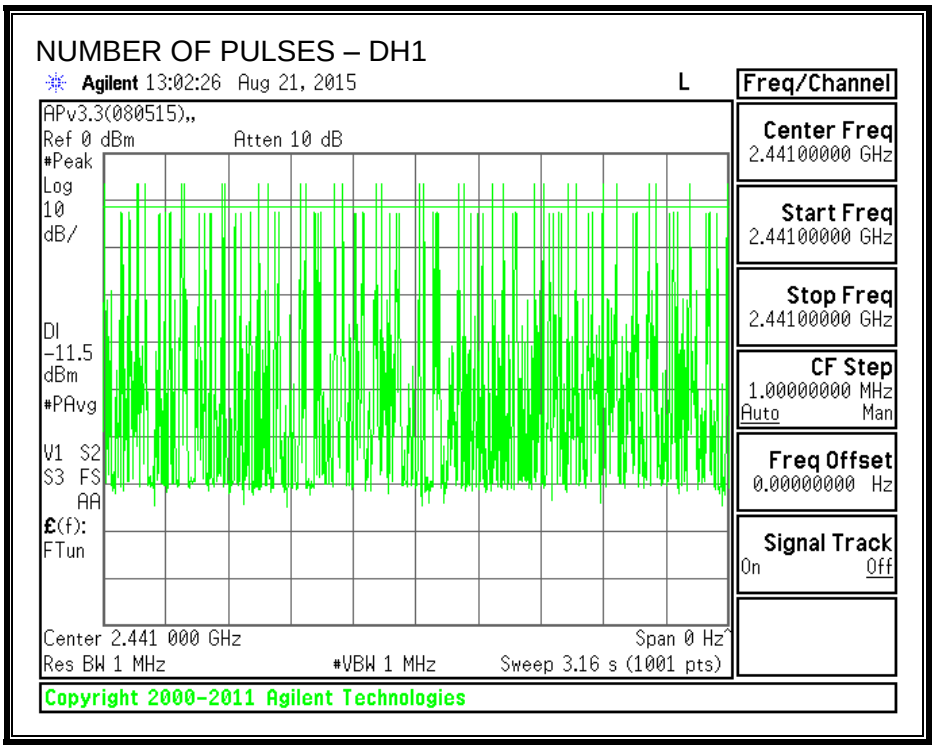
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1**





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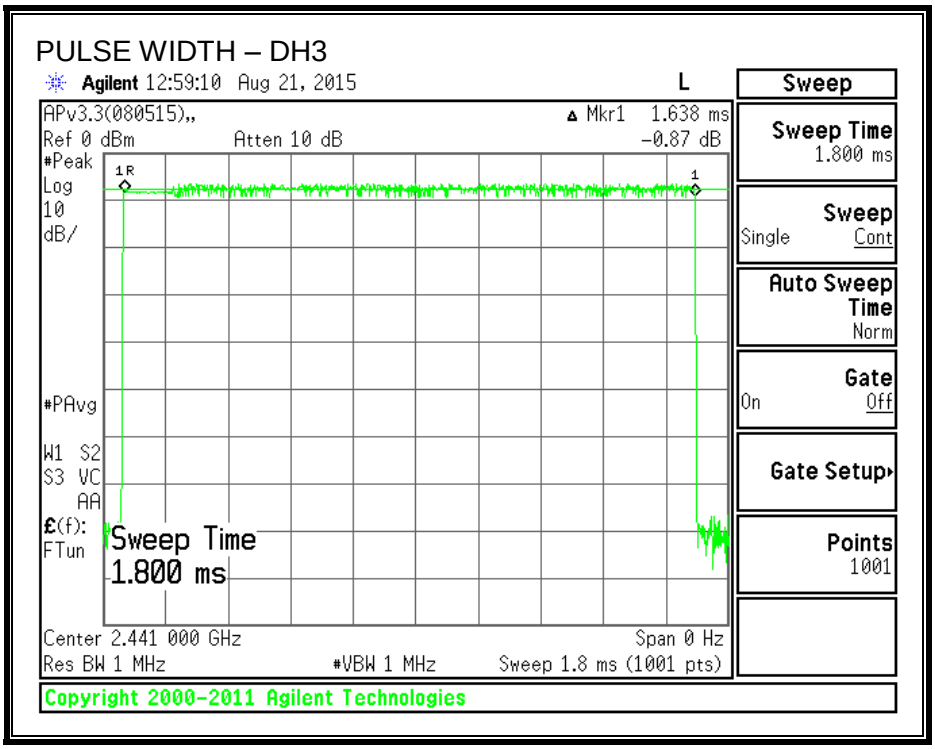
**PULSE WIDTH – DH3**





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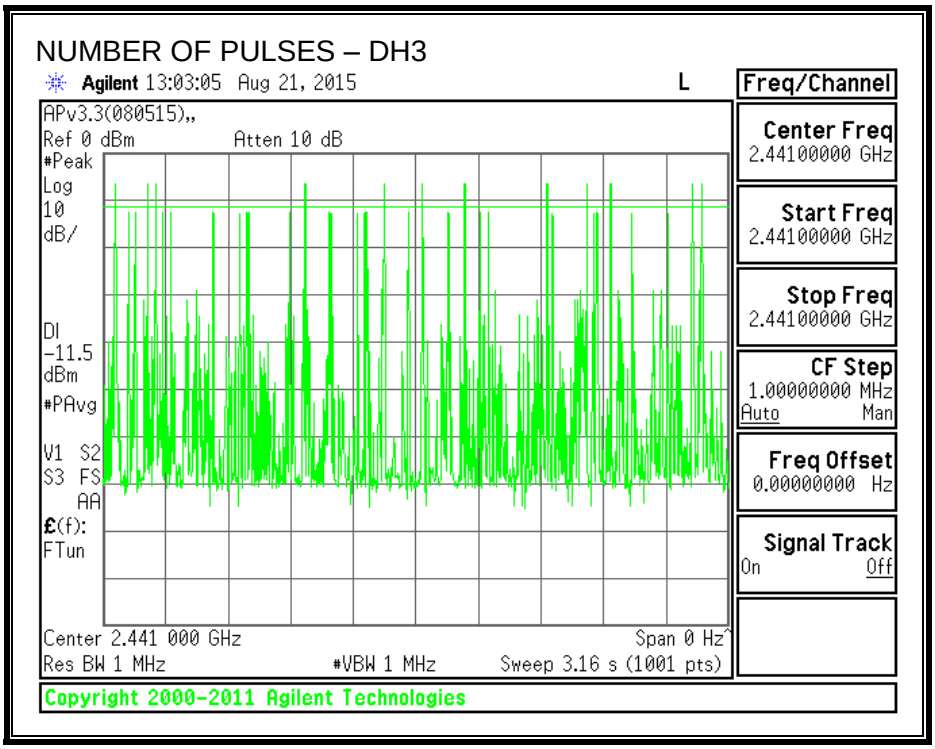
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**





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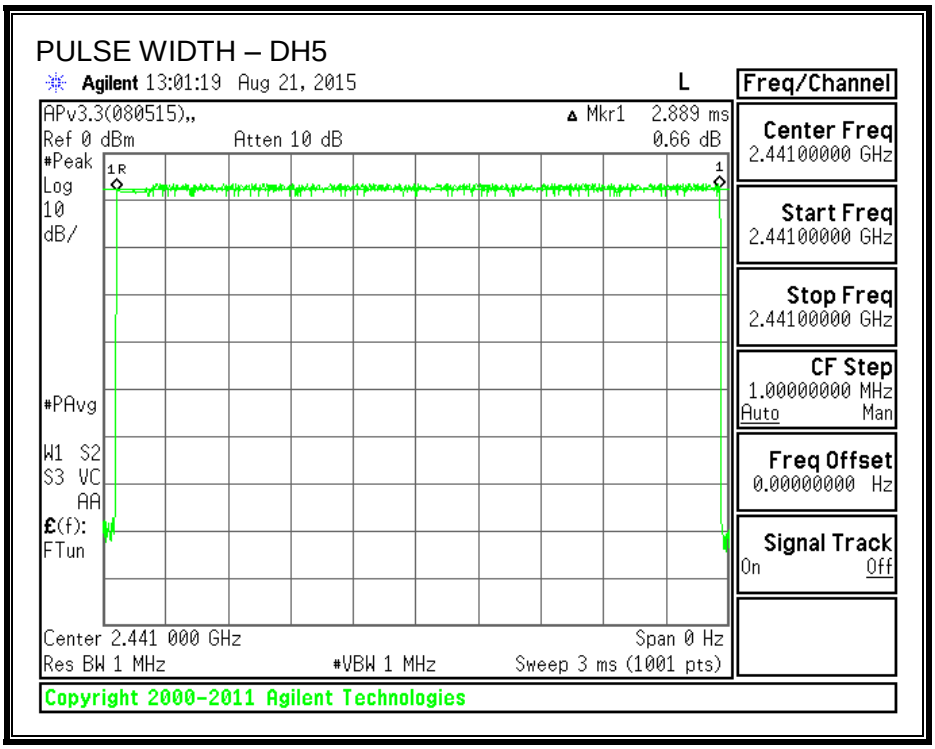
**PULSE WIDTH – DH5**





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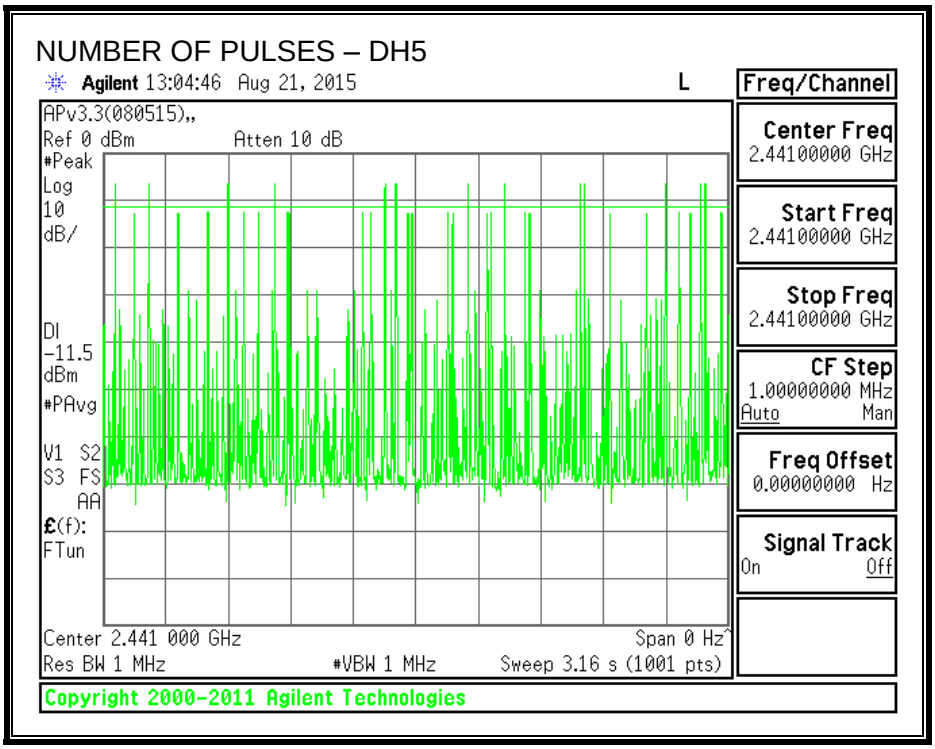
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**





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## 8.5.5. OUTPUT POWER

**LIMIT**

§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.

**TEST PROCEDURE**

The transmitter output is connected to a peak power meter.

**RESULTS**

For 75 or more hopping channels

| Channel | Frequency (MHz) | Output Power (dBm) | Directional Gain (dBi) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | 2402 | 6.11 | 1.70 | 30 | -23.89 |
| Middle | 2441 | 5.93 | 1.70 | 30 | -24.07 |
| High | 2480 | 5.71 | 1.70 | 30 | -24.29 |


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### 8.5.6. AVERAGE POWER

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

**RESULTS**

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Average Power (dBm) |
|---|---|---|
| Low | 2402 | 3.06 |
| Middle | 2441 | 2.89 |
| High | 2480 | 2.60 |


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## 8.5.7. CONDUCTED SPURIOUS EMISSIONS

**LIMITS**

FCC §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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set with hopping off and to the normal hopping mode.


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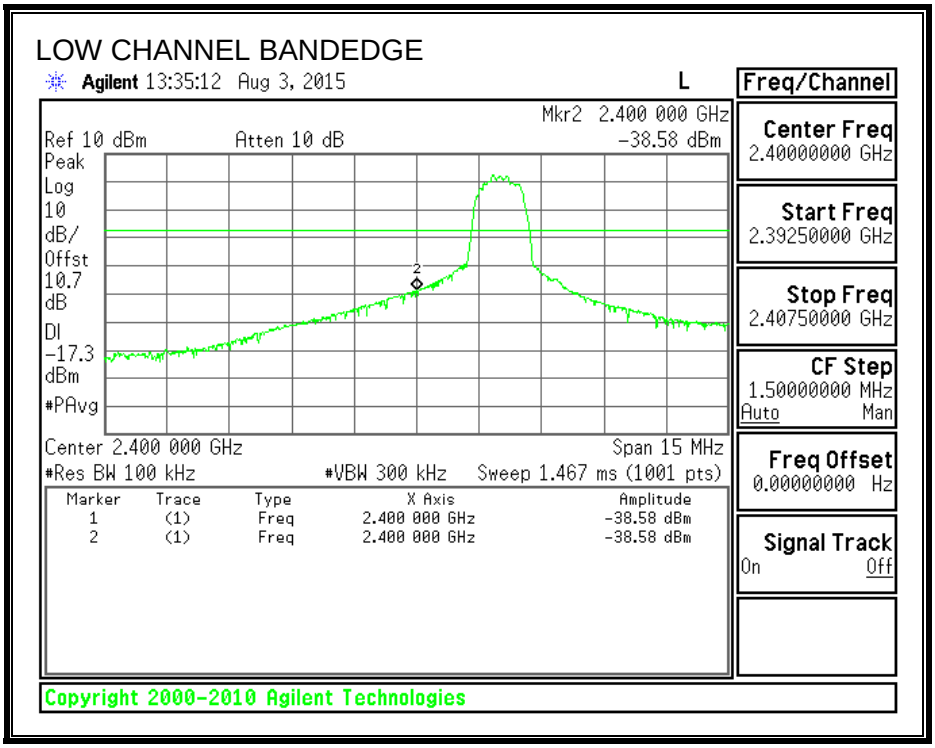
**RESULTS**

**SPURIOUS EMISSIONS, LOW CHANNEL**





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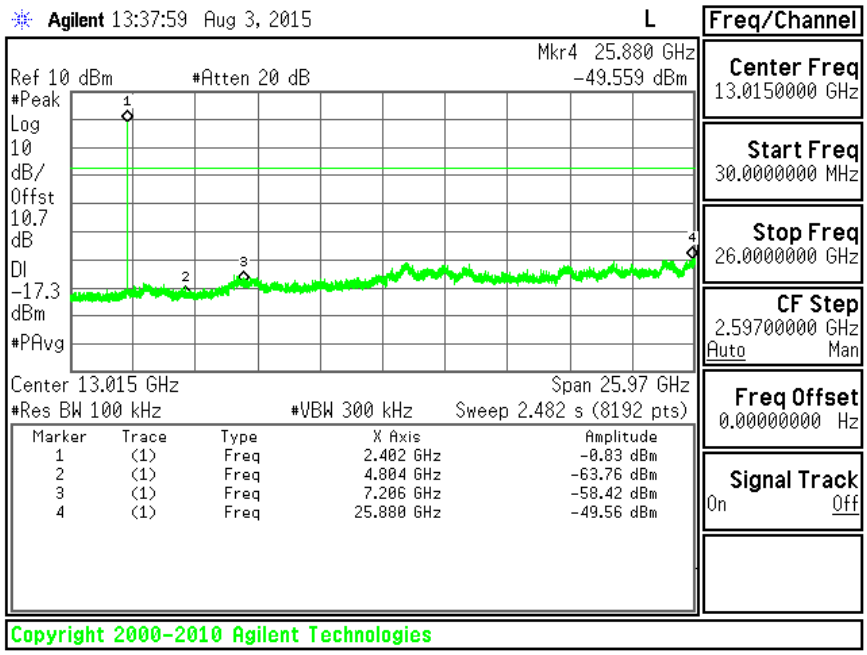
LOW CHANNEL SPURIOUS





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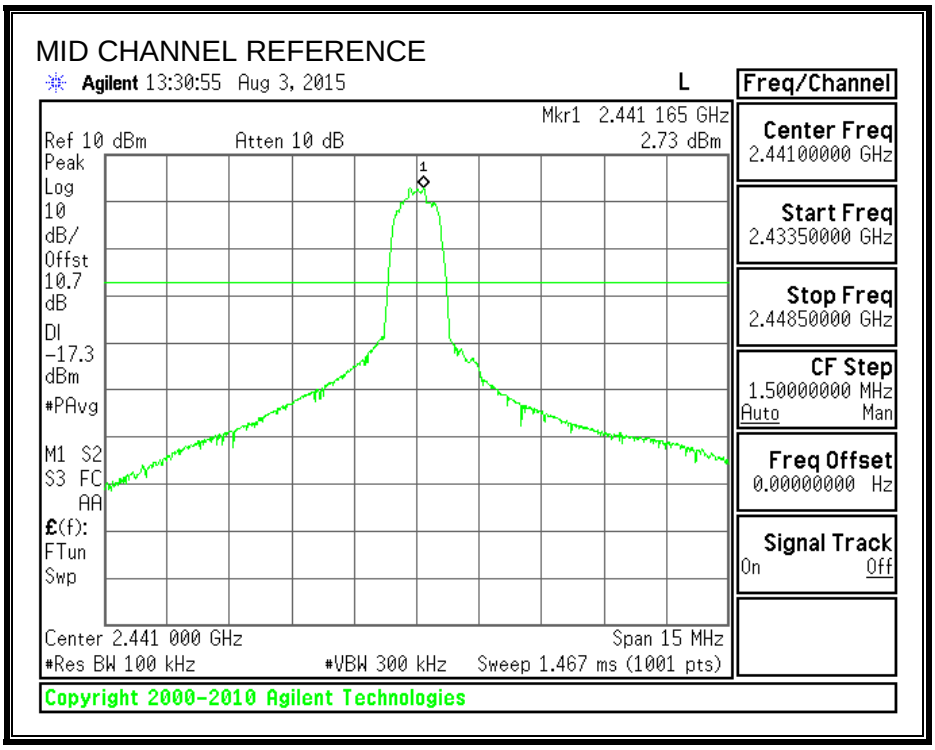
**SPURIOUS EMISSIONS, MID CHANNEL**





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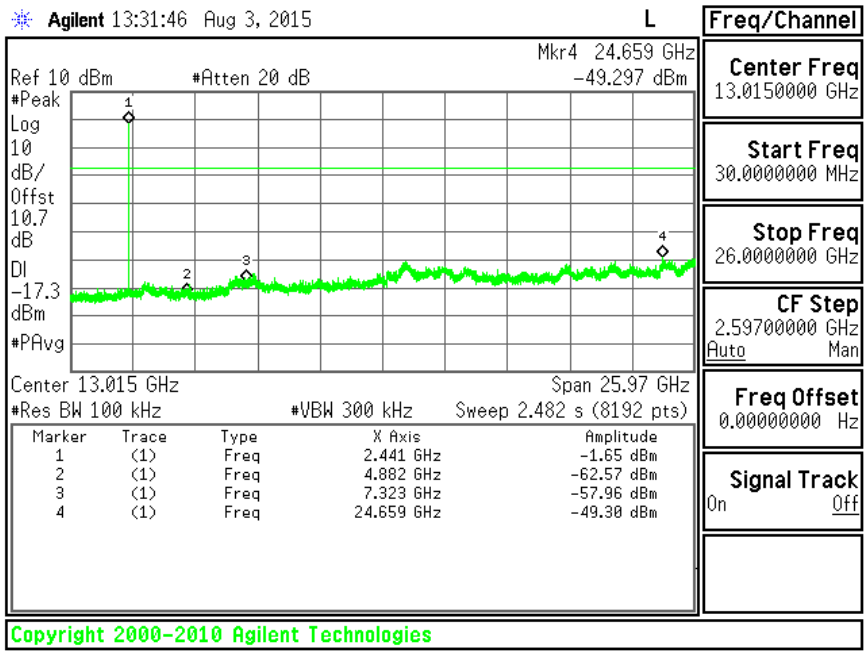
MID CHANNEL SPURIOUS





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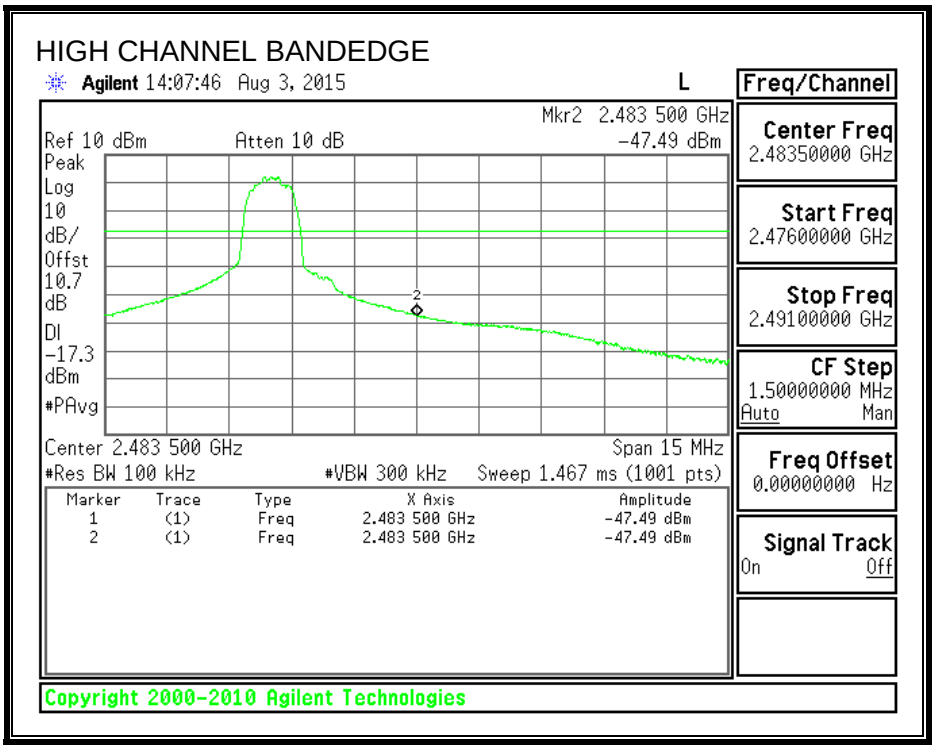
**SPURIOUS EMISSIONS, HIGH CHANNEL**





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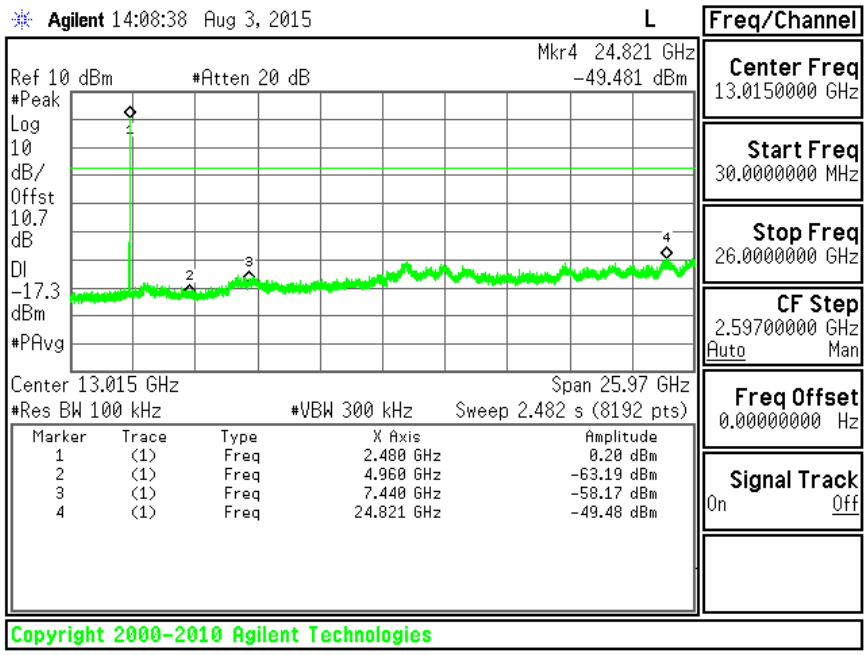
HIGH CHANNEL SPURIOUS





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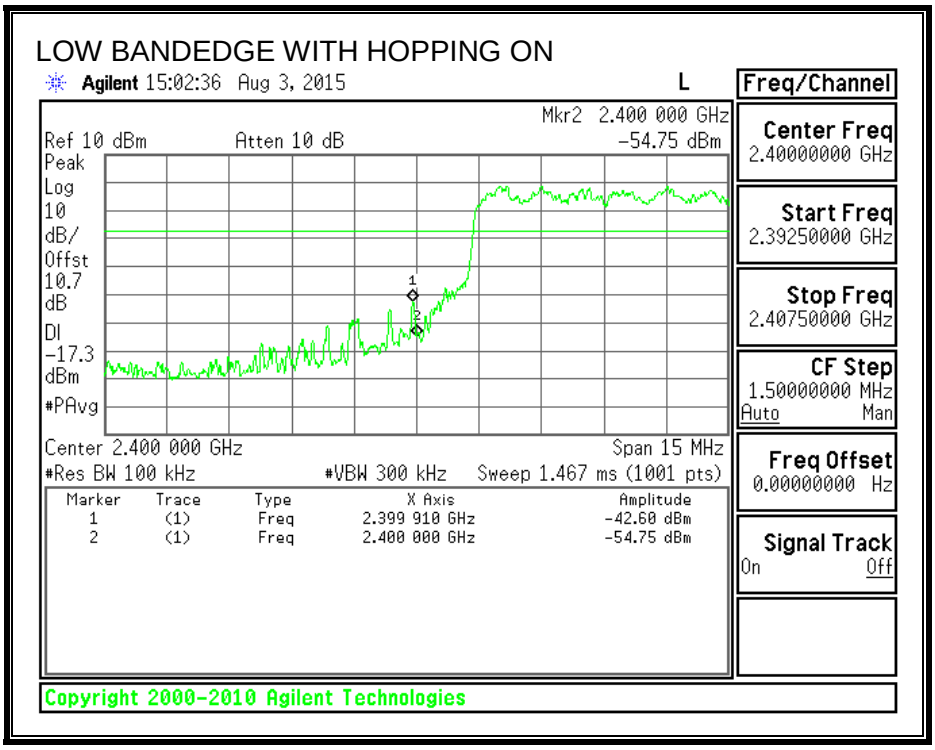
**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**





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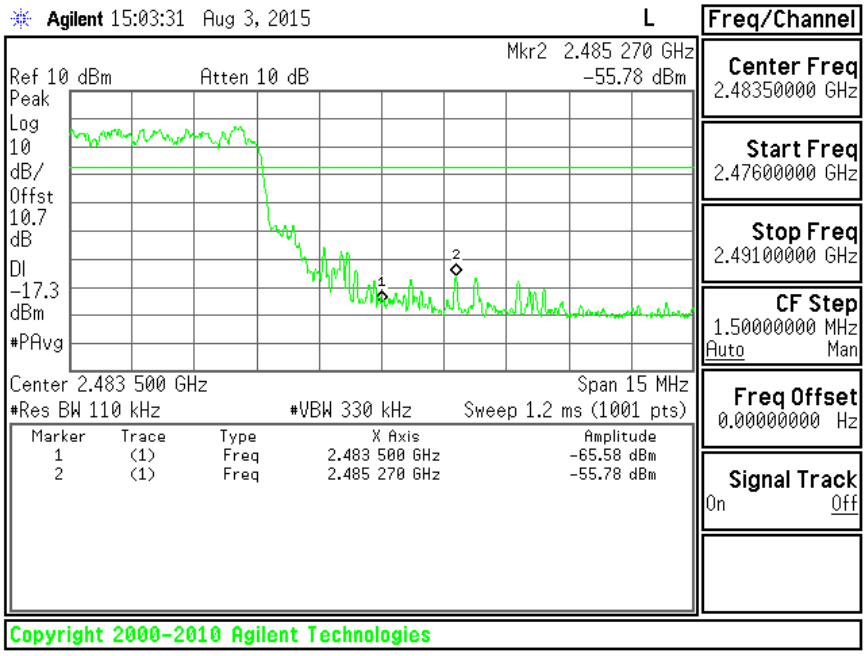
HIGH BANDEDGE WITH HOPPING ON





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# 9. RADIATED TEST RESULTS

## 9.1. LIMITS AND PROCEDURE

**LIMITS**

FCC §15.205 and §15.209

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|---|---|---|
| 30 - 88 | 100 | 40 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46 |
| Above 960 | 500 | 54 |

**TEST PROCEDURE**

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz measurements and 1.5 m above the ground plane for above 1GHz measurements. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 100 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.


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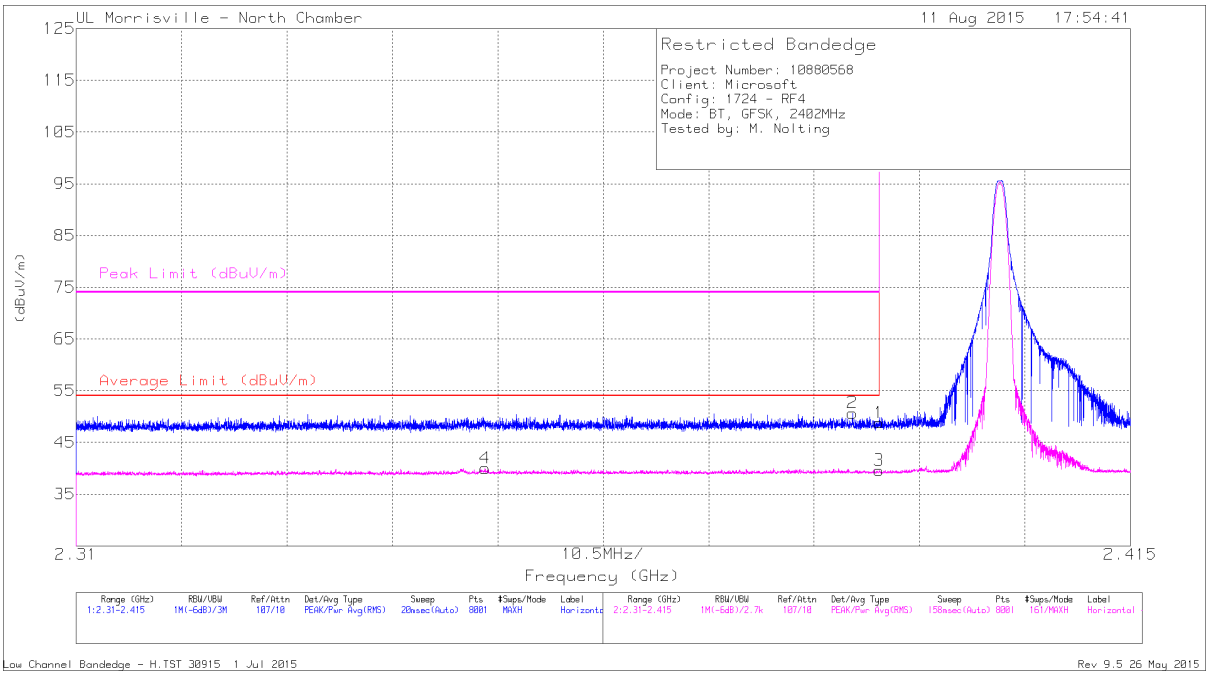
# 9.2. TRANSMITTER ABOVE 1 GHz

## 9.2.1. BASIC DATA RATE GFSK MODULATION

**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.39 | 40.89 | Pk | 31.9 | -24 | 48.79 | - | - | 74 | -25.21 | 22 | 117 | H |
| 2 | * 2.387 | 42.79 | Pk | 31.9 | -24 | 50.69 | - | - | 74 | -23.31 | 22 | 117 | H |
| 3 | * 2.39 | 31.67 | VB1T | 31.9 | -24 | 39.57 | 54 | -14.43 | - | - | 22 | 117 | H |
| 4 | * 2.351 | 32.3 | VB1T | 31.8 | -24.1 | 40 | 54 | -14 | - | - | 22 | 117 | H |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration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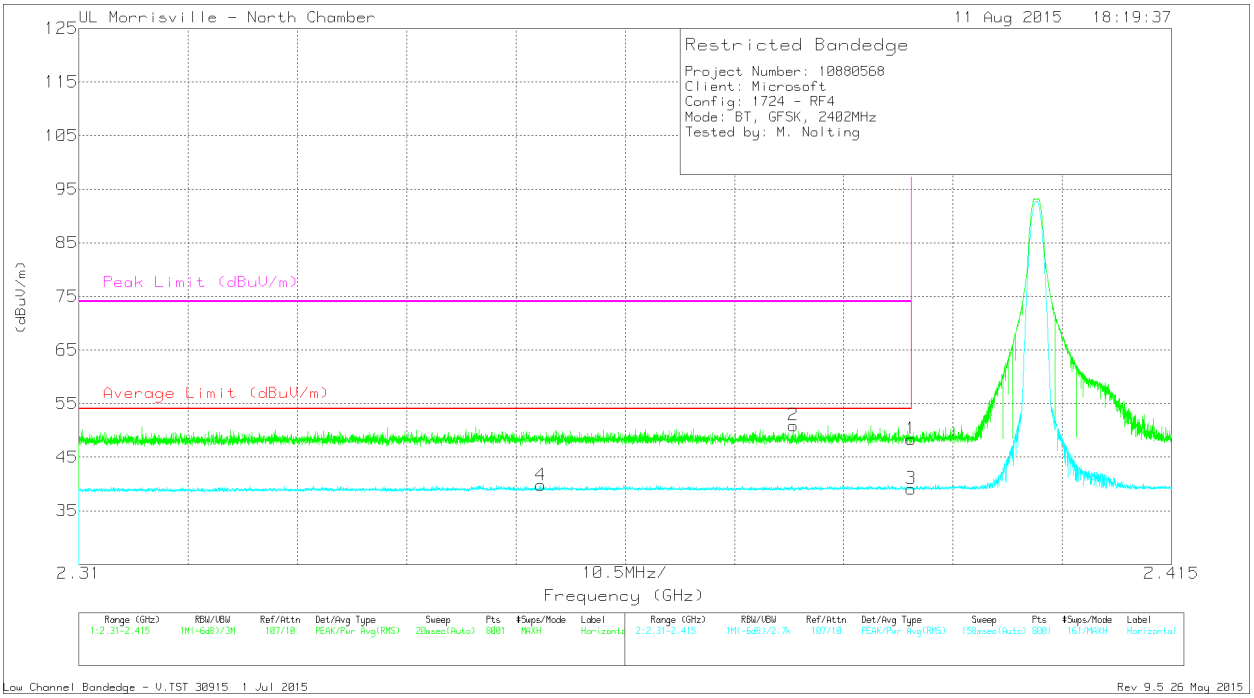
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | * 2.354 | 32.1 | VB1T | 31.8 | -24.1 | 39.8 | 54 | -14.2 | - | - | 63 | 288 | V |
| 2 | * 2.379 | 43.04 | Pk | 31.9 | -24 | 50.94 | - | - | 74 | -23.06 | 63 | 288 | V |
| 1 | * 2.39 | 40.48 | Pk | 31.9 | -24 | 48.38 | - | - | 74 | -25.62 | 63 | 288 | V |
| 3 | * 2.39 | 31.22 | VB1T | 31.9 | -24 | 39.12 | 54 | -14.88 | - | - | 63 | 288 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration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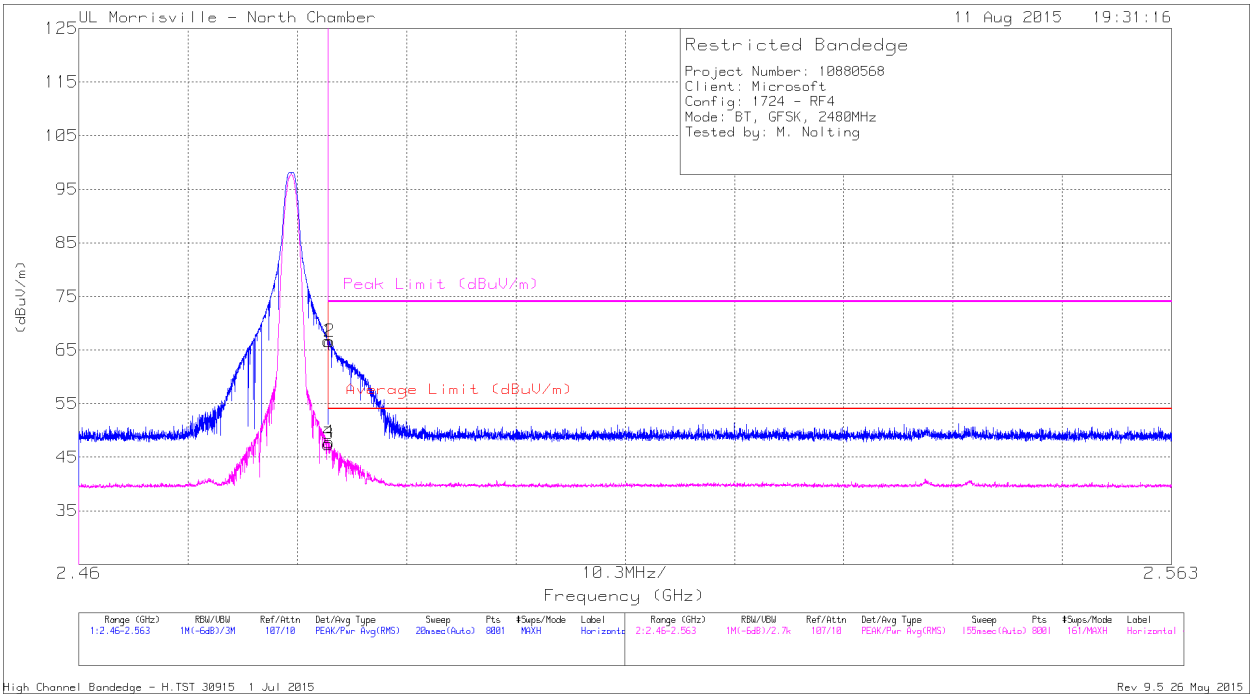
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.484 | 58.47 | Pk | 32.1 | -23.9 | 66.67 | - | - | 74 | -7.33 | 18 | 114 | H |
| 2 | * 2.484 | 58.41 | Pk | 32.1 | -23.9 | 66.61 | - | - | 74 | -7.39 | 18 | 114 | H |
| 3 | * 2.484 | 39.23 | VB1T | 32.1 | -23.9 | 47.43 | 54 | -6.57 | - | - | 18 | 114 | H |
| 4 | * 2.484 | 39.59 | VB1T | 32.1 | -23.9 | 47.79 | 54 | -6.21 | - | - | 18 | 114 | H |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration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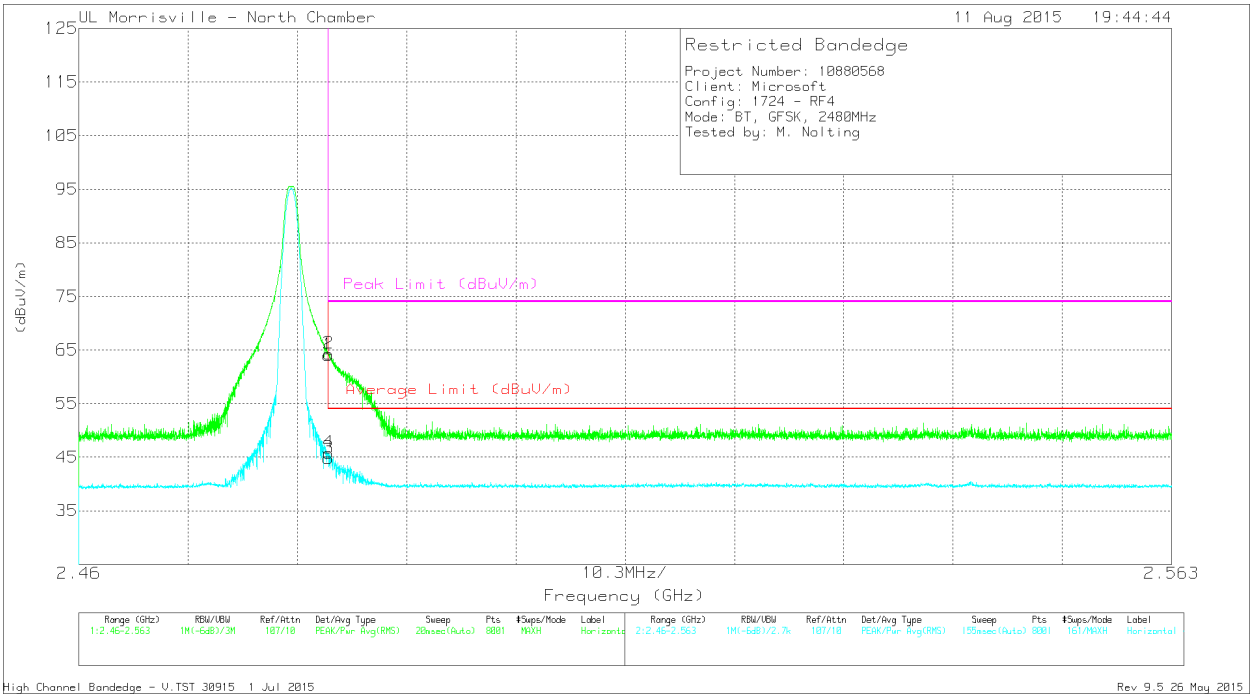
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.484 | 55.89 | Pk | 32.1 | -23.9 | 64.09 | - | - | 74 | -9.91 | 60 | 298 | V |
| 2 | * 2.484 | 56.13 | Pk | 32.1 | -23.9 | 64.33 | - | - | 74 | -9.67 | 60 | 298 | V |
| 3 | * 2.484 | 36.64 | VB1T | 32.1 | -23.9 | 44.84 | 54 | -9.16 | - | - | 60 | 298 | V |
| 4 | * 2.484 | 37.63 | VB1T | 32.1 | -23.9 | 45.83 | 54 | -8.17 | - | - | 60 | 298 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration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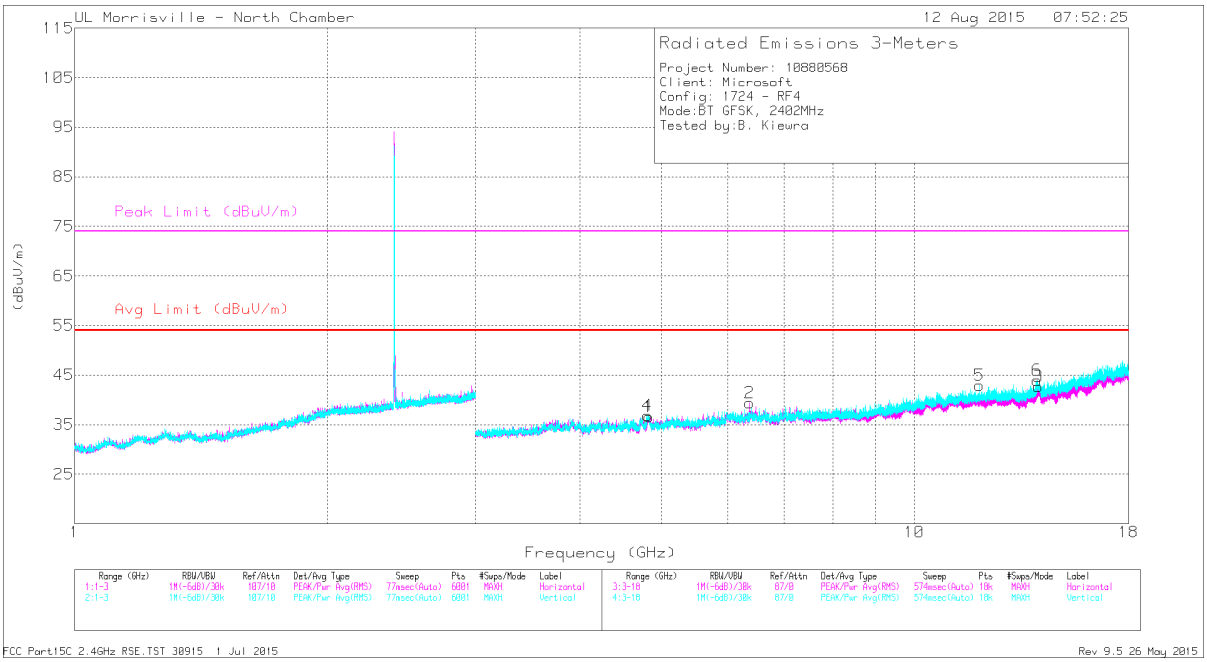
## HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 4.814 | 41.98 | PK3 | 34.1 | -30.8 | 45.28 | - | - | 74 | -28.72 | 285 | 110 | H |
| | * 4.808 | 30.79 | VB1T | 34.1 | -30.7 | 34.19 | 54 | -19.81 | - | - | 285 | 110 | H |
| 2 | 6.371 | 32.44 | Pk | 35.5 | -28.6 | 39.34 | - | - | 74 | -34.66 | 0-360 | 101 | H |
| 3 | 14.05 | 27.03 | Pk | 39.2 | -23.6 | 42.63 | - | - | 74 | -31.37 | 0-360 | 199 | H |
| 4 | * 4.829 | 41.01 | PK3 | 34.1 | -30.7 | 44.41 | - | - | 74 | -29.59 | 239 | 211 | V |
| | * 4.806 | 30.59 | VB1T | 34.1 | -30.7 | 33.99 | 54 | -20.01 | - | - | 239 | 211 | V |
| 5 | * 11.941 | 34.97 | PK3 | 38.8 | -24.2 | 49.57 | - | - | 74 | -24.43 | 199 | 247 | V |
| | * 11.974 | 24.78 | VB1T | 38.9 | -24.1 | 39.58 | 54 | -14.42 | - | - | 199 | 247 | V |
| 6 | 14.014 | 28.11 | Pk | 39.2 | -23.4 | 43.91 | - | - | 74 | -30.09 | 0-360 | 102 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK3 - Maximum Peak

VB1T - VB-A VB=1/Ton, RMS Average where: Ton is packet duration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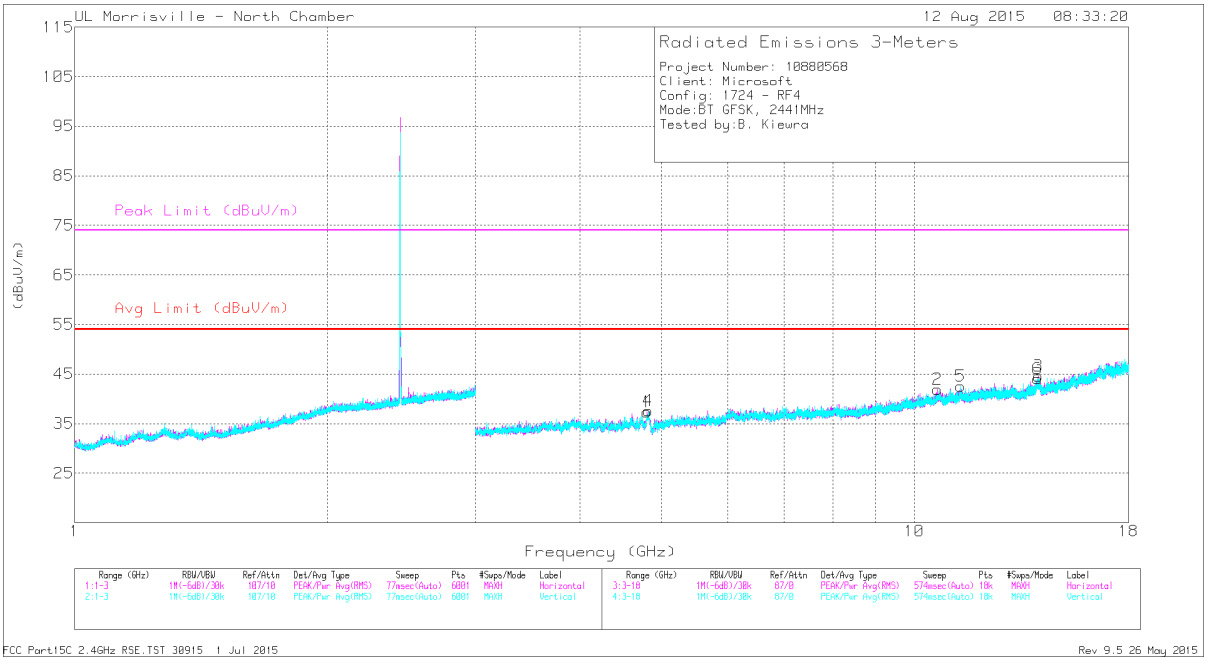
## MID CHANNEL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 4.811 | 40.85 | PK3 | 34.1 | -30.8 | 44.15 | - | - | 74 | -29.85 | 318 | 211 | H |
| | * 4.831 | 30.87 | VB1T | 34.1 | -30.7 | 34.27 | 54 | -19.73 | - | - | 318 | 211 | H |
| 2 | * 10.656 | 34.6 | PK3 | 37.8 | -23.4 | 49 | - | - | 74 | -25 | 1 | 121 | H |
| | * 10.634 | 24.31 | VB1T | 37.8 | -23.7 | 38.41 | 54 | -15.59 | - | - | 1 | 121 | H |
| 3 | 14.049 | 29.03 | Pk | 39.2 | -23.6 | 44.63 | - | - | 74 | -29.37 | 0-360 | 200 | H |
| 4 | * 4.828 | 40.79 | PK3 | 34.1 | -30.7 | 44.19 | - | - | 74 | -29.81 | 313 | 178 | V |
| | * 4.826 | 31.14 | VB1T | 34.1 | -30.8 | 34.44 | 54 | -19.56 | - | - | 313 | 178 | V |
| 5 | * 11.363 | 34.36 | PK3 | 38.2 | -23 | 49.56 | - | - | 74 | -24.44 | 195 | 158 | V |
| | * 11.361 | 23.68 | VB1T | 38.2 | -23.1 | 38.78 | 54 | -15.22 | - | - | 195 | 158 | V |
| 6 | 14.034 | 28.59 | Pk | 39.2 | -23.7 | 44.09 | - | - | 74 | -29.91 | 0-360 | 102 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK3 - Maximum Peak

VB1T - VB-A VB=1/Ton, RMS Average where: Ton is packet duration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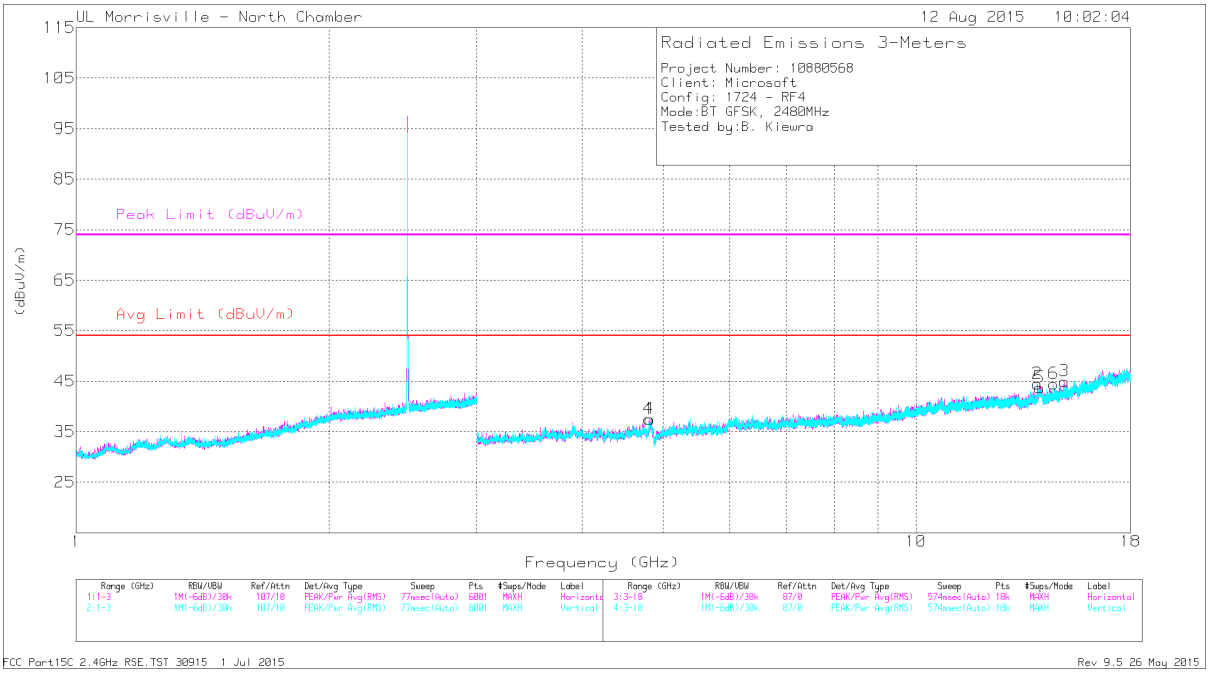
## HIGH CHANNEL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 4.81 | 42.22 | PK3 | 34.1 | -30.8 | 45.52 | - | - | 74 | -28.48 | 40 | 386 | H |
| | * 4.814 | 31.24 | VB1T | 34.1 | -30.8 | 34.54 | 54 | -19.46 | - | - | 40 | 386 | H |
| 2 | 13.951 | 30.21 | Pk | 39.2 | -24.9 | 44.51 | - | - | 74 | -29.49 | 0-360 | 101 | H |
| 3 | 15.013 | 29.1 | Pk | 39.9 | -24 | 45 | - | - | 74 | -29 | 0-360 | 101 | H |
| 4 | * 4.81 | 41.9 | PK3 | 34.1 | -30.8 | 45.2 | - | - | 74 | -28.8 | 298 | 195 | V |
| | * 4.809 | 31.13 | VB1T | 34.1 | -30.8 | 34.43 | 54 | -19.57 | - | - | 298 | 195 | V |
| 5 | 14.03 | 28.13 | Pk | 39.2 | -23.6 | 43.73 | - | - | 74 | -30.27 | 0-360 | 199 | V |
| 6 | 14.591 | 28.61 | Pk | 39.7 | -23.8 | 44.51 | - | - | 74 | -29.49 | 0-360 | 199 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK3 - Maximum Peak

VB1T - VB-A VB=1/Ton, RMS Average where: Ton is packet duration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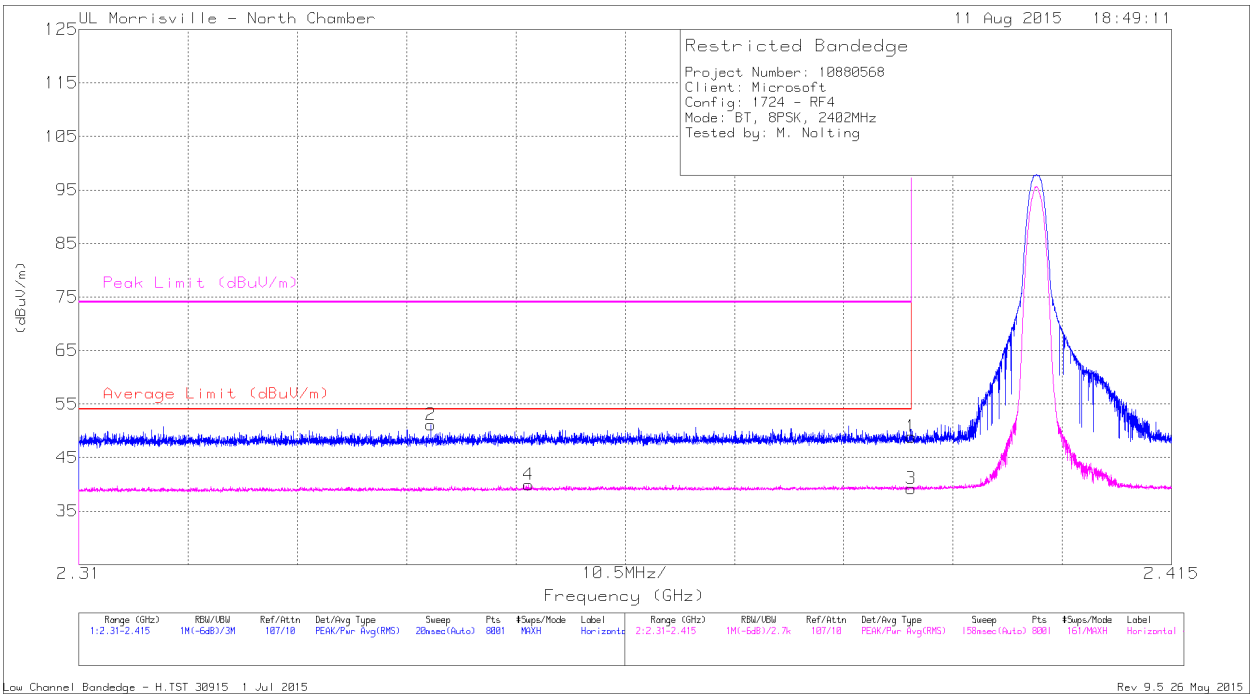
## 9.2.2. ENHANCED DATA RATE 8PSK MODULATION

**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | * 2.344 | 43.5 | Pk | 31.8 | -24.2 | 51.1 | - | - | 74 | -22.9 | 23 | 117 | H |
| 4 | * 2.353 | 32.21 | VB1T | 31.8 | -24.1 | 39.91 | 54 | -14.09 | - | - | 23 | 117 | H |
| 1 | * 2.39 | 40.98 | Pk | 31.9 | -24 | 48.88 | - | - | 74 | -25.12 | 23 | 117 | H |
| 3 | * 2.39 | 31.29 | VB1T | 31.9 | -24 | 39.19 | 54 | -14.81 | - | - | 23 | 117 | H |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration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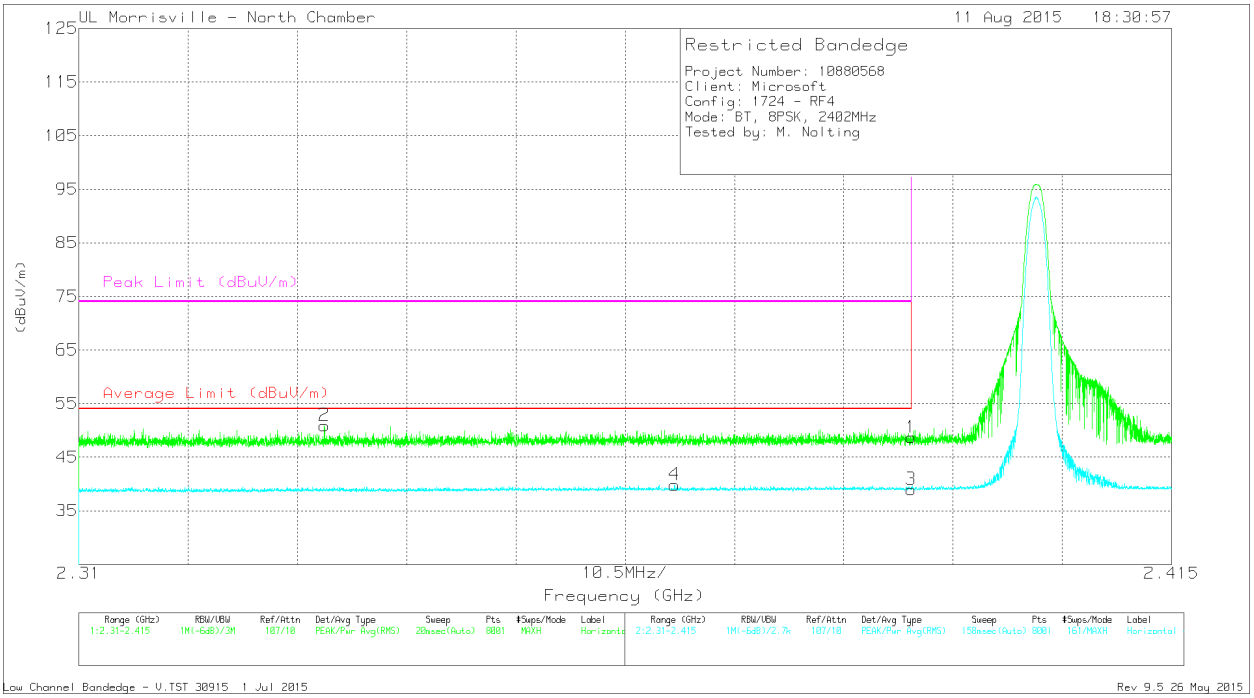
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | * 2.334 | 43.32 | Pk | 31.8 | -24.2 | 50.92 | - | - | 74 | -23.08 | 64 | 288 | V |
| 4 | * 2.367 | 32.15 | VB1T | 31.8 | -24.1 | 39.85 | 54 | -14.15 | - | - | 64 | 288 | V |
| 1 | * 2.39 | 40.78 | Pk | 31.9 | -24 | 48.68 | - | - | 74 | -25.32 | 64 | 288 | V |
| 3 | * 2.39 | 31.07 | VB1T | 31.9 | -24 | 38.97 | 54 | -15.03 | - | - | 64 | 288 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration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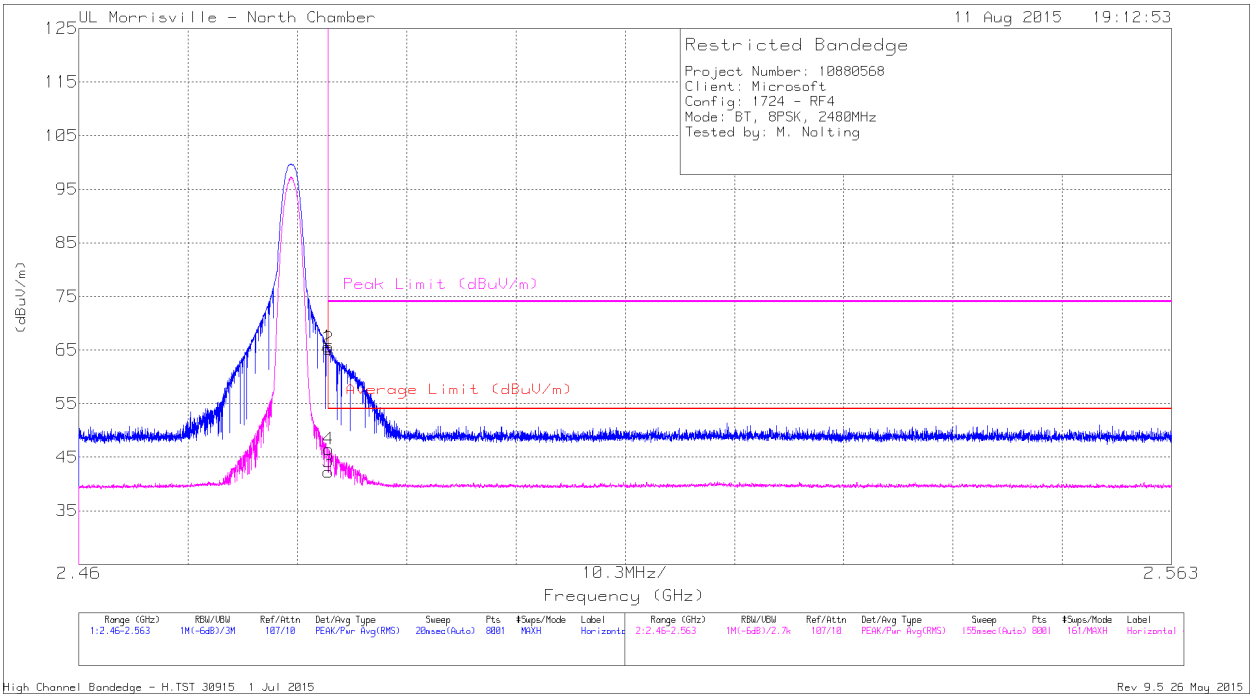
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.484 | 57.39 | Pk | 32.1 | -23.9 | 65.59 | - | - | 74 | -8.41 | 21 | 112 | H |
| 2 | * 2.484 | 57 | Pk | 32.1 | -23.9 | 65.2 | - | - | 74 | -8.8 | 21 | 112 | H |
| 3 | * 2.484 | 34.09 | VB1T | 32.1 | -23.9 | 42.29 | 54 | -11.71 | - | - | 21 | 112 | H |
| 4 | * 2.484 | 38.29 | VB1T | 32.1 | -23.9 | 46.49 | 54 | -7.51 | - | - | 21 | 112 | H |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration





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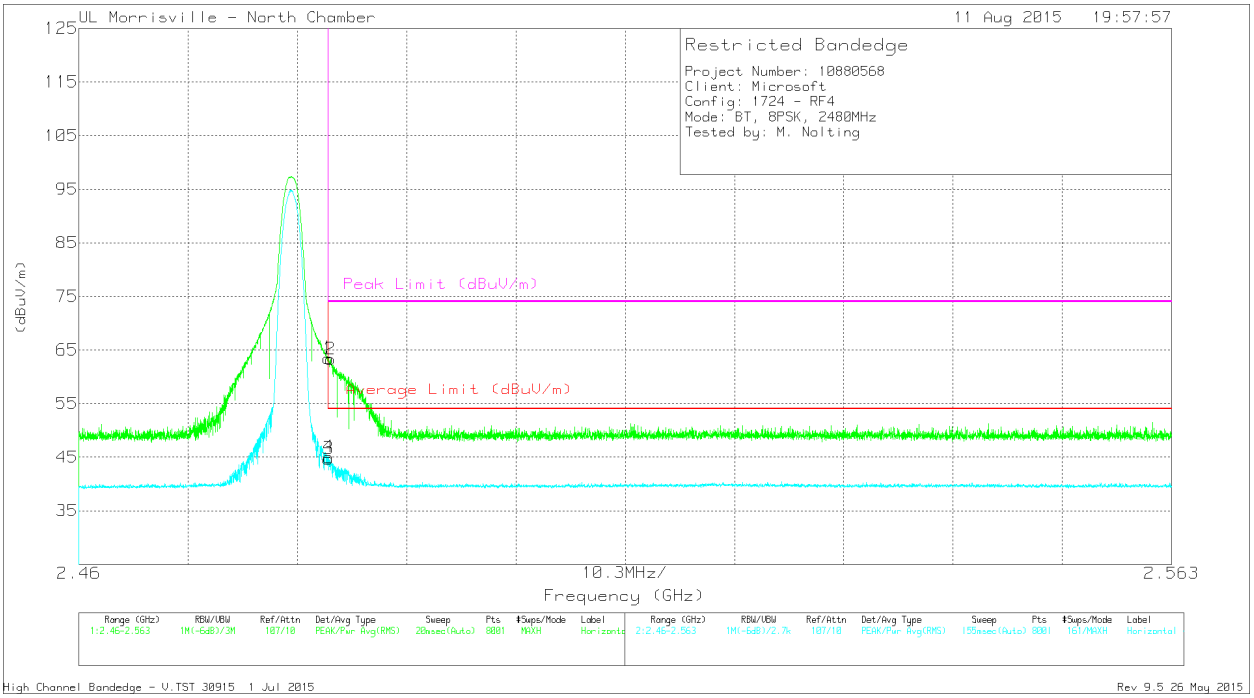
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.484 | 55.22 | Pk | 32.1 | -23.9 | 63.42 | - | - | 74 | -10.58 | 60 | 298 | V |
| 2 | * 2.484 | 55.09 | Pk | 32.1 | -23.9 | 63.29 | - | - | 74 | -10.71 | 60 | 298 | V |
| 3 | * 2.484 | 36.51 | VB1T | 32.1 | -23.9 | 44.71 | 54 | -9.29 | - | - | 60 | 298 | V |
| 4 | * 2.484 | 36.8 | VB1T | 32.1 | -23.9 | 45 | 54 | -9 | - | - | 60 | 298 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VB1T: VB-A VB=1/Ton, RMS Average where: Ton is packet duration

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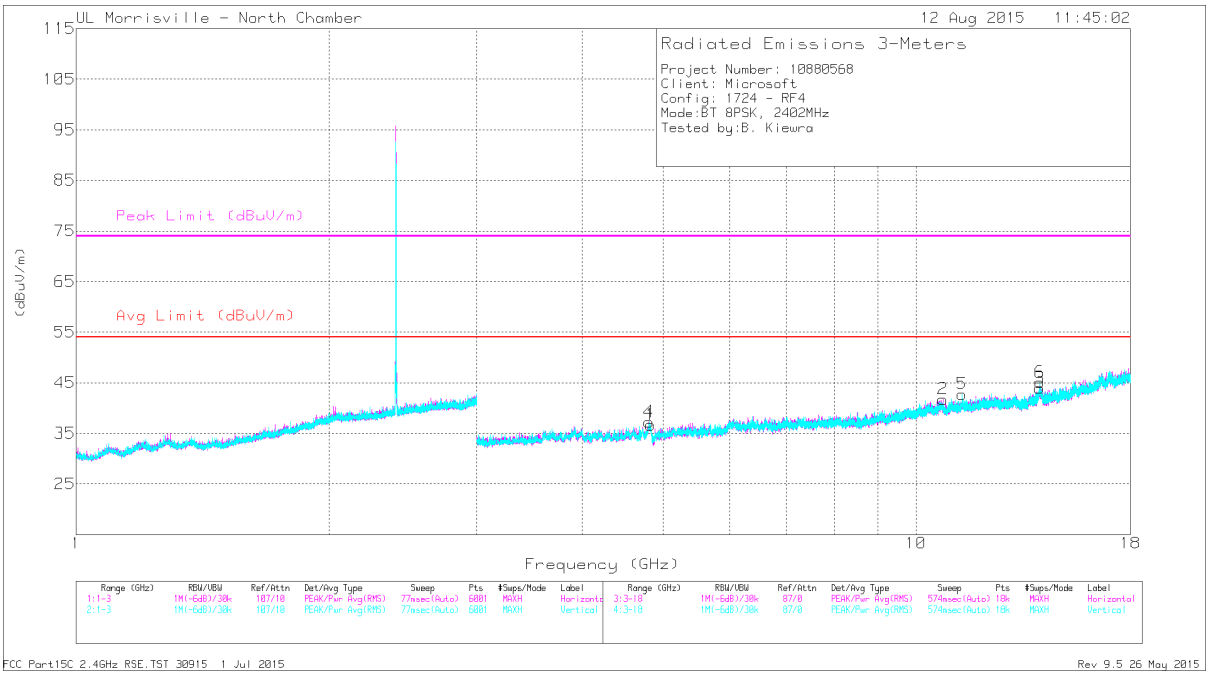
## HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 4.826 | 41.65 | PK3 | 34.1 | -30.8 | 44.95 | - | - | 74 | -29.05 | 11 | 269 | H |
| | * 4.828 | 31.2 | VB1T | 34.1 | -30.7 | 34.6 | 54 | -19.4 | - | - | 11 | 269 | H |
| 2 | * 10.766 | 35.41 | PK3 | 37.8 | -23.9 | 49.31 | - | - | 74 | -24.69 | 239 | 362 | H |
| | * 10.769 | 24.66 | VB1T | 37.8 | -24 | 38.46 | 54 | -15.54 | - | - | 239 | 362 | H |
| 4 | * 4.815 | 41.64 | PK3 | 34.1 | -30.8 | 44.94 | - | - | 74 | -29.06 | 147 | 300 | V |
| | * 4.811 | 31.1 | VB1T | 34.1 | -30.8 | 34.4 | 54 | -19.6 | - | - | 147 | 300 | V |
| 5 | * 11.346 | 34.28 | PK3 | 38.2 | -23 | 49.48 | - | - | 74 | -24.52 | 277 | 369 | V |
| | * 11.344 | 23.95 | VB1T | 38.2 | -22.9 | 39.25 | 54 | -14.75 | - | - | 277 | 369 | V |
| 3 | 14.032 | 28.34 | Pk | 39.2 | -23.6 | 43.94 | - | - | 74 | -30.06 | 0-360 | 101 | H |
| 6 | 14.042 | 29.58 | Pk | 39.2 | -23.7 | 45.08 | - | - | 74 | -28.92 | 0-360 | 102 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK3 - Maximum Peak

VB1T - VB-A VB=1/Ton, RMS Average where: Ton is packet duration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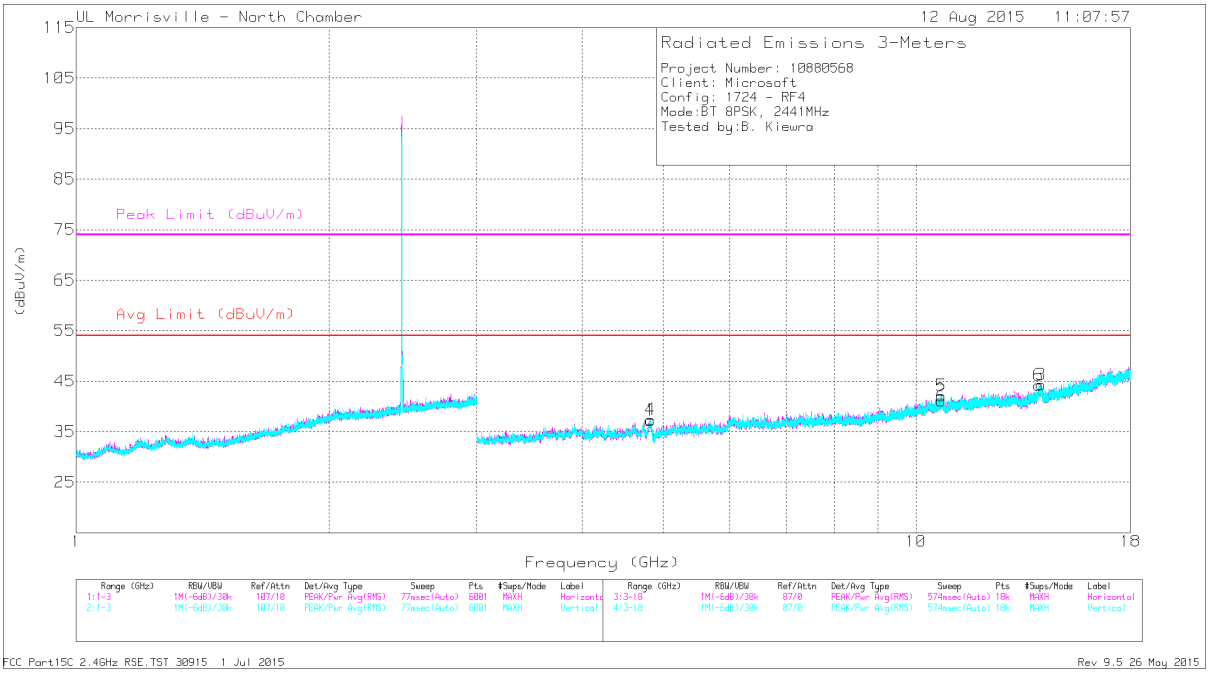
## MID CHANNEL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 4.825 | 41.21 | PK3 | 34.1 | -30.8 | 44.51 | - | - | 74 | -29.49 | 116 | 167 | H |
| | * 4.829 | 31.22 | VB1T | 34.1 | -30.7 | 34.62 | 54 | -19.38 | - | - | 116 | 167 | H |
| 2 | * 10.723 | 35.74 | PK3 | 37.8 | -23.5 | 50.04 | - | - | 74 | -23.96 | 310 | 343 | H |
| | * 10.721 | 24.32 | VB1T | 37.8 | -23.4 | 38.72 | 54 | -15.28 | - | - | 310 | 343 | H |
| 3 | 14.087 | 28.81 | Pk | 39.3 | -23.8 | 44.31 | - | - | 74 | -29.69 | 0-360 | 200 | H |
| 4 | * 4.829 | 41.9 | PK3 | 34.1 | -30.7 | 45.3 | - | - | 74 | -28.7 | 341 | 195 | V |
| | * 4.824 | 31.31 | VB1T | 34.1 | -30.8 | 34.61 | 54 | -19.39 | - | - | 341 | 195 | V |
| 5 | * 10.725 | 33.9 | PK3 | 37.8 | -23.5 | 48.2 | - | - | 74 | -25.8 | 316 | 322 | V |
| | * 10.72 | 24.15 | VB1T | 37.8 | -23.4 | 38.55 | 54 | -15.45 | - | - | 316 | 322 | V |
| 6 | 14.005 | 28.63 | Pk | 39.2 | -23.6 | 44.23 | - | - | 74 | -29.77 | 0-360 | 200 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK3 - Maximum Peak

VB1T - VB-A VB=1/Ton, RMS Average where: Ton is packet duration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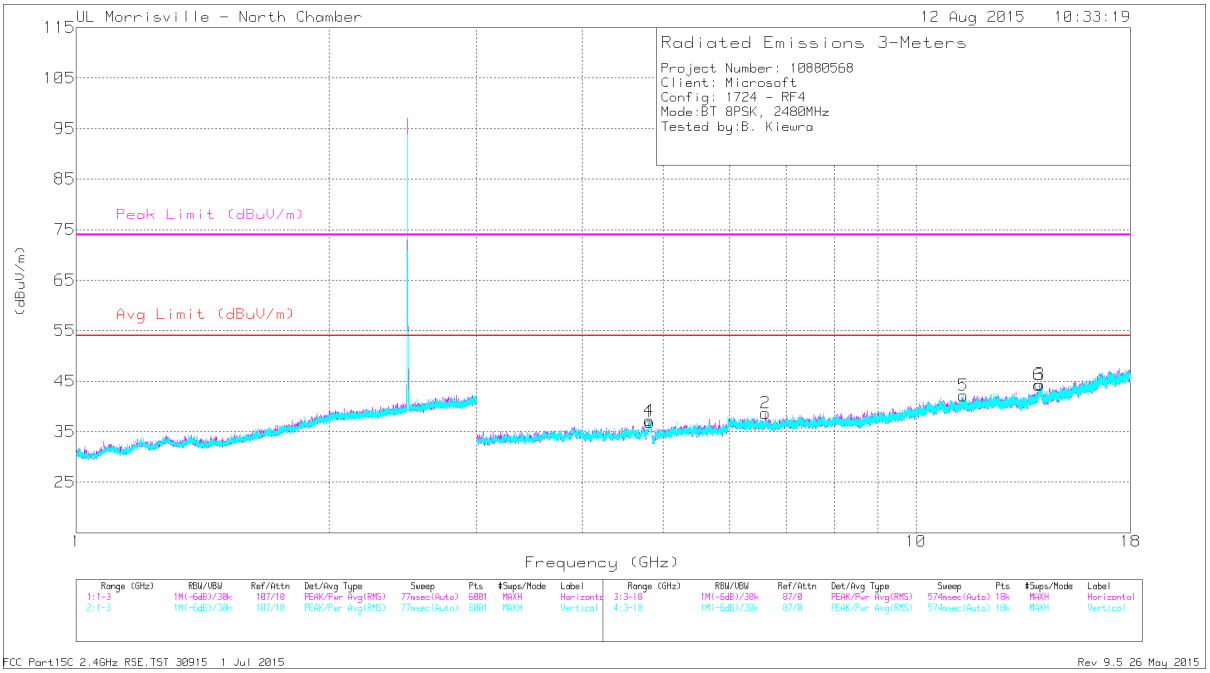
## HIGH CHANNEL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF AT0072 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 4.823 | 41.73 | PK3 | 34.1 | -30.8 | 45.03 | - | - | 74 | -28.97 | 257 | 153 | H |
| | * 4.825 | 31.21 | VB1T | 34.1 | -30.8 | 34.51 | 54 | -19.49 | - | - | 257 | 153 | H |
| 2 | 6.617 | 31.99 | Pk | 35.6 | -28.9 | 38.69 | - | - | 74 | -35.31 | 0-360 | 101 | H |
| 3 | 14.052 | 28.77 | Pk | 39.2 | -23.6 | 44.37 | - | - | 74 | -29.63 | 0-360 | 101 | H |
| 4 | * 4.809 | 42.06 | PK3 | 34.1 | -30.8 | 45.36 | - | - | 74 | -28.64 | 308 | 245 | V |
| | * 4.815 | 31.29 | VB1T | 34.1 | -30.8 | 34.59 | 54 | -19.41 | - | - | 308 | 245 | V |
| 5 | * 11.377 | 34.6 | PK3 | 38.2 | -23.1 | 49.7 | - | - | 74 | -24.3 | 252 | 271 | V |
| | * 11.383 | 23.9 | VB1T | 38.2 | -23.2 | 38.9 | 54 | -15.1 | - | - | 252 | 271 | V |
| 6 | 14.011 | 28.47 | Pk | 39.2 | -23.4 | 44.27 | - | - | 74 | -29.73 | 0-360 | 200 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK3 - Maximum Peak

VB1T - VB-A VB=1/Ton, RMS Average where: Ton is packet duration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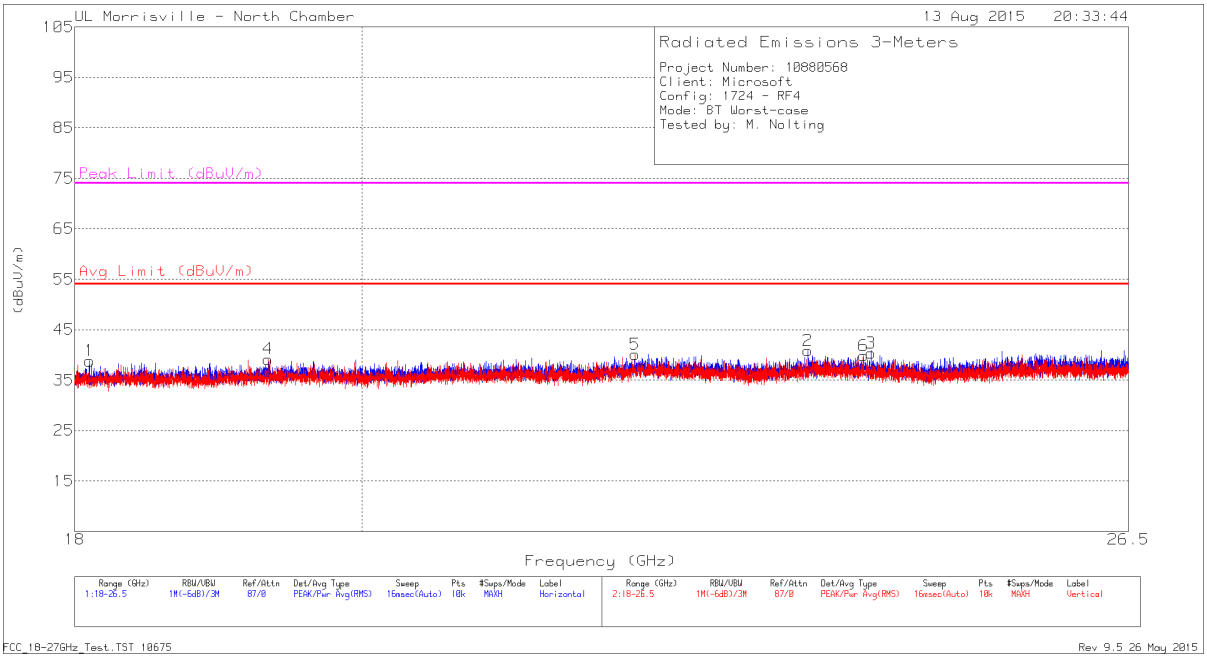
## 9.3. WORST-CASE 18-26GHz

**SPURIOUS EMISSIONS 18 TO 26GHz (WORST-CASE CONFIGURATION)**




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF & G/L (dB/m) | Dist Cor (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 18.098 | 42.7 | Pk | 5.6 | -9.5 | 38.8 | 54 | -15.2 | 74 | -35.2 | 0-360 |
| 4 | * 19.324 | 40.97 | Pk | 7.7 | -9.5 | 39.17 | 54 | -14.83 | 74 | -34.83 | 0-360 |
| 5 | * 22.108 | 38.26 | Pk | 11.3 | -9.5 | 40.06 | 54 | -13.94 | 74 | -33.94 | 0-360 |
| 2 | 23.559 | 38.71 | Pk | 11.6 | -9.5 | 40.81 | - | - | 74 | -33.19 | 0-360 |
| 6 | 24.045 | 38.03 | Pk | 11.3 | -9.5 | 39.83 | - | - | 74 | -34.17 | 0-360 |
| 3 | 24.113 | 38.64 | Pk | 11.2 | -9.5 | 40.34 | - | - | 74 | -33.66 | 0-360 |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
Pk - Peak detector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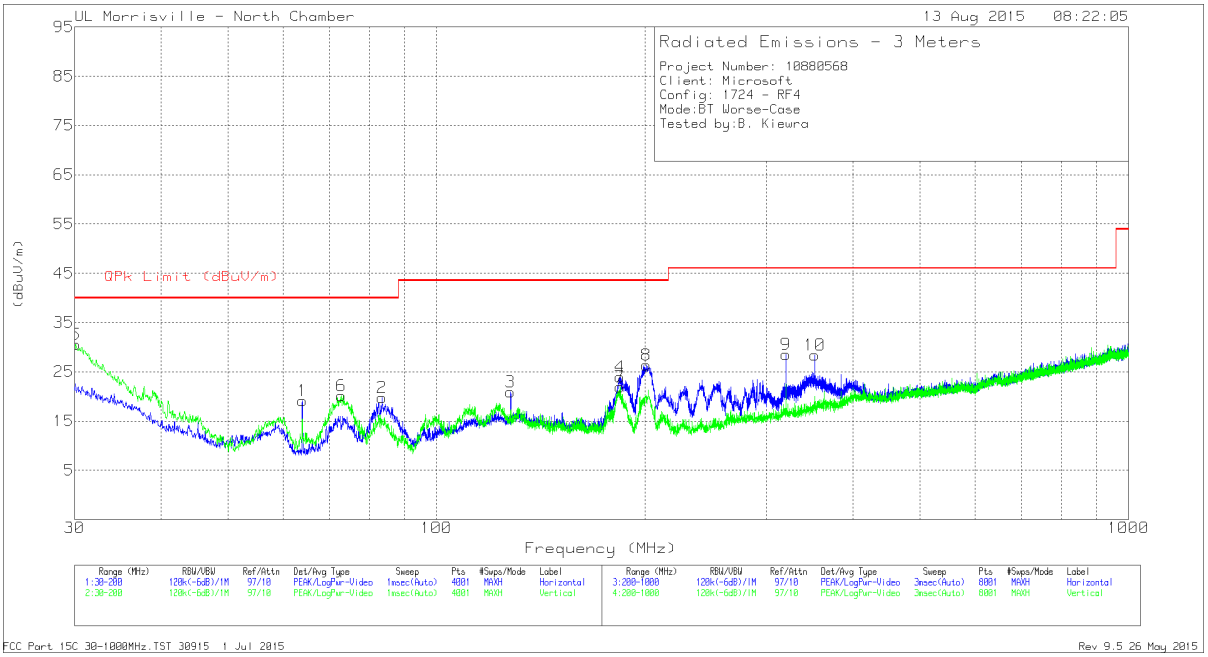
## 9.4. WORST-CASE BELOW 1 GHz

**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)**




| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AF JB3 (dB/m) | Amp/Cbl (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 64 | 38.57 | Pk | 11.7 | -31.2 | 19.07 | 40 | -20.93 | 0-360 | 199 | H |
| 2 | 83.465 | 39.62 | Pk | 11.2 | -31.1 | 19.72 | 40 | -20.28 | 0-360 | 299 | H |
| 3 | * 128.005 | 33.56 | Pk | 17.9 | -30.6 | 20.86 | 43.52 | -22.66 | 0-360 | 199 | H |
| 4 | 184.3175 | 38.8 | Pk | 15.3 | -30.2 | 23.9 | 43.52 | -19.62 | 0-360 | 100 | H |
| 8 | 201 | 39.92 | Pk | 16.5 | -30.1 | 26.32 | 43.52 | -17.2 | 0-360 | 102 | H |
| 9 | 320 | 39.95 | Pk | 18 | -29.4 | 28.55 | 46.02 | -17.47 | 0-360 | 102 | H |
| 10 | 352 | 39.2 | Pk | 18.5 | -29.3 | 28.4 | 46.02 | -17.62 | 0-360 | 102 | H |
| 5 | 30.1275 | 37.13 | Pk | 25 | -31.6 | 30.53 | 40 | -9.47 | 0-360 | 102 | V |
| 6 | 72.7975 | 39.37 | Pk | 12 | -31.2 | 20.17 | 40 | -19.83 | 0-360 | 102 | V |
| 7 | 184.3175 | 36.81 | Pk | 15.3 | -30.2 | 21.91 | 43.52 | -21.61 | 0-360 | 102 | V |

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
Pk - Peak detector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# 10. AC POWER LINE CONDUCTED EMISSIONS

**LIMITS**

FCC §15.207 (a)

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**TEST PROCEDURE**

ANSI C63.10



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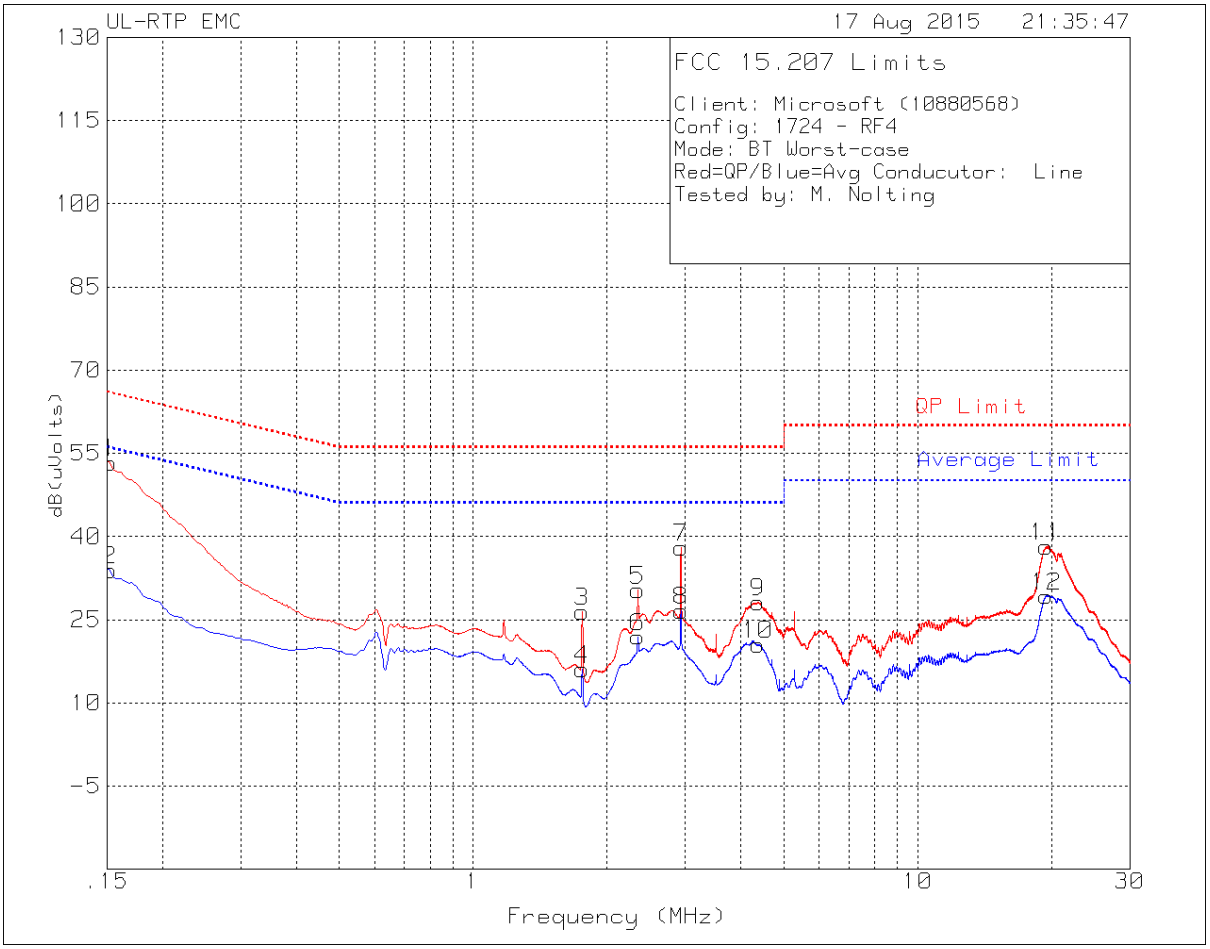
## RESULTS

### LINE 1 RESULTS




| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN VCF (dB) | Limiter/Cbl (dB) | Corrected Reading dB(uVolts) | QP Limit | Margin (dB) | Average Limit | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15225 | 43.62 | Qp | .4 | 9.3 | 53.32 | 65.88 | -12.56 | - | - |
| 2 | .15225 | 24.24 | Ca | .4 | 9.3 | 33.94 | - | - | 55.88 | -21.94 |
| 3 | 1.75875 | 17.03 | Qp | 0 | 9.4 | 26.43 | 56 | -29.57 | - | - |
| 4 | 1.75875 | 6.62 | Ca | 0 | 9.4 | 16.02 | - | - | 46 | -29.98 |
| 5 | 2.346 | 20.9 | Qp | 0 | 9.4 | 30.3 | 56 | -25.7 | - | - |
| 6 | 2.346 | 12.53 | Ca | 0 | 9.4 | 21.93 | - | - | 46 | -24.07 |
| 7 | 2.93325 | 28.6 | Qp | 0 | 9.4 | 38 | 56 | -18 | - | - |
| 8 | 2.93325 | 17.21 | Ca | 0 | 9.4 | 26.61 | - | - | 46 | -19.39 |
| 9 | 4.36875 | 18.62 | Qp | .1 | 9.4 | 28.12 | 56 | -27.88 | - | - |
| 10 | 4.37325 | 10.98 | Ca | .1 | 9.4 | 20.48 | - | - | 46 | -25.52 |
| 11 | 19.43025 | 28.37 | Qp | .2 | 9.6 | 38.17 | 60 | -21.83 | - | - |
| 12 | 19.44825 | 19.43 | Ca | .2 | 9.6 | 29.23 | - | - | 50 | -20.77 |

Qp - Quasi-Peak detector
Ca - CISPR average detection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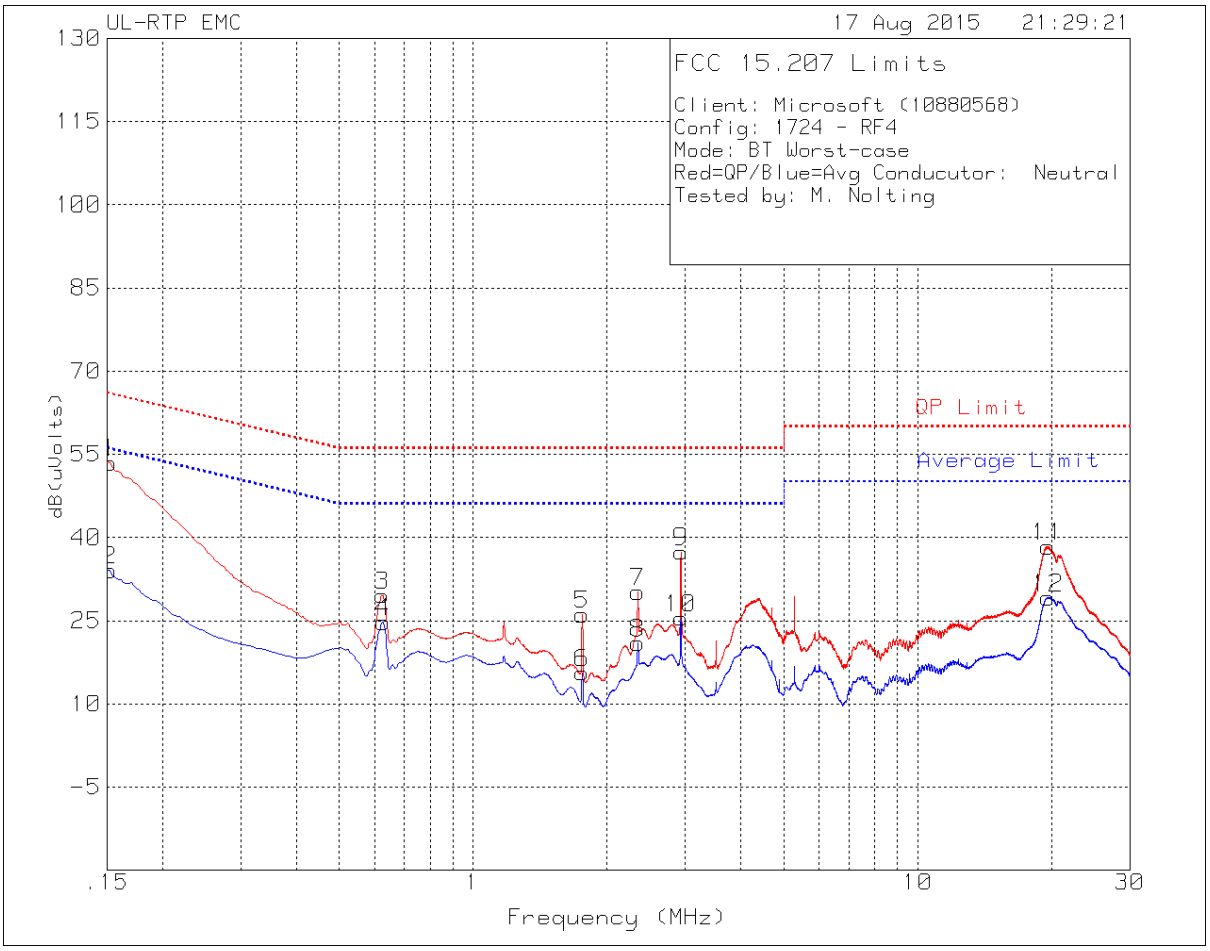
**LINE 2 RESULTS**




| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN VCF (dB) | Limiter/Cbl (dB) | Corrected Reading dB(uVolts) | QP Limit | Margin (dB) | Average Limit | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15225 | 43.8 | Qp | .4 | 9.3 | 53.5 | 65.88 | -12.38 | - | - |
| 2 | .15225 | 24.37 | Ca | .4 | 9.3 | 34.07 | - | - | 55.88 | -21.81 |
| 3 | .62475 | 20.08 | Qp | .1 | 9.4 | 29.58 | 56 | -26.42 | - | - |
| 4 | .627 | 15.27 | Ca | .1 | 9.4 | 24.77 | - | - | 46 | -21.23 |
| 5 | 1.75875 | 16.72 | Qp | 0 | 9.4 | 26.12 | 56 | -29.88 | - | - |
| 6 | 1.75875 | 6.23 | Ca | 0 | 9.4 | 15.63 | - | - | 46 | -30.37 |
| 7 | 2.346 | 20.81 | Qp | 0 | 9.4 | 30.21 | 56 | -25.79 | - | - |
| 8 | 2.346 | 11.57 | Ca | 0 | 9.4 | 20.97 | - | - | 46 | -25.03 |
| 9 | 2.93325 | 28.01 | Qp | 0 | 9.4 | 37.41 | 56 | -18.59 | - | - |
| 10 | 2.93325 | 16.07 | Ca | 0 | 9.4 | 25.47 | - | - | 46 | -20.53 |
| 11 | 19.61025 | 28.57 | Qp | .2 | 9.6 | 38.37 | 60 | -21.63 | - | - |
| 12 | 19.62825 | 19.33 | Ca | .2 | 9.6 | 29.13 | - | - | 50 | -20.87 |

Qp - Quasi-Peak detector
Ca - CISPR average detection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