

FCC RF TEST REPORT

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Test Report Number: SKT-RFC-140002**Date of issue: February 21, 2014****Applicant:****HITRON SYSTEMS INC.**5953-85, SEODONG-DAERO, SAMJUG-MYEON, ANSEONG-SI,
GYEONGGI-DO, KOREA**Manufacturer:****HITRON SYSTEMS INC.**5953-85, SEODONG-DAERO, SAMJUG-MYEON, ANSEONG-SI,
GYEONGGI-DO, KOREA**Product:**

Network Dome Camera

Model:

NVT-7202

(please see P5 for all the model numbers)

FCC ID:

LLINVT72

File number:

SKTEU13-1551

EUT received:

January 29, 2014

Applied standards:

ANSI C63.10-2009 and ANSI C63.4-2009

558074 D01 DTS Meas Guidance v03r01

Rule parts:

FCC Part 15 Subpart C - Intentional radiators

Equipment Class:**DTS - Part 15 Digital Transmission System****Remarks to the standards:** None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.

Inyong Song / **Testing Engineer**Jongsoo Yoon / **Technical Manager**

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Revision History of Report

| Rev. | Revisions | Effect page | Reviewed by | Date |
|------|---------------|-------------|--------------|-------------------|
| - | Initial issue | All | Jongsoo Yoon | February 21, 2014 |



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1 Summary of test results

| Requirement | CFR 47 Section | Result |
|--|---------------------------------|------------------------|
| Antenna Requirement | 15.203, 15.247(b)(4) | Meets the requirements |
| 6dB Bandwidth | 15.247(a)(2) | Meets the requirements |
| Maximum Peak Output Power | 15.247(b)(3), (4) | Meets the requirements |
| Spurious Emission, Band Edge, and Restricted bands | 15.247(d), 15.205(a), 15.209(a) | Meets the requirements |
| Peak Power Spectral Density | 15.247(e) | Meets the requirements |
| AC power line Conducted emissions | 15.207(a) | Meets the requirements |



2 Description of equipment under test (EUT)

| | |
|----------------|---------------------|
| Product: | Network Dome Camera |
| Model: | NVT-7202 |
| Serial number: | None (prototype) |

Model differences:

| Model name | Difference | Tested (checked) |
|------------|---|-------------------------------------|
| NVT-7202 | Original (basic model that was fully tested) | <input checked="" type="checkbox"/> |
| 2M-PTD3W | Listed by the applicant's request without the tests; the applicant declared that the variant models were identical to the tested sample and added for the marketing purpose | |
| GND20L-VW | | |

Note: All the differences were compared with the test sample

Technical data:

| | |
|---------------------------|---|
| Power source | DC 12 V |
| Local Oscillator or X-Tal | XTAL: 32.768 kHz, 24 MHz, 25 MHz, 37.125 MHz (WLAN module) 40 MHz |
| Transmit Frequency | IEEE 802.11b: 2412 MHz ~ 2462 MHz (11 channels) IEEE 802.11g: 2412 MHz ~ 2462 MHz (11 channels) IEEE 802.11n HT20: 2412 MHz ~ 2462 MHz (11 channels) IEEE 802.11n HT40: 2422 MHz ~ 2452 MHz (7 channels) |
| Antenna Type | Whip antenna (reverse polarity SMA type, peak gain : 2.1 dBi) |
| Type of Modulation | IEEE 802.11b: DSSS (DBPSK, DQPSK, CCK) IEEE 802.11g/n HT20/40: OFDM(64QAM, 16QAM, QPSK, BPSK) |
| RF Output power | 20.63 dBm PEAK (measured) |

NOTE The test report for the compliance with FCC Part 15B as a digital device was issued with other test report number

| I/O port | Type | Q'ty | Remark |
|-------------------|---|------|--------|
| Power input | 2 pin terminal block (red, white) | 1 | |
| Video output | RJ45 (LAN) | 1 | |
| Audio output | RCA | 1 | |
| Alarm IN/OUT, GND | 4-pin terminal block(gray, yellow, blue, brown) | 1 | |

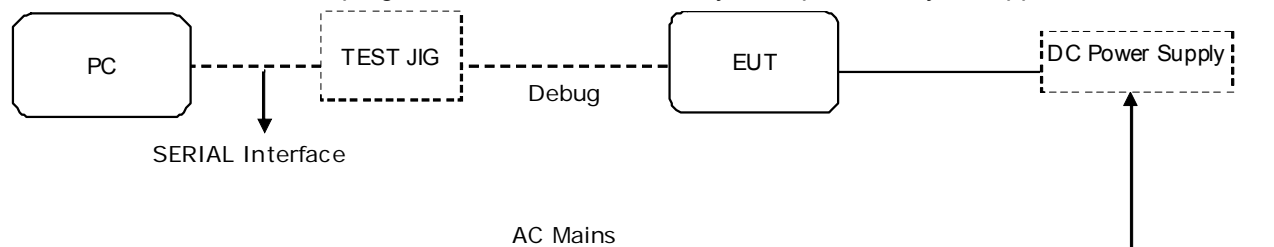
Modification of EUT during the compliance testing : none



3 Test and measurement conditions

3.1. Test configuration (arrangement of EUT)

The measurements were taken in continuous transmitting mode using the TEST MODE. For controlling the EUT as TEST MODE, the test program and the cable assembly were provided by the applicant.



3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

| # | Equipment | Manufacturer | Model No. | Serial No. |
|----|-----------------|---------------------------|-----------|------------|
| 1 | PC | DELL INC. | DCNE | 7XH86BX |
| 2. | TEST JIG | provided by the applicant | - | - |
| 3 | DC Power Supply | HP | 6633A | 3325A04972 |

Note: 1) The PC was used for control of the RF module via SERIAL interface at the Debug port in the EUT.
2) For radiated spurious emission measurements, the measurements were performed without PC after setting the radio module to TEST MODE.

3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

| # | Start | | End | | Cable | |
|---|-----------------|----------|-----------------|----------|------------|----------------|
| | Name | I/O port | Name | I/O port | length (m) | shielded (Y/N) |
| 1 | EUT | DC IN | DC Power Supply | DC OUT | 1.7 | N |
| 2 | DC Power Supply | AC IN | AC Mains | AC Mains | 1.6 | N |

Note: 1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3.4. Measurement Uncertainty (U)

| Measurement Item | Combined Standard Uncertainty U_c | Expanded Uncertainty $U = k \times U_c (k = 2)$ |
|-----------------------|--|--|
| Conducted RF power | ± 1.49 dB | ± 2.98 dB |
| Radiated disturbance | ± 2.30 dB | ± 4.60 dB |
| Conducted disturbance | ± 1.96 dB | ± 3.92 dB |

3.5. Test date

| | |
|-------------|--------------------------------------|
| Date Tested | February 5, 2014 – February 19, 2014 |
|-------------|--------------------------------------|



4 Facilities and accreditations

4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd

Site I: 820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea

Site II: 688-8, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

4.2. Accreditations

The laboratory has been also notified to FCC by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Declaration of Conformity (DOC) and Certification under Parts 15 and 18 of the FCC Rules.

Designation No. KR0007

4.3. List of test and measurement instruments

| No | Description | Manufacturer | Model | Serial No. | Cal. due | Use |
|----|--------------------------------------|---------------|---------------|-------------|------------|-----|
| 1 | Spectrum Analyzer | Agilent | E4405B | US40520856 | 2014.03.07 | |
| 2 | Spectrum Analyzer | Agilent | E4440A | MY46186322 | 2014.03.18 | ☒ |
| 3 | EMC Spectrum Analyzer | Agilent | E7405A | US40240203 | 2014.07.08 | |
| 4 | EMI Test Receiver | Rohde&Schwarz | ESPI7 | 101206 | 2014.07.08 | ☒ |
| 5 | EMI Test Receiver | Rohde&Schwarz | ESHS10 | 835871/002 | 2014.07.08 | ☒ |
| 6 | Artificial Mains Network | Rohde&Schwarz | ESH2-Z5 | 834549/011 | 2014.07.08 | ☒ |
| 7 | Pre-amplifier | HP | 8447F | 3113A05153 | 2014.07.08 | ☒ |
| 8 | Pre-amplifier | MITEQ | AFS44 | 1116321 | 2014.12.06 | |
| 9 | Pre-amplifier | MITEQ | AFS44 | 1116322 | 2014.03.08 | ☒ |
| 10 | Power Meter | Agilent | E4417A | MY45100426 | 2014.07.09 | |
| 11 | Power Meter | Agilent | E4418B | US39402176 | 2014.07.09 | |
| 12 | Power Sensor | Agilent | E9327A | MY44420696 | 2014.07.09 | |
| 13 | Power Sensor | Agilent | 8485A | 3318A13916 | 2014.07.09 | |
| 14 | Attenuator (10dB) | HP | 8491B | 38072 | 2014.07.08 | ☒ |
| 15 | High Pass Filter | Wainwright | WHKX3.0/18G | 8 | 2014.07.08 | ☒ |
| 16 | VHF Precision Dipole Antenna (TX/RX) | Schwarzbeck | VHAP | 1014 / 1015 | 2014.10.25 | |
| 17 | UHF Precision Dipole Antenna (TX/RX) | Schwarzbeck | UHAP | 989 / 990 | 2014.10.25 | |
| 18 | Loop Antenna | Schwarzbeck | HFH2-Z2 | 863048/019 | 2015.12.04 | ☒ |
| 19 | TRILOG Broadband Antenna | Schwarzbeck | VULB9168 | 189 | 2014.05.21 | ☒ |
| 20 | Horn Antenna | EMCO | 3115 | 00040723 | 2014.03.26 | ☒ |
| 21 | Horn Antenna | EMCO | 3115 | 00056768 | 2014.09.05 | |
| 22 | Horn Antenna | Schwarzbeck | BBHA9170 | BBHA9170318 | 2015.09.06 | ☒ |
| 23 | Vector Signal Generator | Agilent | E4438C | MY42080359 | 2014.07.09 | |
| 24 | PSG analog signal generator | Agilent | E8257D-520 | MY45141255 | 2014.07.09 | |
| 25 | DC Power Supply | HP | 6622A | 3348A03223 | 2014.07.09 | |
| 26 | DC Power Supply | HP | HP 6633A | 3325A04972 | 2014.07.09 | ☒ |
| 27 | Hygro/Thermo Graph | SATO | PC-5000TRH-II | - | 2014.07.12 | ☒ |
| 28 | Temperature/Humidity Chamber | All Three | ATM-50M | 20030425 | 2014.03.08 | |



5 Test and measurements

5.1. Antenna requirement

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result:

PASS

The transmitter has the external antenna with reverse polarity SMA connector type.

The directional gain of the antenna is 2.1 dBi.



5.2. Test Configuration of Equipment Under Test

Pre-Scanned RF Power

The value of '37' was used for setting RF power output as applicant's request.

The RF signals were continuously transmitted without off-time interval; duty cycle was 100 %.

Preliminary tests were performed in different data rate as below table and the highest power data rates (11b, 11g, 11g/n (BW 20MHz), 11g/n (BW 40MHz) modes) were chosen for full test in the following sections to demonstrate compliance to the limits.

Measured peak power (dBm) operating 802.11b mode

| | 1 Mbps | 2 Mbps | 5.5 Mbps | 11 Mbps |
|----------|--------|--------|----------|---------|
| 2412 MHz | 17.24 | 18.02 | 19.26 | 20.63 |
| 2437 MHz | 17.44 | 17.96 | 19.21 | 20.56 |
| 2462 MHz | 17.25 | 17.87 | 19.11 | 20.49 |

Measured peak power (dBm) operating 802.11g mode

| | 6 Mbps | 9 Mbps | 12 Mbps | 18 Mbps | 24 Mbps | 36 Mbps | 48 Mbps | 54 Mbps |
|----------|--------|--------|---------|---------|---------|---------|---------|---------|
| 2412 MHz | 17.27 | 17.46 | 17.81 | 17.26 | 18.09 | 17.85 | 17.84 | 18.17 |
| 2437 MHz | 17.36 | 17.50 | 17.82 | 17.26 | 18.02 | 17.80 | 17.82 | 18.13 |
| 2462 MHz | 17.24 | 17.38 | 17.72 | 17.17 | 17.98 | 17.75 | 17.77 | 18.03 |

Measured peak power (dBm) operating 802.11n(HT20) mode

| | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2412 MHz | 17.64 | 17.58 | 17.47 | 17.85 | 17.77 | 17.98 | 18.02 | 18.08 |
| 2437 MHz | 17.73 | 17.68 | 17.58 | 17.95 | 17.86 | 18.03 | 18.10 | 18.19 |
| 2462 MHz | 17.75 | 17.64 | 17.56 | 17.93 | 17.78 | 17.98 | 18.05 | 18.10 |

Measured peak power (dBm) operating 802.11n(HT40) mode

| | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2422 MHz | 17.30 | 17.34 | 17.35 | 17.57 | 17.56 | 17.77 | 17.85 | 17.91 |
| 2437 MHz | 17.53 | 17.44 | 17.43 | 17.64 | 17.65 | 17.86 | 17.92 | 17.96 |
| 2452 MHz | 17.39 | 17.42 | 17.46 | 17.65 | 17.74 | 17.91 | 18.00 | 18.04 |



5.3. 6 dB bandwidth

5.3.1 Regulation

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

5.3.2 Test Procedure

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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 6 dB relative to the maximum level measured in the fundamental emission.

5.3.3 Test Results:

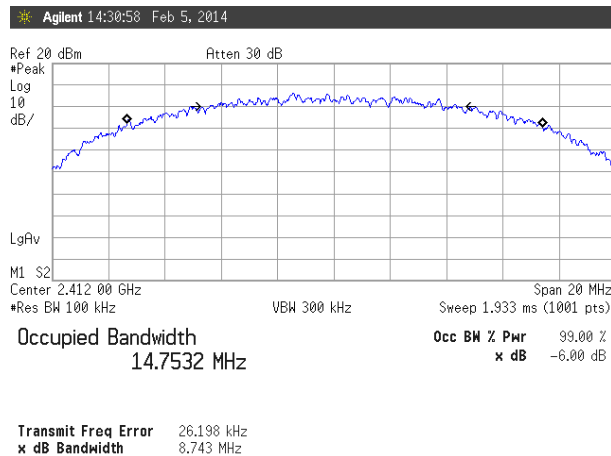
PASS

| Table 1: Measured values of the 6 dB Bandwidth | | | | | |
|--|---------------------|---------------|--------------------------|---------------|----------------|
| Modulation | Operating frequency | Transfer Rate | Occupied Bandwidth (99%) | 6dB Bandwidth | Limit |
| 802.11b | 2412 MHz | 11 Mbps | 14.75 MHz | 8.74 MHz | ≥ 500 kHz |
| | 2437 MHz | 11 Mbps | 14.76 MHz | 9.44 MHz | ≥ 500 kHz |
| | 2462 MHz | 11 Mbps | 14.74 MHz | 8.73 MHz | ≥ 500 kHz |
| 802.11g | 2412 MHz | 54 Mbps | 16.43 MHz | 16.54 MHz | ≥ 500 kHz |
| | 2437 MHz | 54 Mbps | 16.43 MHz | 16.54 MHz | ≥ 500 kHz |
| | 2462 MHz | 54 Mbps | 16.43 MHz | 16.54 MHz | ≥ 500 kHz |
| 802.11n HT20 | 2412 MHz | MCS7 | 17.63 MHz | 17.78 MHz | ≥ 500 kHz |
| | 2437 MHz | MCS7 | 17.62 MHz | 17.79 MHz | ≥ 500 kHz |
| | 2462 MHz | MCS7 | 17.63 MHz | 17.78 MHz | ≥ 500 kHz |
| 802.11n HT40 | 2422 MHz | MCS7 | 36.35 MHz | 36.41 MHz | ≥ 500 kHz |
| | 2437 MHz | MCS7 | 36.32 MHz | 36.33 MHz | ≥ 500 kHz |
| | 2452 MHz | MCS7 | 36.31 MHz | 36.40 MHz | ≥ 500 kHz |

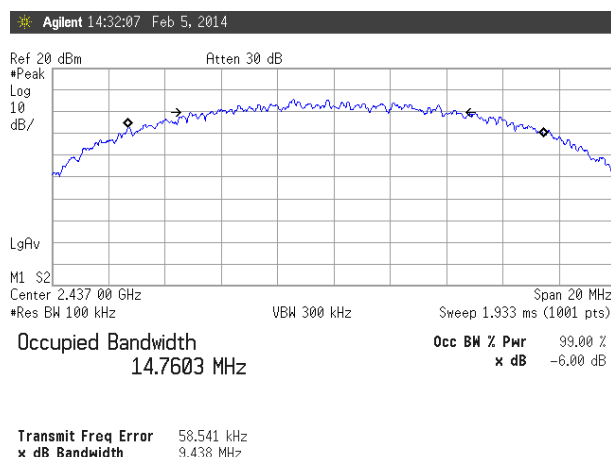
Figure 1. Plot of the 6dB Bandwidth & Occupied Bandwidth (99%)

802.11b mode:

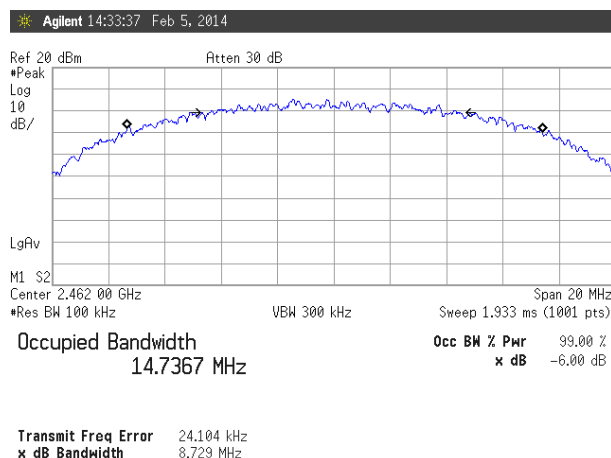
Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)

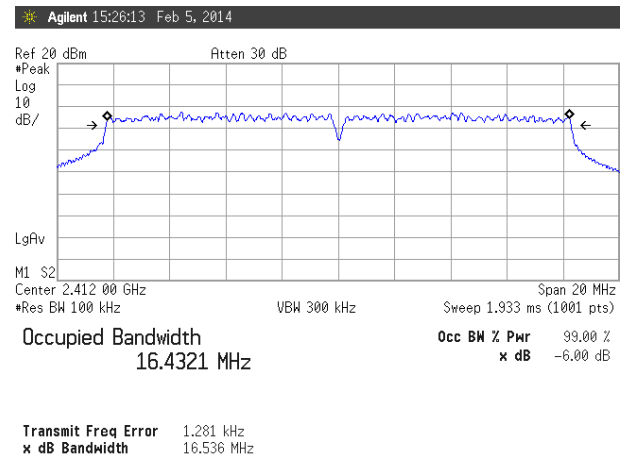


Highest Channel (2462 MHz)

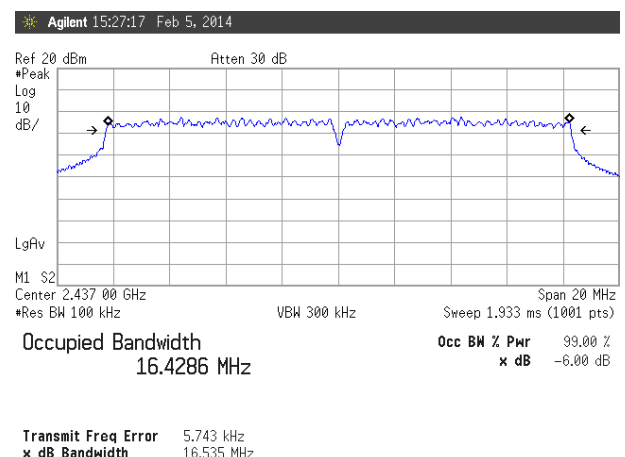


802.11g mode:

Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)



Highest Channel (2462 MHz)

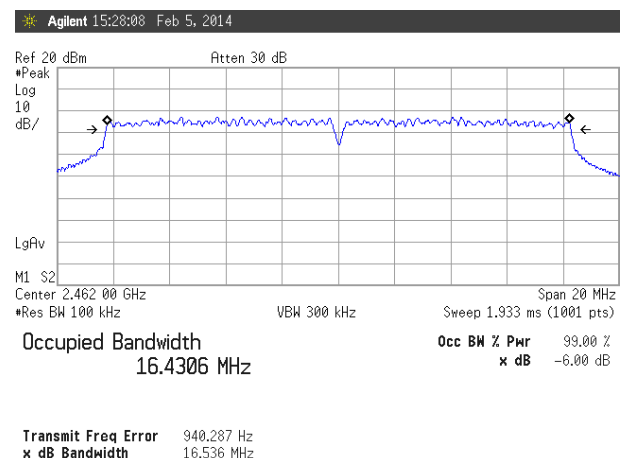
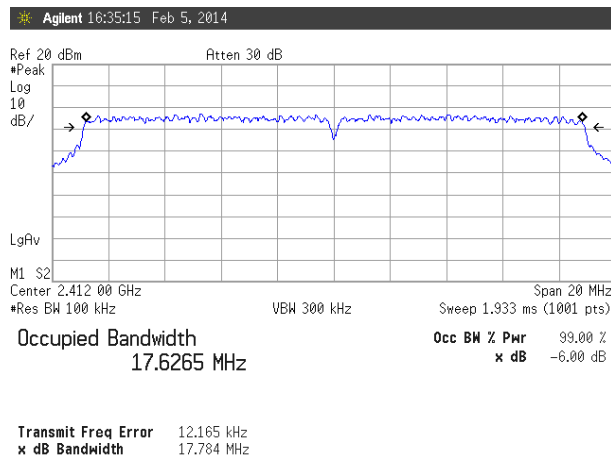
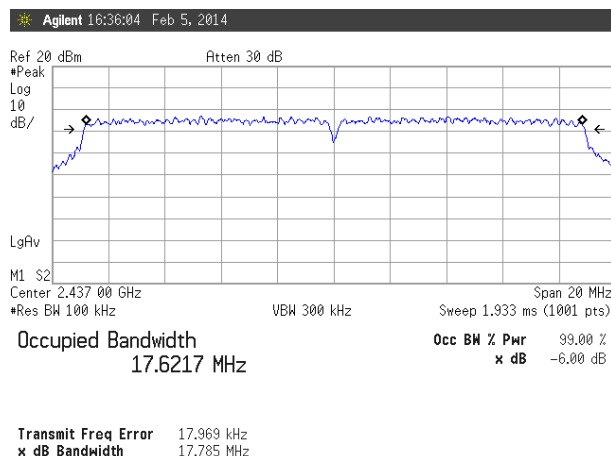
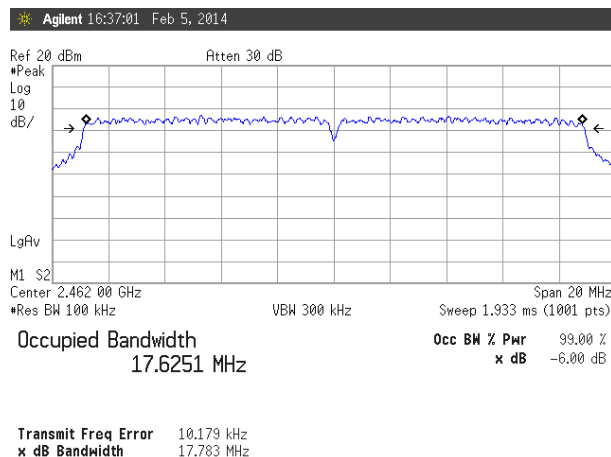
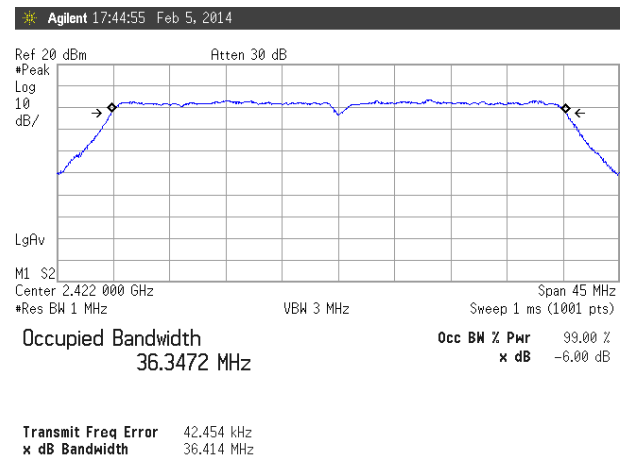
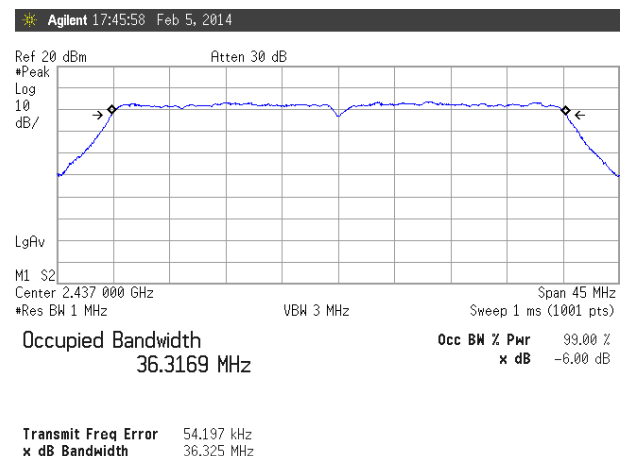
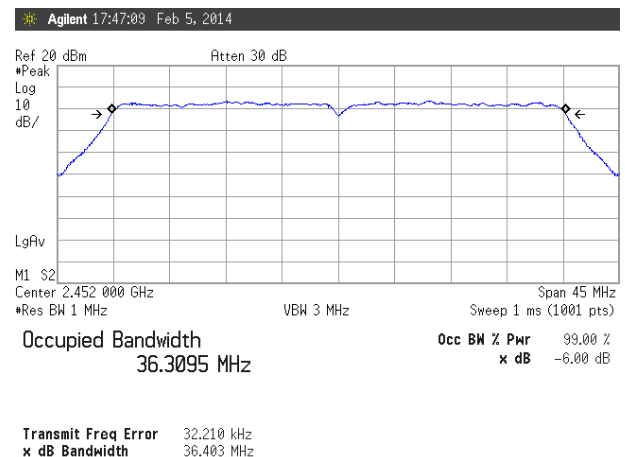


Figure 1. Plot of the 6dB Bandwidth & Occupied Bandwidth (99%) (continued)
802.11n HT20 mode:
Lowest Channel (2412 MHz)

Middle Channel (2437 MHz)

Highest Channel (2462 MHz)

802.11n HT40 mode:
Lowest Channel (2422 MHz)

Middle Channel (2437 MHz)

Highest Channel (2452 MHz)




5.4. Maximum peak output power

5.4.1 Regulation

According to §15.247(b)(3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.4.2 Test Procedure

1. Set the RBW = 1 MHz.
2. Set the VBW $\geq 3 \times$ RBW
3. Set the span $\geq 1.5 \times$ DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select peak detector). If the instrument does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS bandwidth.

5.4.3 Test Results:

PASS

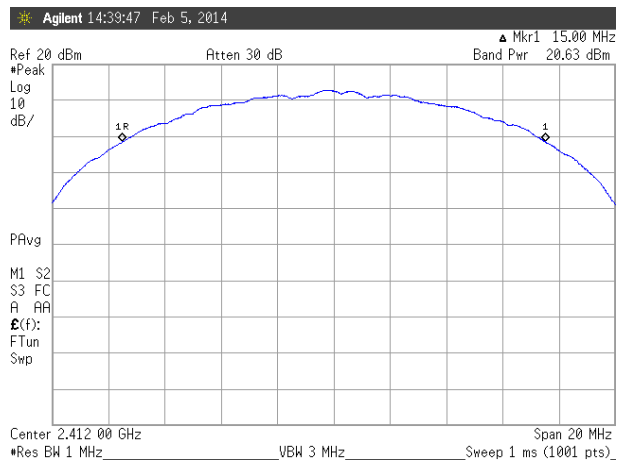
| Table 2: Measured values of the Maximum Peak Conducted Output Power | | | | | | |
|---|---------------------|---------------|------------|-------|----------------------------|-------|
| Modulation | Operating Frequency | Transfer Rate | Peak Power | | Average Power [dBm] (NOTE) | Limit |
| | | | [dBm] | W | | |
| 802.11b | 2412 MHz | 11 Mbps | 20.63 | 0.116 | 14.17 | 1 W |
| | 2437 MHz | | 20.56 | 0.114 | 14.26 | 1 W |
| | 2462 MHz | | 20.49 | 0.112 | 14.10 | 1 W |
| 802.11g | 2412 MHz | 54 Mbps | 18.17 | 0.066 | 9.61 | 1 W |
| | 2437 MHz | | 18.13 | 0.065 | 9.63 | 1 W |
| | 2462 MHz | | 18.03 | 0.064 | 9.51 | 1 W |
| 802.11n HT20 | 2412 MHz | MCS7 | 18.08 | 0.064 | 9.73 | 1 W |
| | 2437 MHz | | 18.19 | 0.066 | 9.78 | 1 W |
| | 2462 MHz | | 18.10 | 0.065 | 9.77 | 1 W |
| 802.11n HT40 | 2422 MHz | MCS7 | 17.91 | 0.062 | 9.46 | 1 W |
| | 2437 MHz | | 17.96 | 0.063 | 9.56 | 1 W |
| | 2452 MHz | | 18.04 | 0.064 | 9.62 | 1 W |

NOTE The Average power were measured using AVGSA- 1 method as the reference only.

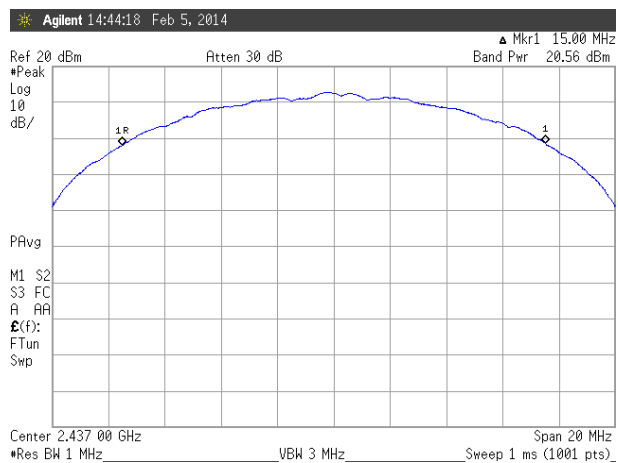
Figure 2. Plot of the Maximum Peak Conducted Output Power

802.11b mode:

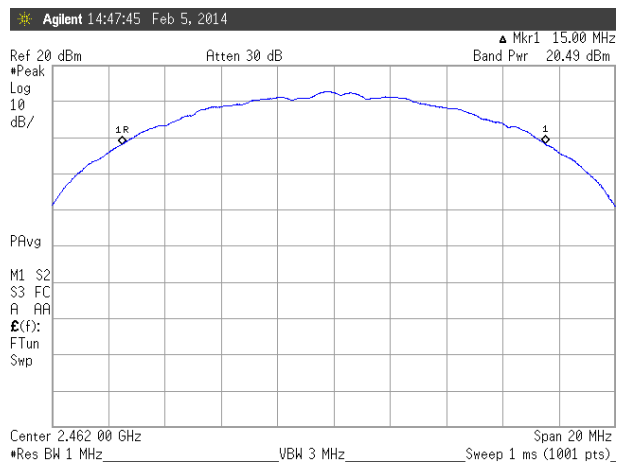
Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)

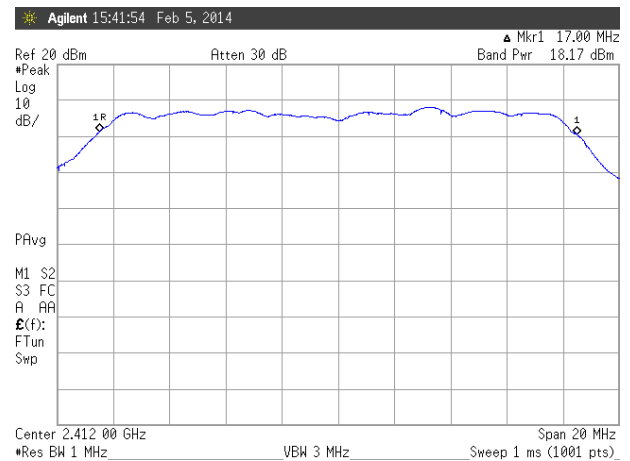


Highest Channel (2462 MHz)

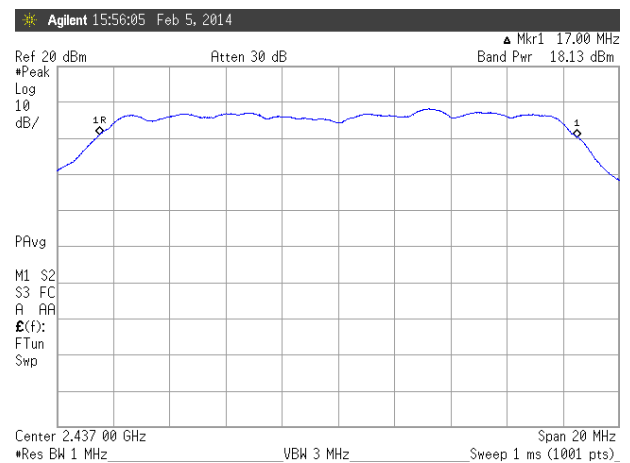


802.11g mode:

Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)



Highest Channel (2462 MHz)

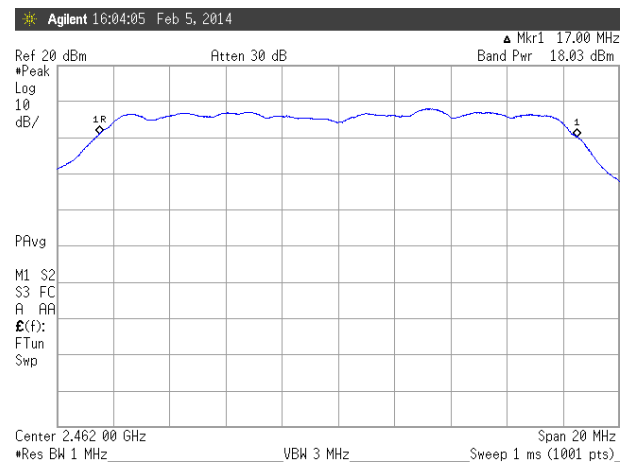
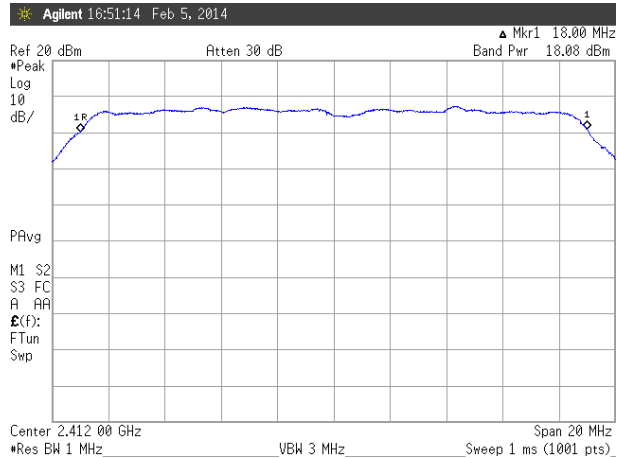


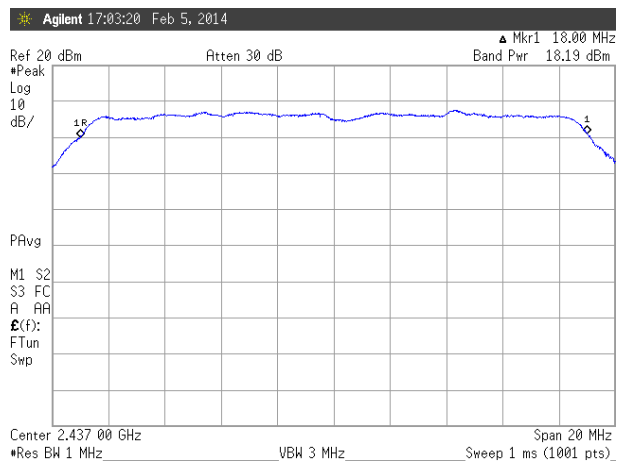
Figure 2. Plot of the Maximum Peak Conducted Output Power (continued)

802.11n HT20 mode:

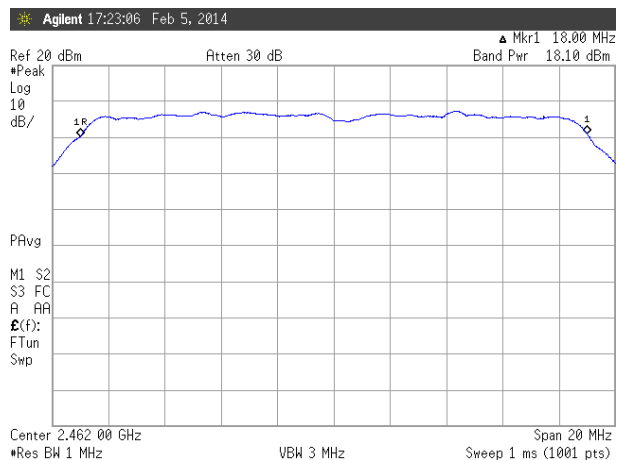
Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)

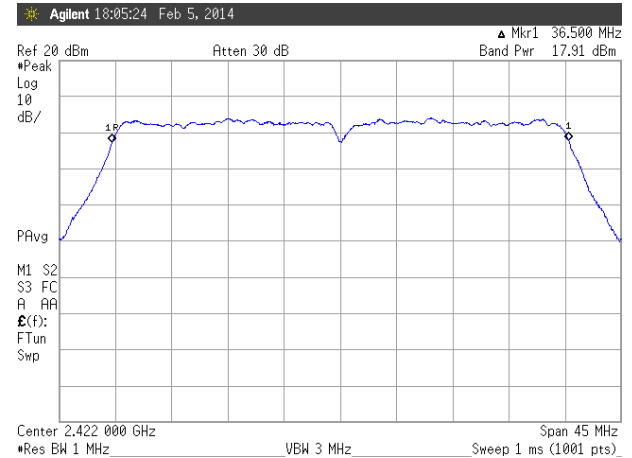


Highest Channel (2462 MHz)

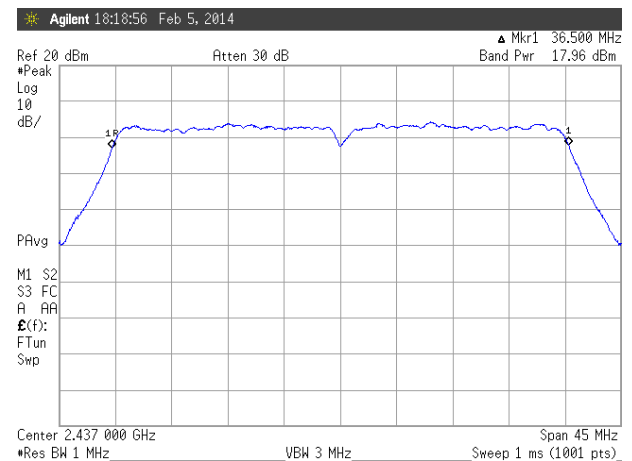


802.11n HT40 mode:

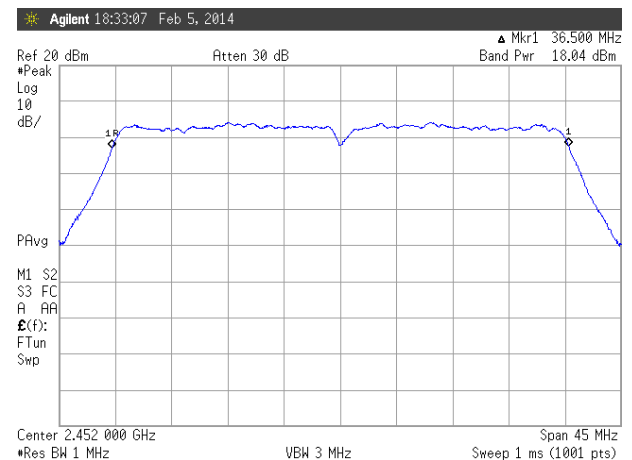
Lowest Channel (2422 MHz)



Middle Channel (2437 MHz)



Highest Channel (2452 MHz)





5.5. Spurious emissions, Band edge, and Restricted bands

5.5.1 Regulation

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency (MHz) | Field strength ($\mu\text{V/m}$ @ 3m) | Field strength ($\text{dB}\mu\text{V/m}$ @ 3m) |
|-----------------|--|---|
| 30–88 | 100 | 40.0 |
| 88–216 | 150 | 43.5 |
| 216–960 | 200 | 46.0 |
| Above 960 | 500 | 54.0 |

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

5.5.2 Test Procedure

1) Band-edge measurements for RF conducted emissions

1. Set the spectrum analyzer as follows:

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

RBW \geq 1 % of spectrum analyzer display span

VBW \geq 3 x RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. 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, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.



2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

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 10th harmonic.

Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter / 3 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function specified in 6.3 and 6.4, 6.5, or 6.6, as applicable, and the appropriate regulatory requirements for the frequency being measured.⁴³
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to approximately 1 % to 5 % of the total span, unless otherwise specified, with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not an absolute field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band edge relative to the highest fundamental emission level.
3. Subtract the delta measured in b) from the field strengths measured in a). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance of the restricted bands, described in 5.9.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band edge, where a "standard" bandwidth is the bandwidth specified by 4.2.3.2 for the frequency being measured. For example, band-edge measurements in the restricted band that begins at 2483.5 MHz require a measurement bandwidth of at least 1 MHz. Therefore the "delta" technique for measuring emissions up to 2 MHz removed from the band edge may be used. Radiated emissions that are removed by more than two "standard" bandwidths shall be measured in the conventional manner.



5.5.3 Test Results:

PASS

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 3 and 4. Spurious RF conducted emissions were shown in the Figure 5.

NOTE 1: for conducted measurement, we took the insertion loss of the cable loss into consideration within the measuring instrument. And for radiated measurement, the results were calibrated to the field strength within the measuring instrument; Table 3 contains the correction factors at the operating frequencies such as antenna factor, cable loss, etc.

| Table 3: Measured values of the Field strength of spurious emission (Radiated) | | | | | | | | | | | | |
|--|--------------------|-------|----------------|------------|----------|----------|------|---------|------|------------|------------|--------|
| BELOW 1 GHz | | | | | | | | | | | | |
| Frequency | Receiver Bandwidth | Pol. | Antenna Height | Turn Table | Reading | Amp Gain | ATT | AF | CL | Actual | Limit | Margin |
| [MHz] | [kHz] | [V/H] | [m] | [degree] | [dB(μV)] | [dB] | [dB] | dB(1/m) | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| Average/Peak/Quasi-peak data, emissions below 30 MHz | | | | | | | | | | | | |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Quasi-peak data, emissions below 1000 MHz | | | | | | | | | | | | |
| 30.00 | 120 | H | 1.0 | 123 | 40.6 | 28.7 | - | 12.4 | 0.7 | 25.0 | 40.0 | 15.0 |
| 30.00 | 120 | V | 1.3 | 86 | 50.8 | 28.7 | - | 12.4 | 0.7 | 35.2 | 40.0 | 4.8 |
| 183.00 | 120 | H | 1.0 | 130 | 43.1 | 28.0 | - | 11.0 | 1.7 | 27.8 | 43.5 | 15.7 |
| 183.00 | 120 | V | 1.5 | 279 | 50.4 | 28.0 | - | 11.0 | 1.7 | 35.1 | 43.5 | 8.4 |
| 325.00 | 120 | H | 1.0 | 21 | 46.9 | 27.9 | - | 14.0 | 2.2 | 35.2 | 46.0 | 10.8 |
| 325.00 | 120 | V | 1.0 | 291 | 47.5 | 27.9 | - | 14.0 | 2.2 | 35.8 | 46.0 | 10.2 |
| 274.90 | 120 | H | 1.4 | 292 | 45.1 | 27.8 | - | 12.5 | 2.0 | 31.8 | 46.0 | 14.2 |
| 274.90 | 120 | V | 1.0 | 249 | 42.0 | 27.8 | - | 12.5 | 2.0 | 28.7 | 46.0 | 17.3 |
| 327.61 | 120 | H | 1.0 | 8 | 38.4 | 27.9 | - | 14.1 | 2.2 | 26.8 | 46.0 | 19.2 |
| 327.10 | 120 | V | 1.3 | 283 | 39.3 | 27.9 | - | 14.1 | 2.2 | 27.7 | 46.0 | 18.3 |

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



Measured values of the Field strength of spurious emission (Radiated) (continued)

ABOVE 1 GHz

| Frequency | Receiver Bandwidth | Pol. | Antenna Height | Turn Table | Reading | Amp Gain | ATT | AF | CL | Actual | Limit | Margin |
|--|--------------------|-------|----------------|------------|----------|----------|-------|-----------|------|------------|----------------|--------|
| [MHz] | [kHz] | [V/H] | [m] | [degree] | [dB(μV)] | [dB] | [dB] | [dB(1/m)] | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| PEAK data, emissions above 1000 MHz (802.11b mode) | | | | | | | | | | | | |
| 2412.0 | 1000 | H | 1.30 | 240 | 105.08 | 48.46 | 10.23 | 28.18 | 6.52 | 101.55 | Not Applicable | |
| 2412.0 | 1000 | V | 1.21 | 272 | 110.45 | 48.46 | 10.23 | 28.18 | 6.52 | 106.92 | | |
| 2335.6 | 1000 | H | 1.30 | 240 | 56.66 | 48.44 | 10.24 | 27.94 | 6.40 | 52.80 | 74.00 | 21.20 |
| 2390.0 | 1000 | V | 1.21 | 272 | 57.85 | 48.45 | 10.23 | 28.11 | 6.48 | 54.22 | 74.00 | 19.78 |
| 4823.0 | 1000 | H | 1.15 | 246 | 53.20 | 49.00 | 0.42 | 33.13 | 9.70 | 47.45 | 74.00 | 26.55 |
| 4823.0 | 1000 | V | 1.08 | 280 | 59.00 | 49.00 | 0.42 | 33.13 | 9.70 | 53.25 | 74.00 | 20.75 |
| 2436.8 | 1000 | H | 1.30 | 240 | 103.88 | 48.48 | 10.23 | 28.26 | 6.55 | 100.44 | Not Applicable | |
| 2436.6 | 1000 | V | 1.22 | 275 | 110.01 | 48.47 | 10.23 | 28.26 | 6.55 | 106.58 | | |
| 4874.0 | 1000 | H | 1.15 | 245 | 52.79 | 49.02 | 0.39 | 33.17 | 9.75 | 47.08 | 74.00 | 26.92 |
| 4874.0 | 1000 | V | 1.08 | 283 | 55.81 | 49.02 | 0.39 | 33.17 | 9.75 | 50.10 | 74.00 | 23.90 |
| 2461.6 | 1000 | H | 1.31 | 241 | 103.19 | 48.49 | 10.23 | 28.34 | 6.59 | 99.86 | Not Applicable | |
| 2461.6 | 1000 | V | 1.22 | 276 | 109.94 | 48.49 | 10.23 | 28.34 | 6.59 | 106.61 | | |
| 2488.0 | 1000 | H | 1.31 | 241 | 54.27 | 48.50 | 10.23 | 28.43 | 6.62 | 51.05 | 74.00 | 22.95 |
| 2484.0 | 1000 | V | 1.22 | 276 | 57.59 | 48.50 | 10.23 | 28.41 | 6.62 | 54.35 | 74.00 | 19.65 |
| 4943.0 | 1000 | H | 1.15 | 246 | 52.08 | 49.04 | 0.35 | 33.21 | 9.81 | 46.41 | 74.00 | 27.59 |
| 4943.0 | 1000 | V | 1.08 | 285 | 60.28 | 49.04 | 0.35 | 33.21 | 9.81 | 54.61 | 74.00 | 19.39 |
| PEAK data, emissions above 1000 MHz (802.11g mode) | | | | | | | | | | | | |
| 2415.2 | 1000 | H | 1.31 | 240 | 98.88 | 48.47 | 10.23 | 28.19 | 6.52 | 95.35 | Not Applicable | |
| 2406.4 | 1000 | V | 1.21 | 274 | 105.14 | 48.46 | 10.23 | 28.17 | 6.51 | 101.59 | | |
| 2336.8 | 1000 | H | 1.31 | 240 | 56.20 | 48.44 | 10.24 | 27.94 | 6.40 | 52.34 | 74.00 | 21.66 |
| 2390.0 | 1000 | V | 1.21 | 274 | 61.94 | 48.45 | 10.23 | 28.11 | 6.48 | 58.31 | 74.00 | 15.69 |
| 4826.0 | 1000 | H | 1.15 | 246 | 48.07 | 49.01 | 0.42 | 33.14 | 9.71 | 42.33 | 74.00 | 31.67 |
| 4824.0 | 1000 | V | 1.08 | 281 | 53.98 | 49.00 | 0.42 | 33.14 | 9.70 | 48.24 | 74.00 | 25.76 |
| 2431.4 | 1000 | H | 1.30 | 241 | 98.18 | 48.47 | 10.23 | 28.25 | 6.54 | 94.73 | Not Applicable | |
| 2440.2 | 1000 | V | 1.22 | 274 | 104.64 | 48.48 | 10.23 | 28.27 | 6.56 | 101.22 | | |
| 4874.0 | 1000 | H | 1.15 | 246 | 47.90 | 49.02 | 0.39 | 33.17 | 9.75 | 42.19 | 74.00 | 31.81 |
| 4874.0 | 1000 | V | 1.08 | 283 | 51.02 | 49.02 | 0.39 | 33.17 | 9.75 | 45.31 | 74.00 | 28.69 |
| 2465.2 | 1000 | H | 1.31 | 241 | 97.69 | 48.49 | 10.23 | 28.35 | 6.59 | 94.37 | Not Applicable | |
| 2456.4 | 1000 | V | 1.22 | 277 | 104.45 | 48.48 | 10.23 | 28.33 | 6.58 | 101.11 | | |
| 2484.4 | 1000 | H | 1.31 | 241 | 54.10 | 48.50 | 10.23 | 28.42 | 6.62 | 50.87 | 74.00 | 23.13 |
| 2484.0 | 1000 | V | 1.22 | 277 | 59.01 | 48.50 | 10.23 | 28.41 | 6.62 | 55.77 | 74.00 | 18.23 |
| 4944.0 | 1000 | H | 1.15 | 245 | 47.43 | 49.04 | 0.35 | 33.21 | 9.82 | 41.77 | 74.00 | 32.23 |
| 4944.0 | 1000 | V | 1.08 | 285 | 55.88 | 49.04 | 0.35 | 33.21 | 9.82 | 50.22 | 74.00 | 23.78 |

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

**Measured values of the Field strength of spurious emission (Radiated) (continued)****ABOVE 1 GHz**

| Frequency | Receiver Bandwidth | Pol. | Antenna Height | Turn Table | Reading | Amp Gain | ATT | AF | CL | Actual | Limit | Margin |
|--|--------------------|-------|----------------|------------|----------|----------|-------|-----------|------|------------|----------------|--------|
| [MHz] | [kHz] | [V/H] | [m] | [degree] | [dB(μV)] | [dB] | [dB] | [dB(1/m)] | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| AVERAGE data, emissions above 1000 MHz (802.11b mode) | | | | | | | | | | | | |
| 2412.0 | 1000 | H | 1.30 | 240 | 96.89 | 48.46 | 10.23 | 28.18 | 6.52 | 93.36 | Not Applicable | |
| 2412.0 | 1000 | V | 1.21 | 272 | 102.35 | 48.46 | 10.23 | 28.18 | 6.52 | 98.82 | | |
| 2335.6 | 1000 | H | 1.30 | 240 | 42.61 | 48.44 | 10.24 | 27.94 | 6.40 | 38.75 | 54.00 | 15.25 |
| 2390.0 | 1000 | V | 1.21 | 272 | 44.36 | 48.45 | 10.23 | 28.11 | 6.48 | 40.73 | 54.00 | 13.27 |
| 4823.0 | 1000 | H | 1.15 | 246 | 43.38 | 49.00 | 0.42 | 33.13 | 9.70 | 37.63 | 54.00 | 16.37 |
| 4823.0 | 1000 | V | 1.08 | 280 | 49.22 | 49.00 | 0.42 | 33.13 | 9.70 | 43.47 | 54.00 | 10.53 |
| 2436.8 | 1000 | H | 1.30 | 240 | 96.28 | 48.48 | 10.23 | 28.26 | 6.55 | 92.84 | Not Applicable | |
| 2436.6 | 1000 | V | 1.22 | 275 | 102.03 | 48.47 | 10.23 | 28.26 | 6.55 | 98.60 | | |
| 4874.0 | 1000 | H | 1.15 | 245 | 42.83 | 49.02 | 0.39 | 33.17 | 9.75 | 37.12 | 54.00 | 16.88 |
| 4874.0 | 1000 | V | 1.08 | 283 | 45.87 | 49.02 | 0.39 | 33.17 | 9.75 | 40.16 | 54.00 | 13.84 |
| 2461.6 | 1000 | H | 1.31 | 241 | 95.06 | 48.49 | 10.23 | 28.34 | 6.59 | 91.73 | Not Applicable | |
| 2461.6 | 1000 | V | 1.22 | 276 | 101.77 | 48.49 | 10.23 | 28.34 | 6.59 | 98.44 | | |
| 2488.0 | 1000 | H | 1.31 | 241 | 40.99 | 48.50 | 10.23 | 28.43 | 6.62 | 37.77 | 54.00 | 16.23 |
| 2484.0 | 1000 | V | 1.22 | 276 | 44.47 | 48.50 | 10.23 | 28.41 | 6.62 | 41.23 | 54.00 | 12.77 |
| 4943.0 | 1000 | H | 1.15 | 246 | 41.93 | 49.04 | 0.35 | 33.21 | 9.81 | 36.26 | 54.00 | 17.74 |
| 4943.0 | 1000 | V | 1.08 | 285 | 50.51 | 49.04 | 0.35 | 33.21 | 9.81 | 44.84 | 54.00 | 9.16 |
| AVERAGE data, emissions above 1000 MHz (802.11g mode) | | | | | | | | | | | | |
| 2415.2 | 1000 | H | 1.31 | 240 | 88.93 | 48.47 | 10.23 | 28.19 | 6.52 | 85.40 | Not Applicable | |
| 2406.4 | 1000 | V | 1.21 | 274 | 95.46 | 48.46 | 10.23 | 28.17 | 6.51 | 91.91 | | |
| 2336.8 | 1000 | H | 1.31 | 240 | 42.48 | 48.44 | 10.24 | 27.94 | 6.40 | 38.62 | 54.00 | 15.38 |
| 2390.0 | 1000 | V | 1.21 | 274 | 46.66 | 48.45 | 10.23 | 28.11 | 6.48 | 43.03 | 54.00 | 10.97 |
| 4826.0 | 1000 | H | 1.15 | 246 | 38.32 | 49.01 | 0.42 | 33.14 | 9.71 | 32.58 | 54.00 | 21.42 |
| 4824.0 | 1000 | V | 1.08 | 281 | 44.13 | 49.00 | 0.42 | 33.14 | 9.70 | 38.39 | 54.00 | 15.61 |
| 2431.4 | 1000 | H | 1.30 | 241 | 88.44 | 48.47 | 10.23 | 28.25 | 6.54 | 84.99 | Not Applicable | |
| 2440.2 | 1000 | V | 1.22 | 274 | 94.97 | 48.48 | 10.23 | 28.27 | 6.56 | 91.55 | | |
| 4874.0 | 1000 | H | 1.15 | 246 | 38.07 | 49.02 | 0.39 | 33.17 | 9.75 | 32.36 | 54.00 | 21.64 |
| 4874.0 | 1000 | V | 1.08 | 283 | 41.02 | 49.02 | 0.39 | 33.17 | 9.75 | 35.31 | 54.00 | 18.69 |
| 2465.2 | 1000 | H | 1.31 | 241 | 87.74 | 48.49 | 10.23 | 28.35 | 6.59 | 84.42 | Not Applicable | |
| 2456.4 | 1000 | V | 1.22 | 277 | 94.76 | 48.48 | 10.23 | 28.33 | 6.58 | 91.42 | | |
| 2484.4 | 1000 | H | 1.31 | 241 | 41.19 | 48.50 | 10.23 | 28.42 | 6.62 | 37.96 | 54.00 | 16.04 |
| 2484.0 | 1000 | V | 1.22 | 277 | 45.00 | 48.50 | 10.23 | 28.41 | 6.62 | 41.76 | 54.00 | 12.24 |
| 4944.0 | 1000 | H | 1.15 | 245 | 37.40 | 49.04 | 0.35 | 33.21 | 9.82 | 31.74 | 54.00 | 22.26 |
| 4944.0 | 1000 | V | 1.08 | 285 | 45.99 | 49.04 | 0.35 | 33.21 | 9.82 | 40.33 | 54.00 | 13.67 |

Margin (dB) = Limit – Actual**[Actual = Reading – Amp Gain + Attenuator + AF + CL]**

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



Measured values of the Field strength of spurious emission (Radiated) (continued)

ABOVE 1 GHz

| Frequency | Receiver Bandwidth | Pol. | Antenna Height | Turn Table | Reading | Amp Gain | ATT | AF | CL | Actual | Limit | Margin |
|--|--------------------|-------|----------------|------------|----------|----------|-------|-----------|------|------------|----------------|--------|
| [MHz] | [kHz] | [V/H] | [m] | [degree] | [dB(μV)] | [dB] | [dB] | [dB(1/m)] | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| PEAK data, emissions above 1000 MHz (802.11n HT20 mode) | | | | | | | | | | | | |
| 2416.4 | 1000 | H | 1.31 | 241 | 98.84 | 48.47 | 10.23 | 28.20 | 6.52 | 95.32 | Not Applicable | |
| 2416.4 | 1000 | V | 1.22 | 272 | 105.24 | 48.47 | 10.23 | 28.20 | 6.52 | 101.72 | | |
| 2390.0 | 1000 | H | 1.31 | 241 | 56.72 | 48.45 | 10.23 | 28.11 | 6.48 | 53.09 | 74.00 | 20.91 |
| 2390.0 | 1000 | V | 1.22 | 272 | 63.22 | 48.45 | 10.23 | 28.11 | 6.48 | 59.59 | 74.00 | 14.41 |
| 4824.0 | 1000 | H | 1.15 | 248 | 49.62 | 49.00 | 0.42 | 33.14 | 9.70 | 43.88 | 74.00 | 30.12 |
| 4824.0 | 1000 | V | 1.08 | 281 | 55.40 | 49.00 | 0.42 | 33.14 | 9.70 | 49.66 | 74.00 | 24.34 |
| 2441.4 | 1000 | H | 1.31 | 242 | 98.24 | 48.48 | 10.23 | 28.28 | 6.56 | 94.83 | Not Applicable | |
| 2441.4 | 1000 | V | 1.22 | 275 | 104.30 | 48.48 | 10.23 | 28.28 | 6.56 | 100.89 | | |
| 4874.0 | 1000 | H | 1.15 | 246 | 48.43 | 49.02 | 0.39 | 33.17 | 9.75 | 42.72 | 74.00 | 31.28 |
| 4874.0 | 1000 | V | 1.08 | 284 | 51.64 | 49.02 | 0.39 | 33.17 | 9.75 | 45.93 | 74.00 | 28.07 |
| 2466.4 | 1000 | H | 1.31 | 241 | 97.16 | 48.49 | 10.23 | 28.36 | 6.59 | 93.85 | Not Applicable | |
| 2458.8 | 1000 | V | 1.22 | 276 | 103.93 | 48.49 | 10.23 | 28.33 | 6.58 | 100.58 | | |
| 2483.6 | 1000 | H | 1.31 | 241 | 56.67 | 48.50 | 10.23 | 28.41 | 6.62 | 53.43 | 74.00 | 20.57 |
| 2484.0 | 1000 | V | 1.22 | 276 | 61.42 | 48.50 | 10.23 | 28.41 | 6.62 | 58.18 | 74.00 | 15.82 |
| 4944.0 | 1000 | H | 1.15 | 247 | 47.10 | 49.04 | 0.35 | 33.21 | 9.82 | 41.44 | 74.00 | 32.56 |
| 4944.0 | 1000 | V | 1.08 | 286 | 55.26 | 49.04 | 0.35 | 33.21 | 9.82 | 49.60 | 74.00 | 24.40 |
| PEAK data, emissions above 1000 MHz (802.11n HT40 mode) | | | | | | | | | | | | |
| 2425.2 | 1000 | H | 1.35 | 240 | 95.65 | 48.47 | 10.23 | 28.23 | 6.54 | 92.18 | Not Applicable | |
| 2430.4 | 1000 | V | 1.21 | 272 | 101.97 | 48.47 | 10.23 | 28.24 | 6.54 | 98.51 | | |
| 2331.6 | 1000 | H | 1.35 | 240 | 55.65 | 48.44 | 10.24 | 27.93 | 6.39 | 51.77 | 74.00 | 22.23 |
| 2389.2 | 1000 | V | 1.21 | 272 | 66.67 | 48.45 | 10.23 | 28.11 | 6.48 | 63.04 | 74.00 | 10.96 |
| 4844.0 | 1000 | H | 1.15 | 254 | 47.99 | 49.01 | 0.40 | 33.15 | 9.72 | 42.25 | 74.00 | 31.75 |
| 4844.0 | 1000 | V | 1.07 | 277 | 53.88 | 49.01 | 0.40 | 33.15 | 9.72 | 48.14 | 74.00 | 25.86 |
| 2427.2 | 1000 | H | 1.34 | 240 | 94.62 | 48.47 | 10.23 | 28.23 | 6.54 | 91.15 | Not Applicable | |
| 2427.2 | 1000 | V | 1.21 | 273 | 101.90 | 48.47 | 10.23 | 28.23 | 6.54 | 98.43 | | |
| 4874.0 | 1000 | H | 1.15 | 253 | 47.56 | 49.02 | 0.39 | 33.17 | 9.75 | 41.85 | 74.00 | 32.15 |
| 4874.0 | 1000 | V | 1.07 | 278 | 50.63 | 49.02 | 0.39 | 33.17 | 9.75 | 44.92 | 74.00 | 29.08 |
| 2455.2 | 1000 | H | 1.33 | 239 | 94.26 | 48.48 | 10.23 | 28.32 | 6.58 | 90.91 | Not Applicable | |
| 2455.2 | 1000 | V | 1.21 | 273 | 101.95 | 48.48 | 10.23 | 28.32 | 6.58 | 98.60 | | |
| 2485.2 | 1000 | H | 1.33 | 239 | 55.47 | 48.50 | 10.23 | 28.42 | 6.62 | 52.24 | 74.00 | 21.76 |
| 2484.8 | 1000 | V | 1.21 | 273 | 63.41 | 48.50 | 10.23 | 28.42 | 6.62 | 60.18 | 74.00 | 13.82 |
| 4924.0 | 1000 | H | 1.15 | 253 | 46.86 | 49.03 | 0.36 | 33.20 | 9.80 | 41.19 | 74.00 | 32.81 |
| 4924.0 | 1000 | V | 1.07 | 277 | 55.12 | 49.03 | 0.36 | 33.20 | 9.80 | 49.45 | 74.00 | 24.55 |

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



Measured values of the Field strength of spurious emission (Radiated) (continued)

ABOVE 1 GHz

| Frequency | Receiver Bandwidth | Pol. | Antenna Height | Turn Table | Reading | Amp Gain | ATT | AF | CL | Actual | Limit | Margin |
|---|--------------------|-------|----------------|------------|----------|----------|-------|-----------|------|------------|----------------|--------|
| [MHz] | [kHz] | [V/H] | [m] | [degree] | [dB(μV)] | [dB] | [dB] | [dB(1/m)] | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| AVERAGE data, emissions above 1000 MHz (802.11n HT20 mode) | | | | | | | | | | | | |
| 2416.4 | 1000 | H | 1.31 | 241 | 88.52 | 48.47 | 10.23 | 28.20 | 6.52 | 85.00 | Not Applicable | |
| 2416.4 | 1000 | V | 1.22 | 272 | 95.32 | 48.47 | 10.23 | 28.20 | 6.52 | 91.80 | | |
| 2390.0 | 1000 | H | 1.31 | 241 | 42.92 | 48.45 | 10.23 | 28.11 | 6.48 | 39.29 | 54.00 | 14.71 |
| 2390.0 | 1000 | V | 1.22 | 272 | 48.86 | 48.45 | 10.23 | 28.11 | 6.48 | 45.23 | 54.00 | 8.77 |
| 4824.0 | 1000 | H | 1.15 | 248 | 39.74 | 49.00 | 0.42 | 33.14 | 9.70 | 34.00 | 54.00 | 20.00 |
| 4824.0 | 1000 | V | 1.08 | 281 | 45.49 | 49.00 | 0.42 | 33.14 | 9.70 | 39.75 | 54.00 | 14.25 |
| 2441.4 | 1000 | H | 1.31 | 242 | 88.03 | 48.48 | 10.23 | 28.28 | 6.56 | 84.62 | Not Applicable | |
| 2441.4 | 1000 | V | 1.22 | 275 | 94.92 | 48.48 | 10.23 | 28.28 | 6.56 | 91.51 | | |
| 4874.0 | 1000 | H | 1.15 | 246 | 38.52 | 49.02 | 0.39 | 33.17 | 9.75 | 32.81 | 54.00 | 21.19 |
| 4874.0 | 1000 | V | 1.08 | 284 | 41.58 | 49.02 | 0.39 | 33.17 | 9.75 | 35.87 | 54.00 | 18.13 |
| 2466.4 | 1000 | H | 1.31 | 241 | 87.48 | 48.49 | 10.23 | 28.36 | 6.59 | 84.17 | Not Applicable | |
| 2458.8 | 1000 | V | 1.22 | 276 | 94.41 | 48.49 | 10.23 | 28.33 | 6.58 | 91.06 | | |
| 2483.6 | 1000 | H | 1.31 | 241 | 42.07 | 48.50 | 10.23 | 28.41 | 6.62 | 38.83 | 54.00 | 15.17 |
| 2484.0 | 1000 | V | 1.22 | 276 | 46.14 | 48.50 | 10.23 | 28.41 | 6.62 | 42.90 | 54.00 | 11.10 |
| 4944.0 | 1000 | H | 1.15 | 247 | 36.85 | 49.04 | 0.35 | 33.21 | 9.82 | 31.19 | 54.00 | 22.81 |
| 4944.0 | 1000 | V | 1.08 | 286 | 45.47 | 49.04 | 0.35 | 33.21 | 9.82 | 39.81 | 54.00 | 14.19 |
| AVERAGE data, emissions above 1000 MHz (802.11n HT40 mode) | | | | | | | | | | | | |
| 2425.2 | 1000 | H | 1.35 | 240 | 85.69 | 48.47 | 10.23 | 28.23 | 6.54 | 82.22 | Not Applicable | |
| 2430.4 | 1000 | V | 1.21 | 272 | 92.13 | 48.47 | 10.23 | 28.24 | 6.54 | 88.67 | | |
| 2331.6 | 1000 | H | 1.35 | 240 | 42.23 | 48.44 | 10.24 | 27.93 | 6.39 | 38.35 | 54.00 | 15.65 |
| 2389.2 | 1000 | V | 1.21 | 272 | 51.55 | 48.45 | 10.23 | 28.11 | 6.48 | 47.92 | 54.00 | 6.08 |
| 4844.0 | 1000 | H | 1.15 | 254 | 38.19 | 49.01 | 0.40 | 33.15 | 9.72 | 32.45 | 54.00 | 21.55 |
| 4844.0 | 1000 | V | 1.07 | 277 | 44.08 | 49.01 | 0.40 | 33.15 | 9.72 | 38.34 | 54.00 | 15.66 |
| 2427.2 | 1000 | H | 1.34 | 240 | 84.73 | 48.47 | 10.23 | 28.23 | 6.54 | 81.26 | Not Applicable | |
| 2427.2 | 1000 | V | 1.21 | 273 | 92.11 | 48.47 | 10.23 | 28.23 | 6.54 | 88.64 | | |
| 4874.0 | 1000 | H | 1.15 | 253 | 37.61 | 49.02 | 0.39 | 33.17 | 9.75 | 31.90 | 54.00 | 22.10 |
| 4874.0 | 1000 | V | 1.07 | 278 | 40.74 | 49.02 | 0.39 | 33.17 | 9.75 | 35.03 | 54.00 | 18.97 |
| 2455.2 | 1000 | H | 1.33 | 239 | 84.34 | 48.48 | 10.23 | 28.32 | 6.58 | 80.99 | Not Applicable | |
| 2455.2 | 1000 | V | 1.21 | 273 | 92.12 | 48.48 | 10.23 | 28.32 | 6.58 | 88.77 | | |
| 2485.2 | 1000 | H | 1.33 | 239 | 43.56 | 48.50 | 10.23 | 28.42 | 6.62 | 40.33 | 54.00 | 13.67 |
| 2484.8 | 1000 | V | 1.21 | 273 | 50.25 | 48.50 | 10.23 | 28.42 | 6.62 | 47.02 | 54.00 | 6.98 |
| 4924.0 | 1000 | H | 1.15 | 253 | 36.73 | 49.03 | 0.36 | 33.20 | 9.80 | 31.06 | 54.00 | 22.94 |
| 4924.0 | 1000 | V | 1.07 | 277 | 45.40 | 49.03 | 0.36 | 33.20 | 9.80 | 39.73 | 54.00 | 14.27 |

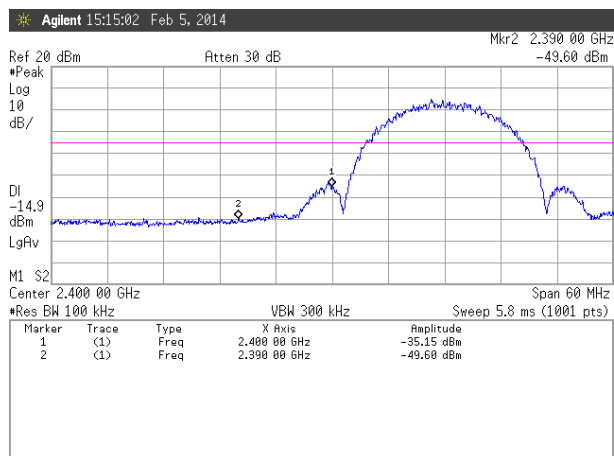
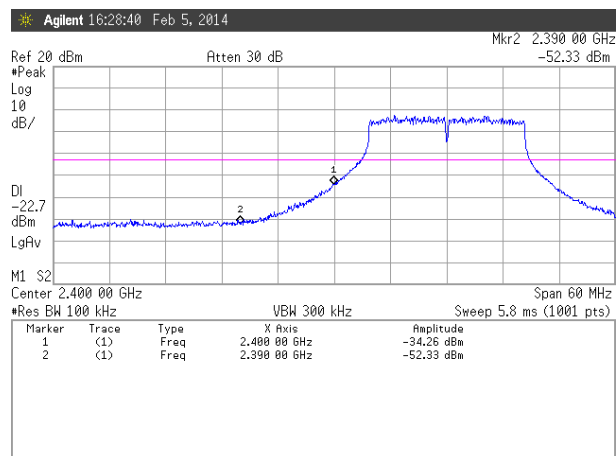
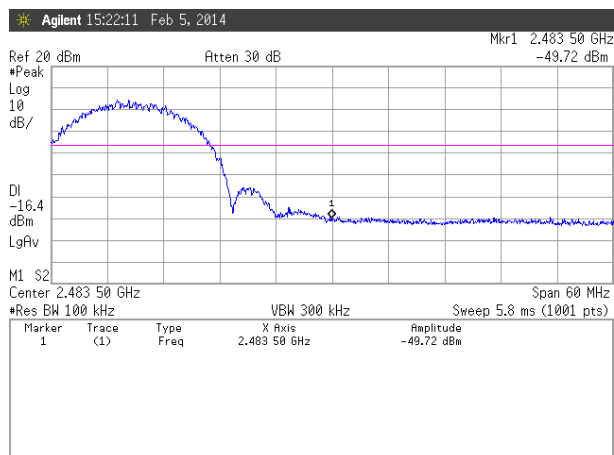
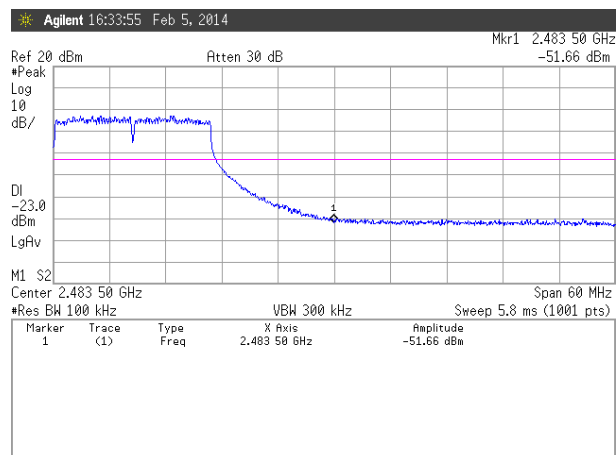
Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

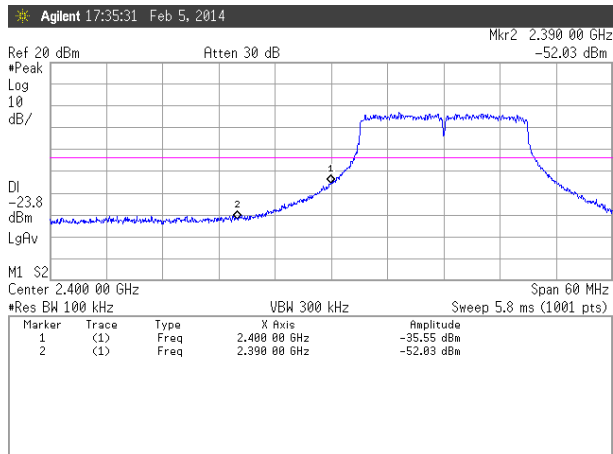
NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

Figure 3. Plot of the Band Edge (Conducted)
802.11b mode:
Lowest Channel (2412 MHz)

802.11g mode:
Lowest Channel (2412 MHz)

Highest Channel (2462 MHz)

Highest Channel (2462 MHz)


Plot of the Band Edge (Conducted) (continued)

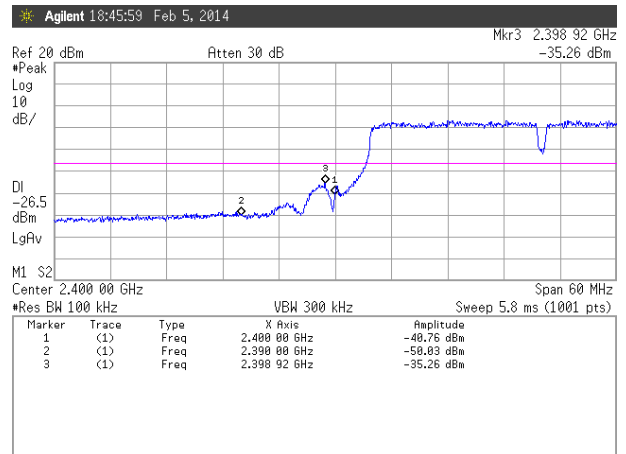
802.11n HT20 mode:

Lowest Channel (2412 MHz)

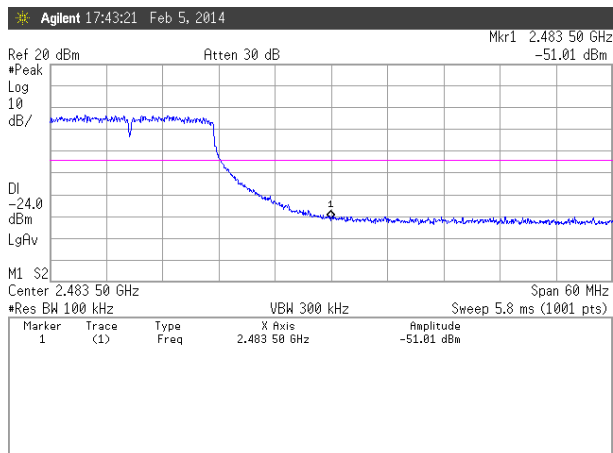


802.11n HT40 mode:

Lowest Channel (2422 MHz)



Highest Channel (2462 MHz)



Highest Channel (2452 MHz)

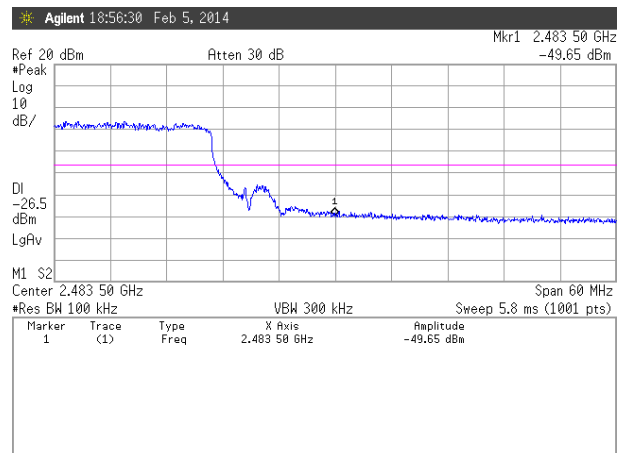
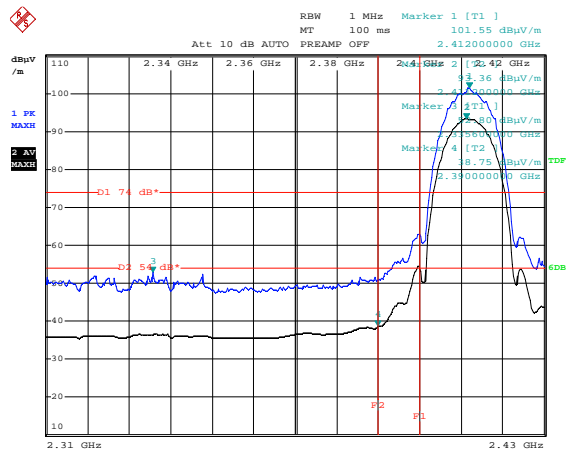


Figure 4. Plot of the Band Edge (Radiated)

802.11b mode:

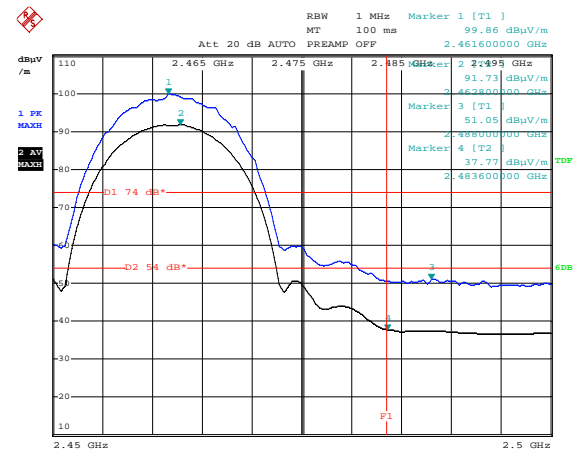
Lowest Channel (2412 MHz)

Horizontal



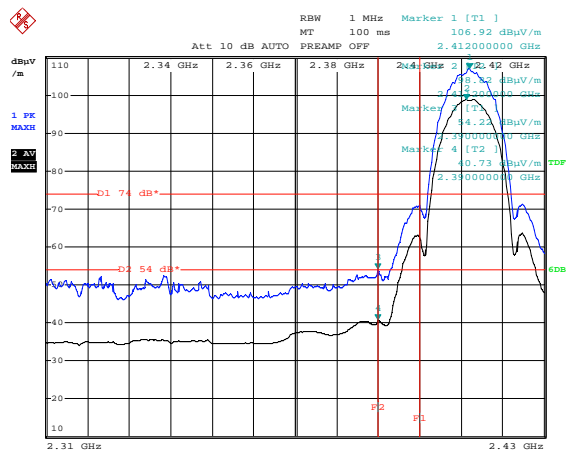
Highest Channel (2462 MHz)

Horizontal



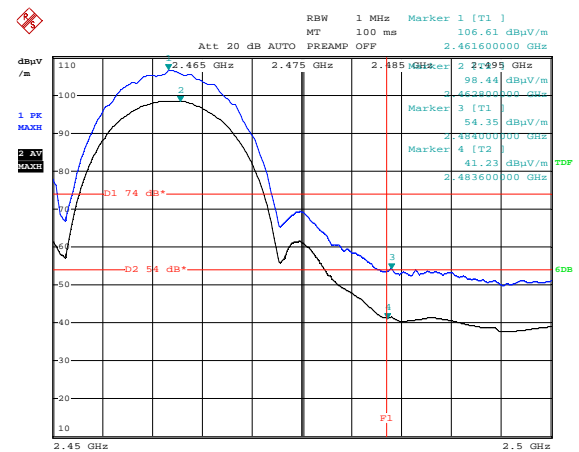
Lowest Channel (2412 MHz)

Vertical



Highest Channel (2462 MHz)

Vertical

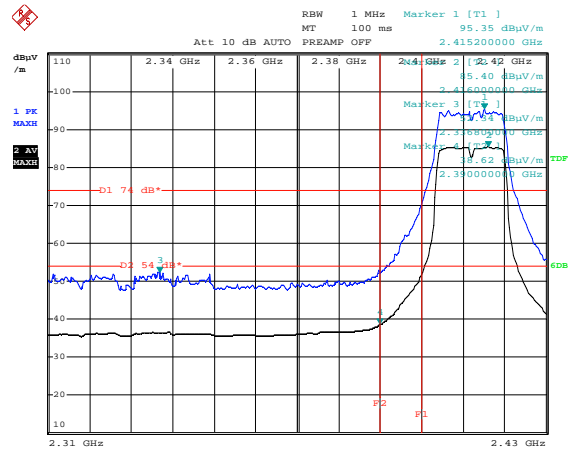


Plot of the Band Edge (Radiated) (continued)

802.11g mode:

Lowest Channel (2412 MHz)

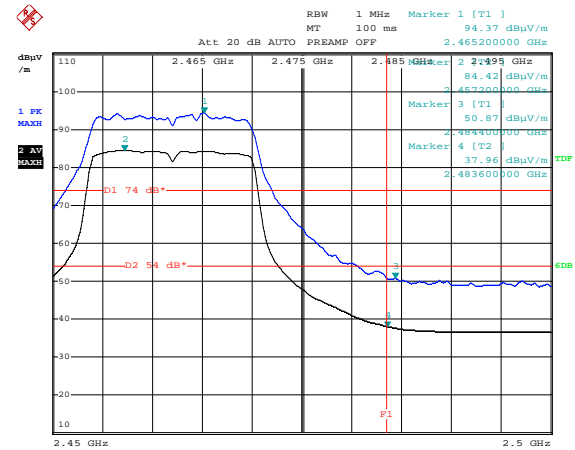
Horizontal



Date: 17.FEB.2014 18:27:31

Highest Channel (2462 MHz)

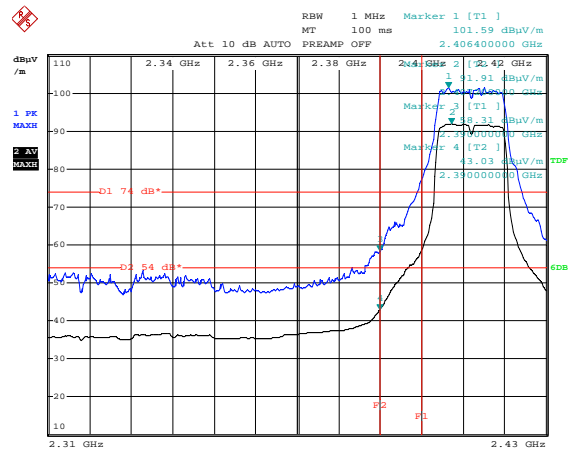
Horizontal



Date: 17.FEB.2014 17:55:20

Lowest Channel (2412 MHz)

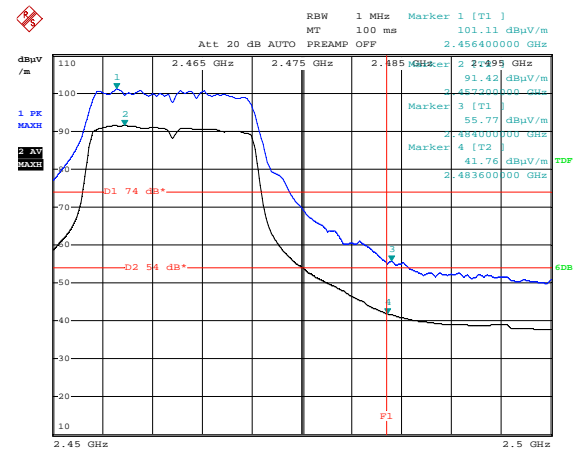
Vertical



Date: 17.FEB.2014 16:46:51

Highest Channel (2462 MHz)

Vertical



Date: 17.FEB.2014 17:34:27

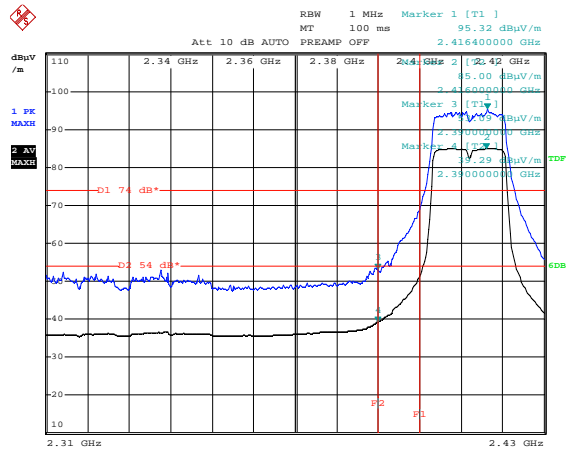


Plot of the Band Edge (Radiated) (*continued*)

802.11n HT20 mode:

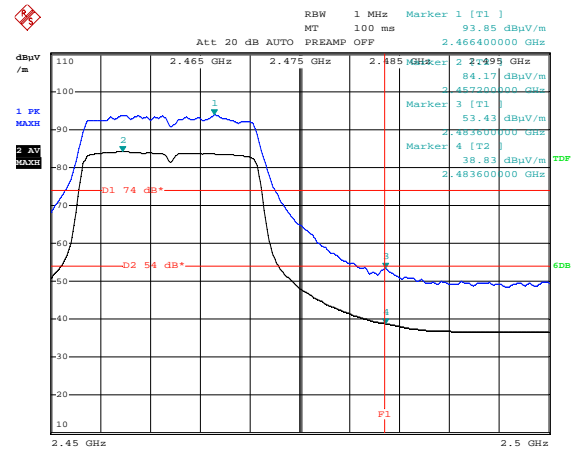
Lowest Channel (2412 MHz)

Horizontal



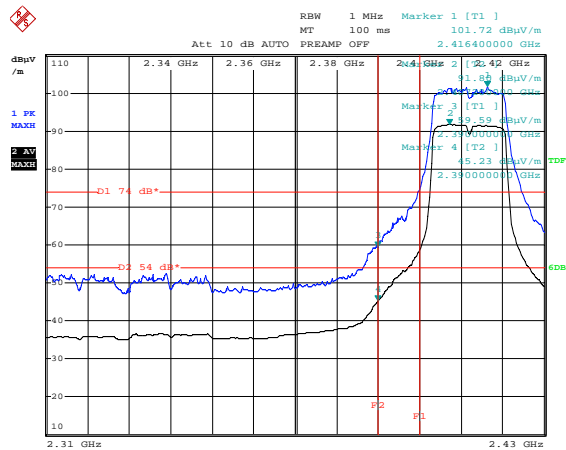
Highest Channel (2462 MHz)

Horizontal



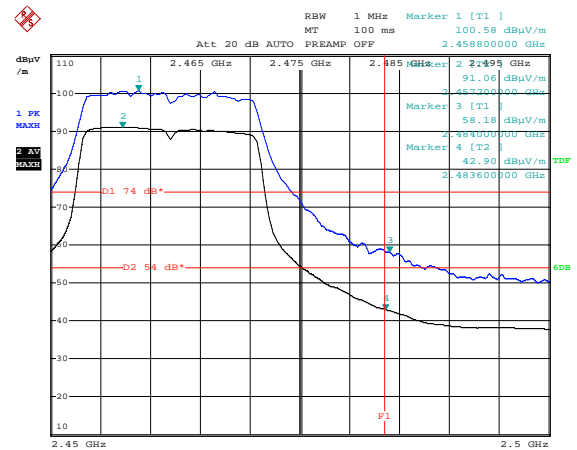
Lowest Channel (2412 MHz)

Vertical



Highest Channel (2462 MHz)

Vertical



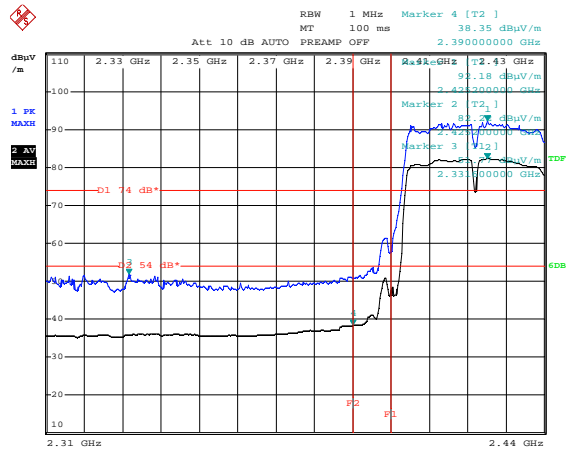


Plot of the Band Edge (Radiated) (*continued*)

802.11n HT40 mode:

Lowest Channel (2422 MHz)

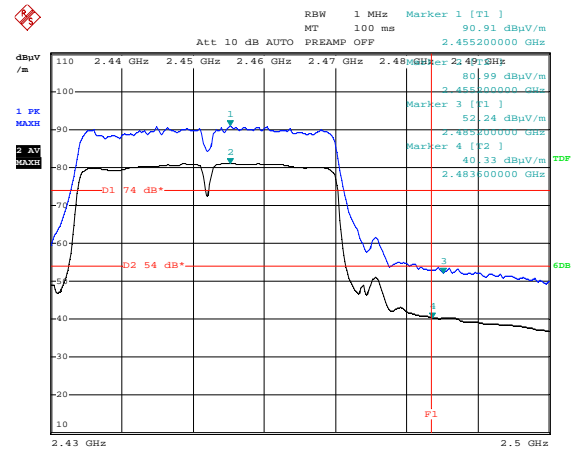
Horizontal



Date: 17.FEB.2014 18:41:43

Highest Channel (2452 MHz)

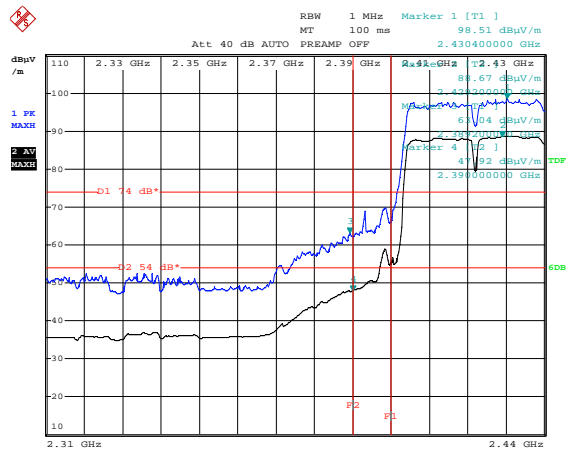
Horizontal



Date: 17.FEB.2014 18:10:05

Lowest Channel (2422 MHz)

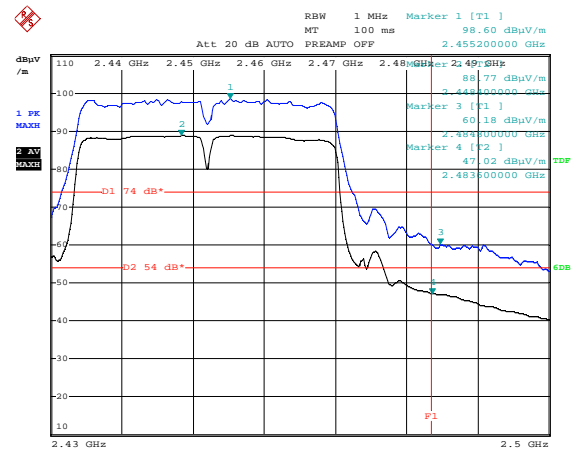
Vertical



Date: 17.FEB.2014 17:05:08

Highest Channel (2452 MHz)

Vertical

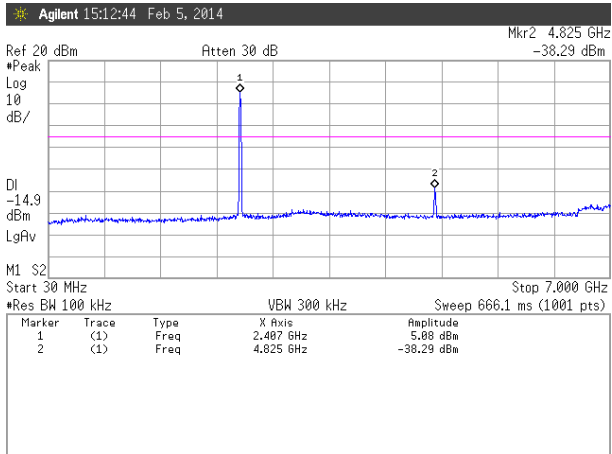


Date: 17.FEB.2014 17:16:42

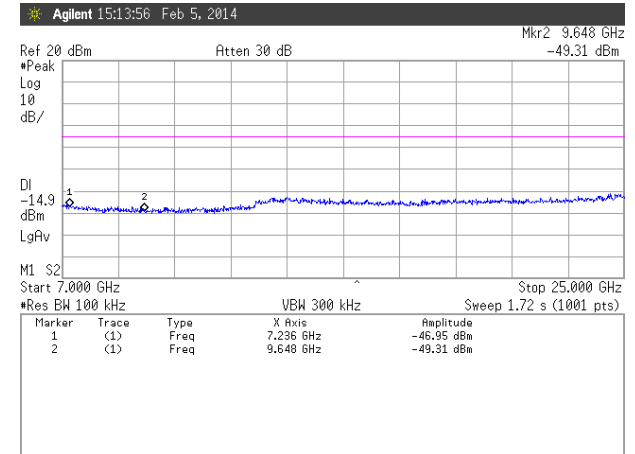
Figure 5. Spurious RF conducted emissions

802.11b mode:

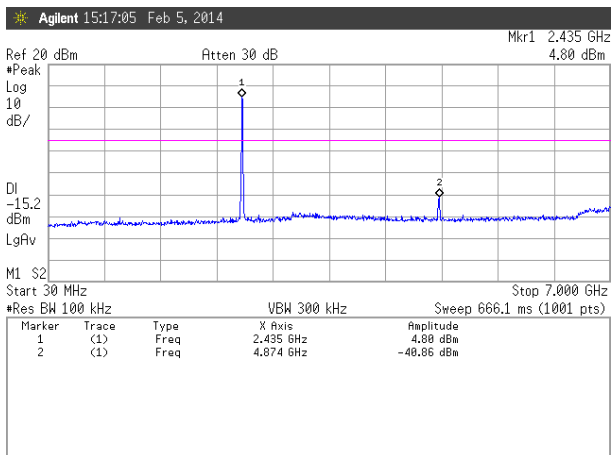
Lowest Channel (2412 MHz): 30 MHz ~ 7 GHz



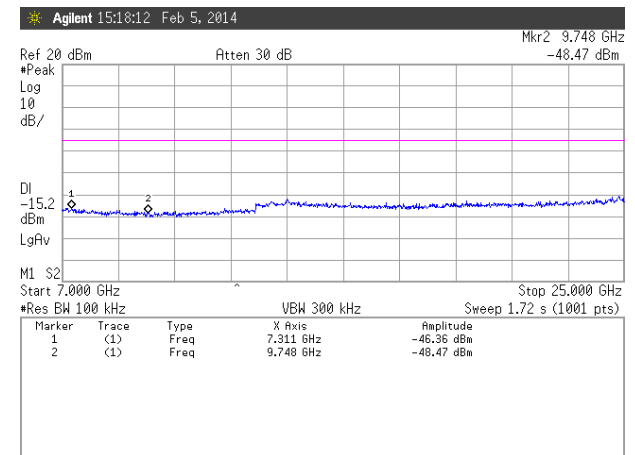
Lowest Channel (2412 MHz): 7 GHz ~ 25 GHz



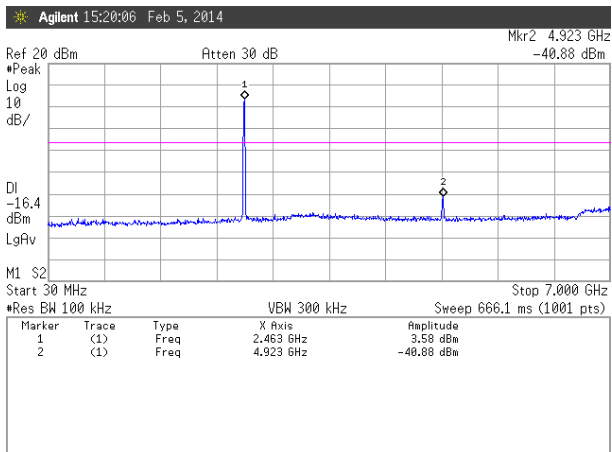
Middle Channel (2437 MHz): 30 MHz ~ 7 GHz



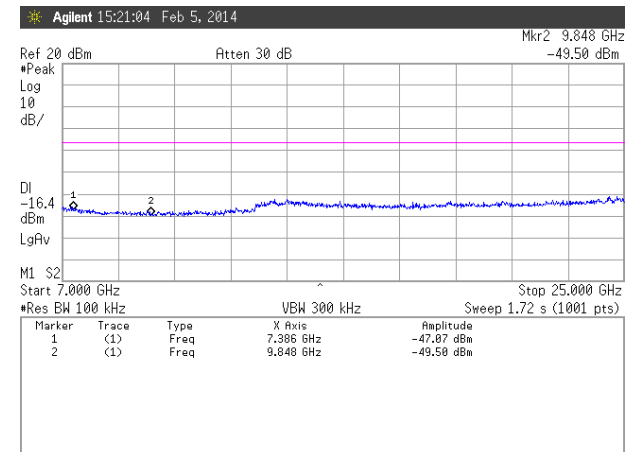
Middle Channel (2437 MHz): 7 GHz ~ 25 GHz



Highest Channel (2462 MHz): 30 MHz ~ 7 GHz



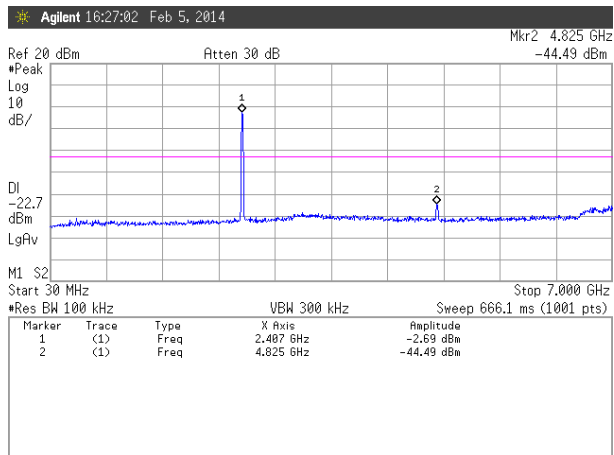
Highest Channel (2462 MHz): 7 GHz ~ 25 GHz



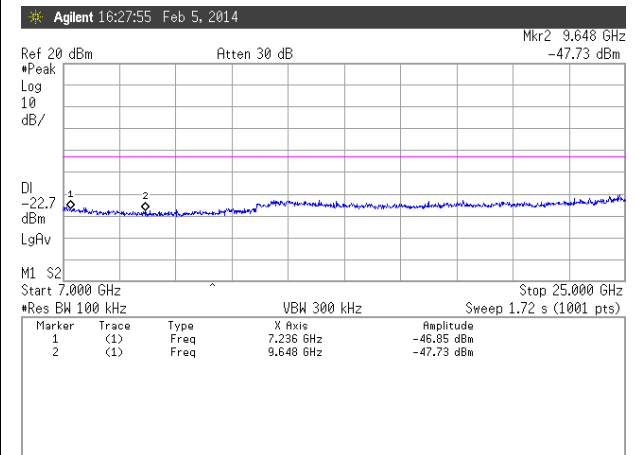
Spurious RF conducted emissions (continued)

802.11g mode:

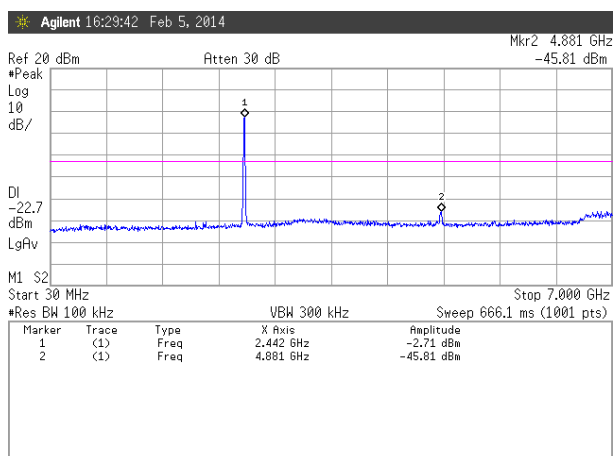
Lowest Channel (2412 MHz): 30 MHz ~ 7 GHz



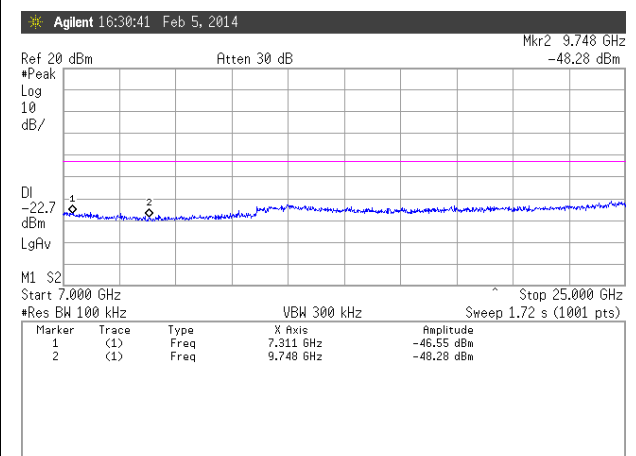
Lowest Channel (2412 MHz): 7 GHz ~ 25 GHz



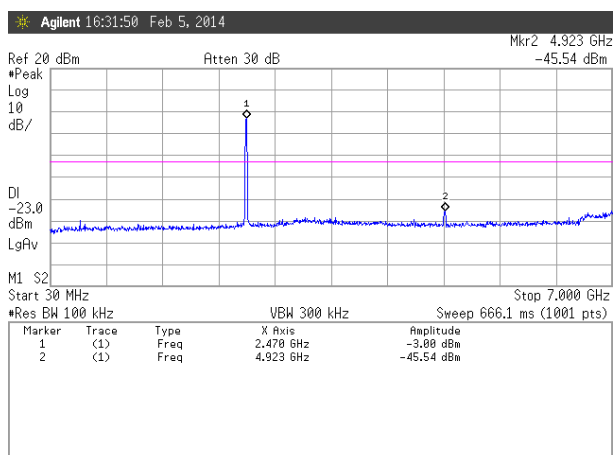
Middle Channel (2437 MHz): 30 MHz ~ 7 GHz



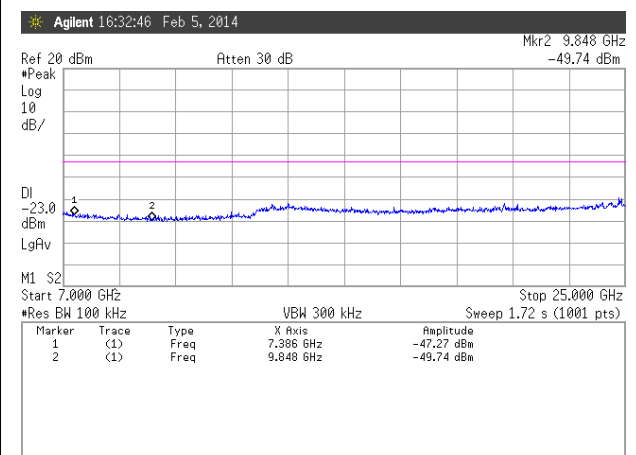
Middle Channel (2437 MHz): 7 GHz ~ 25 GHz



Highest Channel (2462 MHz): 30 MHz ~ 7 GHz



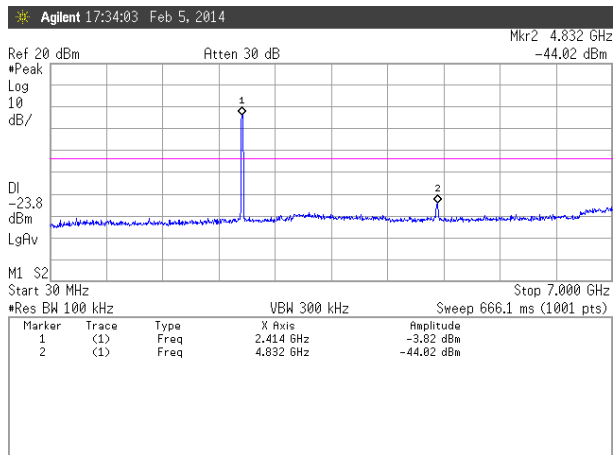
Highest Channel (2462 MHz): 7 GHz ~ 25 GHz



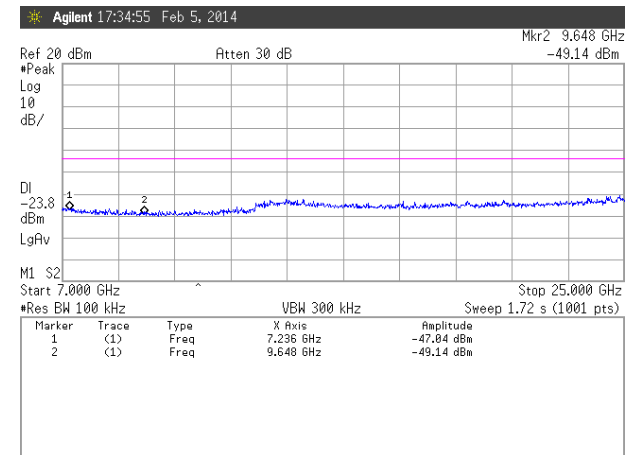
Spurious RF conducted emissions (continued)

802.11n HT20 mode:

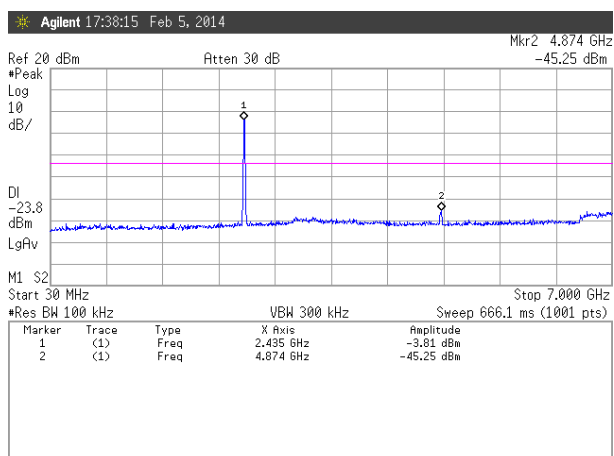
Lowest Channel (2412 MHz): 30 MHz ~ 7 GHz



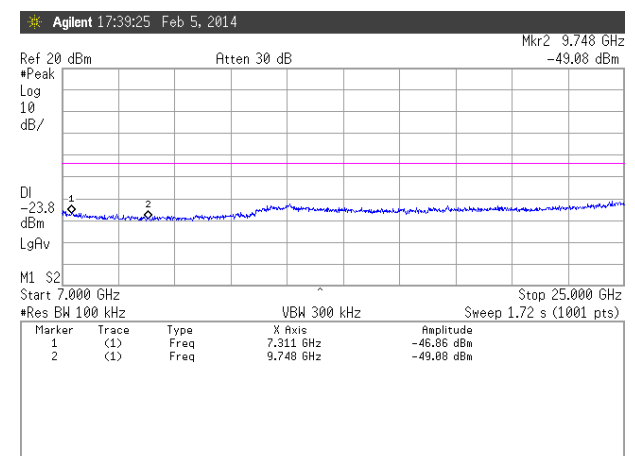
Lowest Channel (2412 MHz): 7 GHz ~ 25 GHz



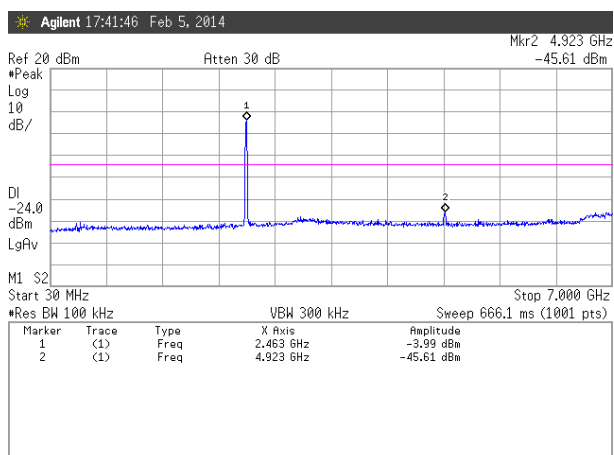
Middle Channel (2437 MHz): 30 MHz ~ 7 GHz



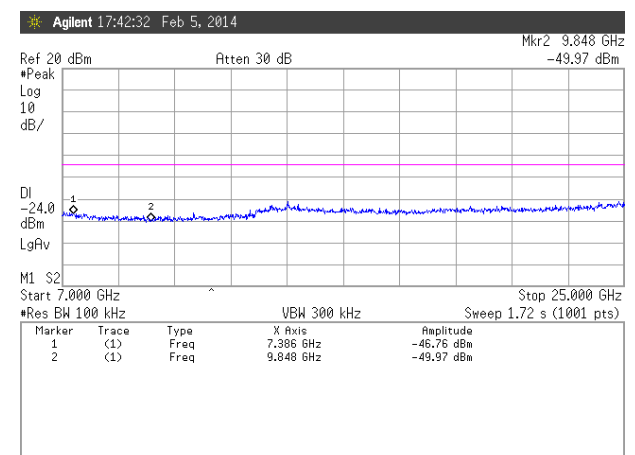
Middle Channel (2437 MHz): 7 GHz ~ 25 GHz



Highest Channel (2462 MHz): 30 MHz ~ 7 GHz



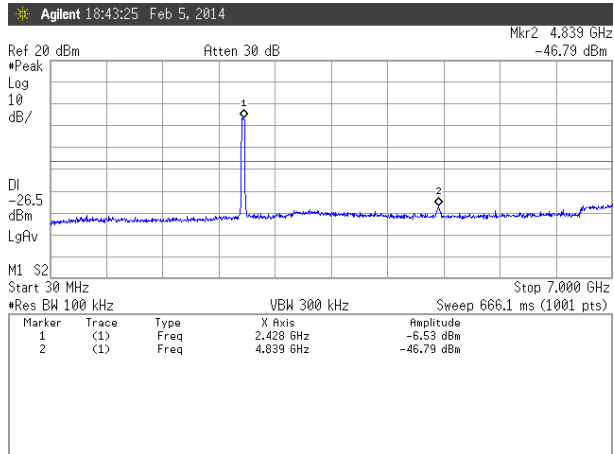
Highest Channel (2462 MHz): 7 GHz ~ 25 GHz



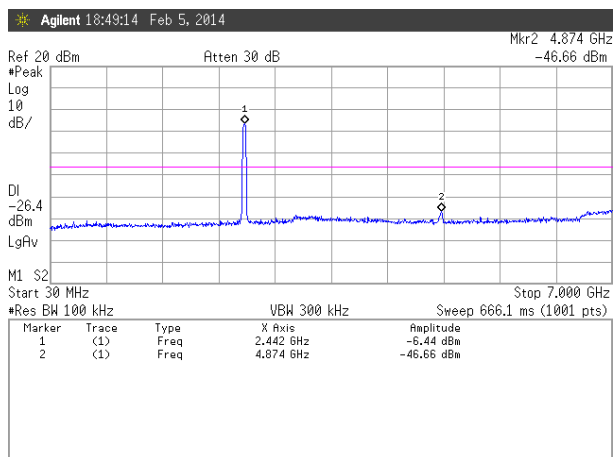
Spurious RF conducted emissions (continued)

802.11n HT40 mode:

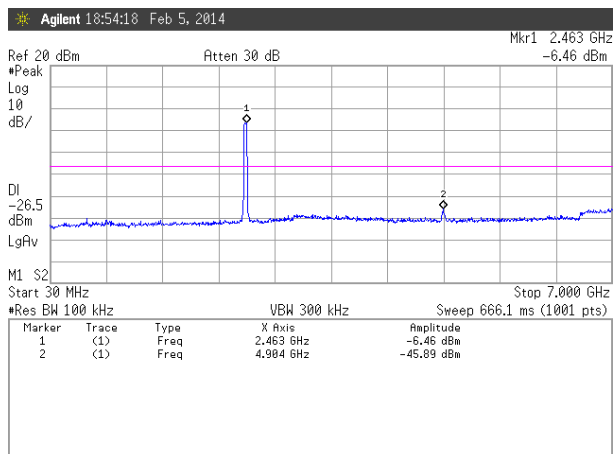
Lowest Channel (2422 MHz): 30 MHz ~ 7 GHz



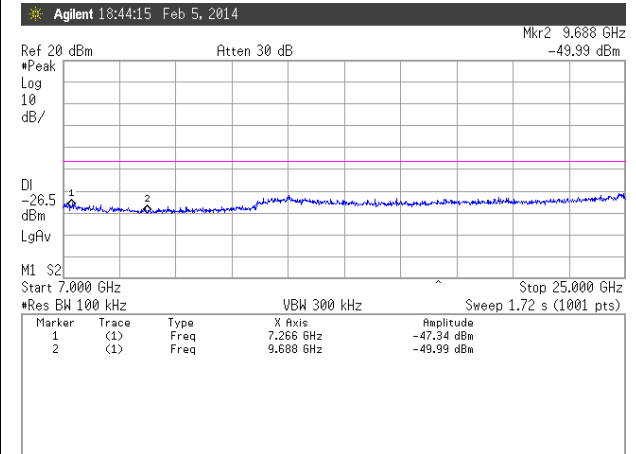
Middle Channel (2437 MHz): 30 MHz ~ 7 GHz



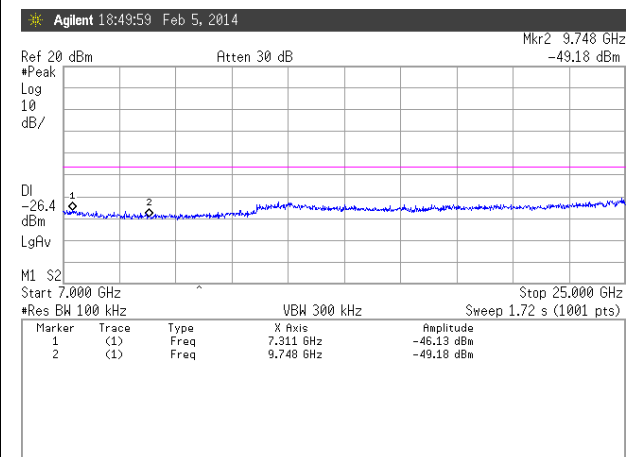
Highest Channel (2452 MHz): 30 MHz ~ 7 GHz



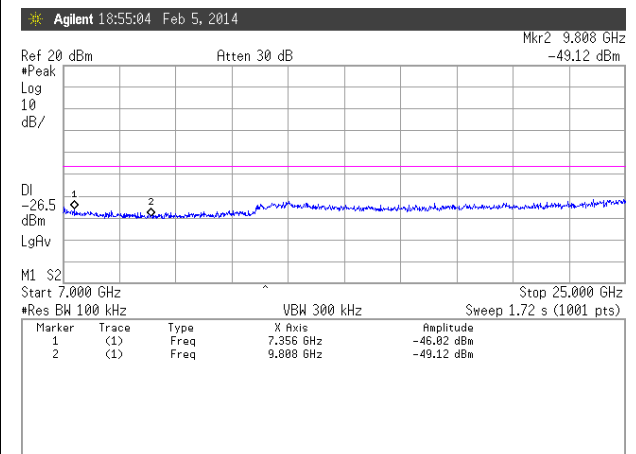
Lowest Channel (2422 MHz): 7 GHz ~ 25 GHz



Middle Channel (2437 MHz): 7 GHz ~ 25 GHz



Highest Channel (2452 MHz): 7 GHz ~ 25 GHz





5.6. Peak power spectral density

5.6.1 Regulation

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.6.2 Test Procedure(peak PSD)

Set the spectrum analyzer as follows:

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the $\text{VBW} \geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.6.3 Test Results:

PASS

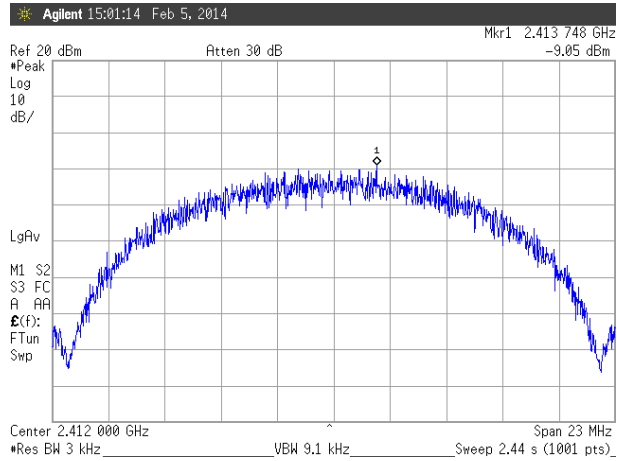
| Table 4: Measured values of the Peak Power Spectral Density (Conducted) | | | | |
|---|---------------------|---------------|-----------------|-------------|
| Modulation | Operating frequency | Transfer Rate | PSD/3 kHz (dBm) | Limit (dBm) |
| 802.11b | 2412 MHz | 11 Mbps | -9.05 | 8 |
| | 2437 MHz | 11 Mbps | -8.96 | 8 |
| | 2462 MHz | 11 Mbps | -9.16 | 8 |
| 802.11g | 2412 MHz | 54 Mbps | -16.93 | 8 |
| | 2437 MHz | 54 Mbps | -16.77 | 8 |
| | 2462 MHz | 54 Mbps | -16.94 | 8 |
| 802.11n HT20 | 2412 MHz | MCS7 | -17.12 | 8 |
| | 2437 MHz | MCS7 | -17.03 | 8 |
| | 2462 MHz | MCS7 | -17.28 | 8 |
| 802.11n HT40 | 2422 MHz | MCS7 | -19.19 | 8 |
| | 2437 MHz | MCS7 | -19.15 | 8 |
| | 2452 MHz | MCS7 | -18.97 | 8 |

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

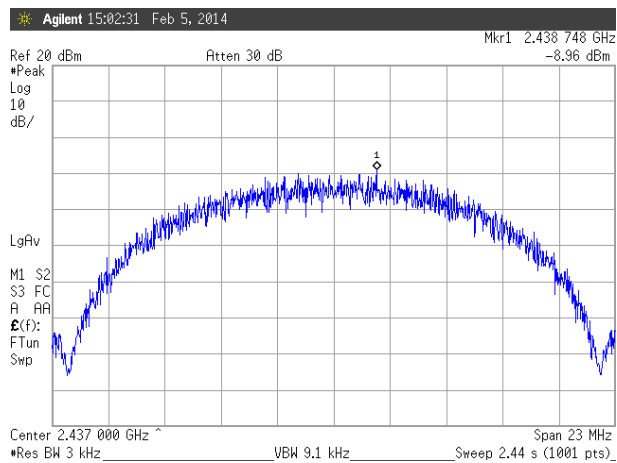
Figure 6. Plot of the Peak Power Spectral Density

802.11b mode:

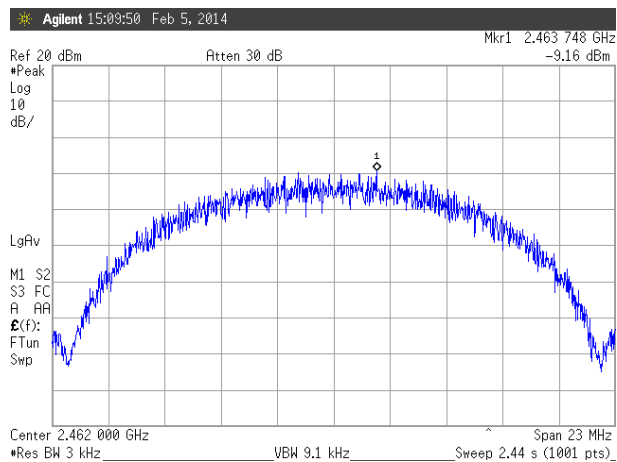
Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)

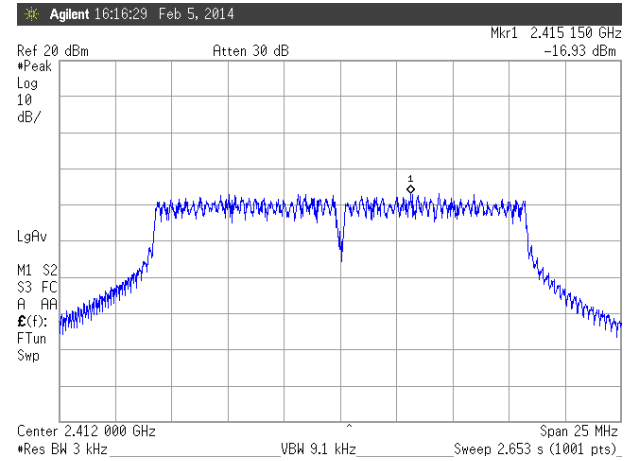


Highest Channel (2462 MHz)

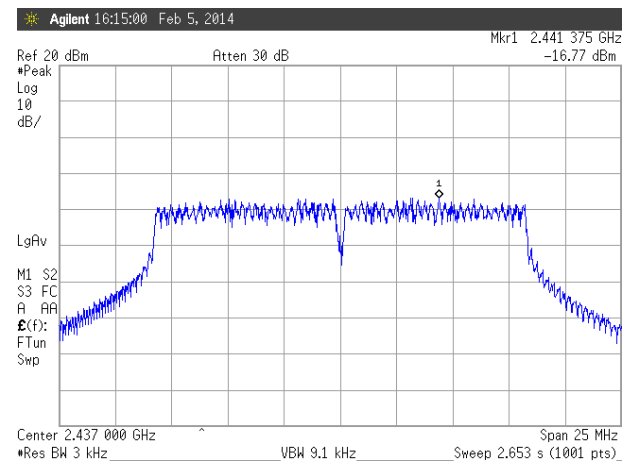


802.11g mode:

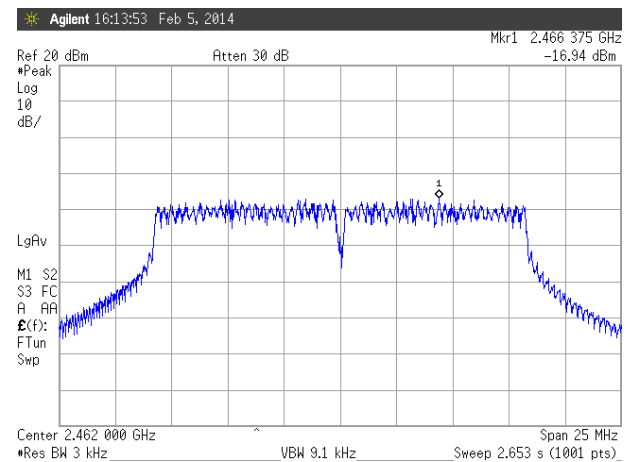
Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)



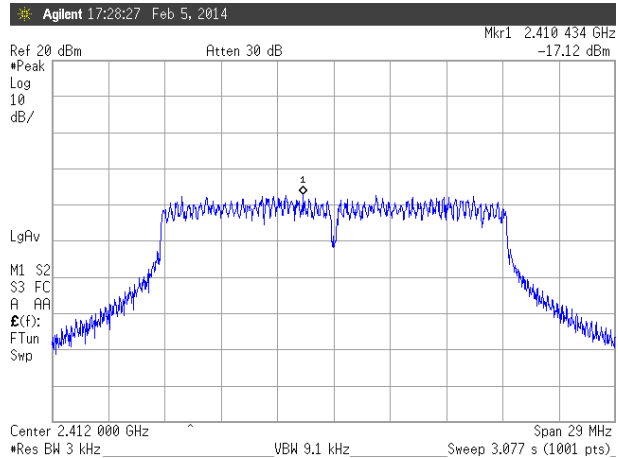
Highest Channel (2462 MHz)



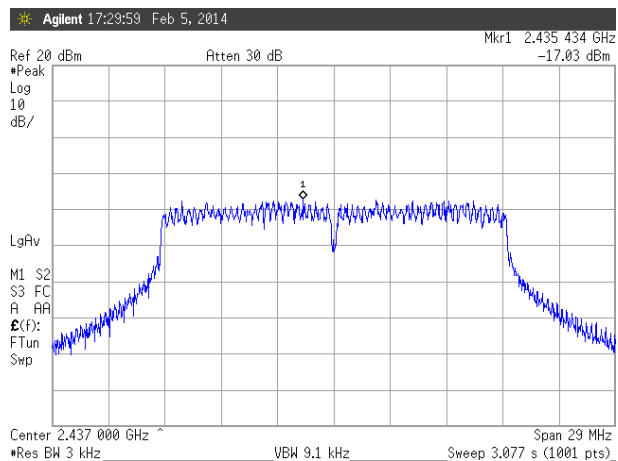
Plot of the Peak Power Spectral Density (continued)

802.11n HT20 mode:

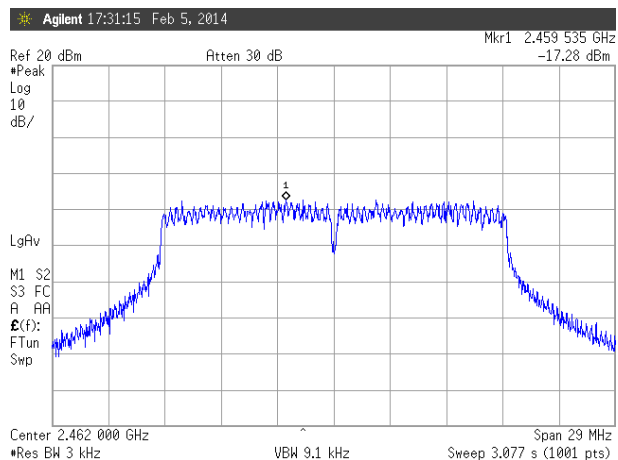
Lowest Channel (2412 MHz)



Middle Channel (2437 MHz)

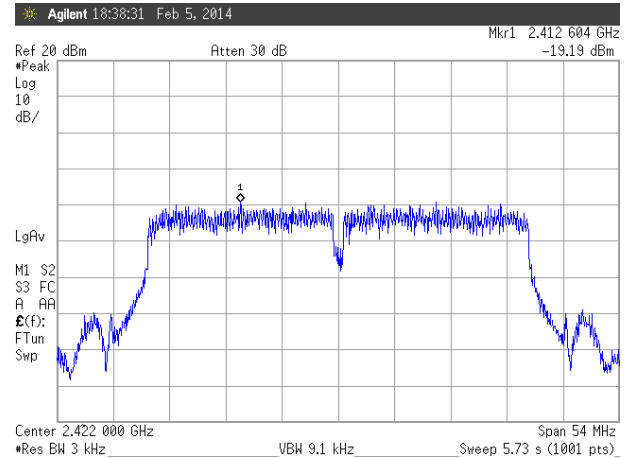


Highest Channel (2462 MHz)

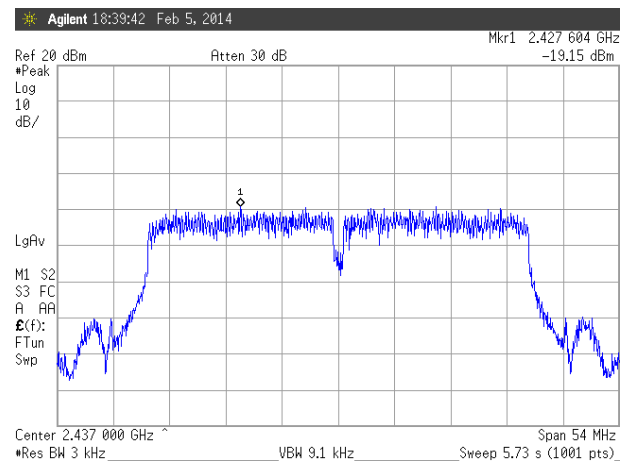


802.11n HT40 mode:

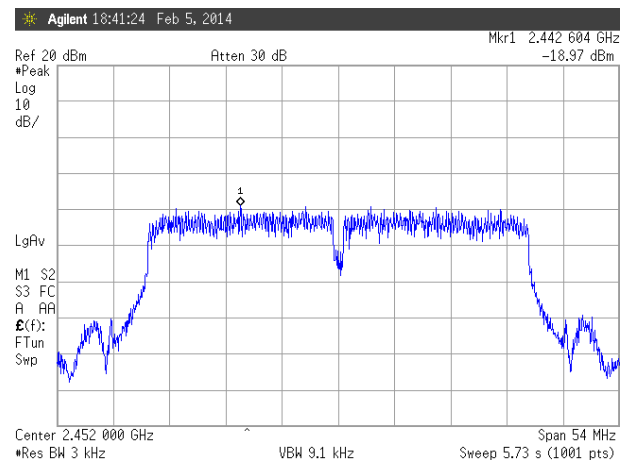
Lowest Channel (2422 MHz)



Middle Channel (2437 MHz)



Highest Channel (2452 MHz)





5.7. AC power line conducted emissions

5.7.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission (MHz) | Conducted limit (dB μ V) | |
|-----------------------------|------------------------------|------------|
| | 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.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.7.2 Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.



5.7.3 Test Results:

PASS

Table 5: Measured values of the AC Power Line Conducted Emissions

| Frequency [MHz] | Reading [dBμV] | L / N | CF [dB] | CL [dB] | Actual [dBμV] | Limit [dBμV] | Margin [dB] |
|------------------------|----------------|-------|---------|---------|---------------|--------------|-------------|
| QUASI-PEAK DATA | | | | | | | |
| 0.160 | 36.11 | L | 0.12 | 0.01 | 36.24 | 65.46 | 29.22 |
| 0.180 | 34.13 | N | 0.13 | 0.01 | 34.27 | 64.49 | 30.22 |
| 0.590 | 22.94 | L | 0.17 | 0.02 | 23.13 | 56.00 | 32.87 |
| 0.615 | 28.26 | L | 0.17 | 0.02 | 28.45 | 56.00 | 27.55 |
| 0.635 | 22.58 | L | 0.17 | 0.02 | 22.77 | 56.00 | 33.23 |
| 18.245 | 26.79 | L | 0.91 | 0.22 | 27.92 | 60.00 | 32.08 |
| 20.055 | 25.09 | N | 1.00 | 0.23 | 26.32 | 60.00 | 33.68 |
| 20.970 | 27.18 | N | 1.05 | 0.24 | 28.47 | 60.00 | 31.53 |
| 22.790 | 31.11 | N | 1.14 | 0.25 | 32.50 | 60.00 | 27.50 |
| 22.810 | 36.00 | L | 1.27 | 0.25 | 37.52 | 60.00 | 22.48 |
| 23.720 | 31.74 | L | 1.33 | 0.25 | 33.32 | 60.00 | 26.68 |
| 24.635 | 37.74 | L | 1.40 | 0.26 | 39.40 | 60.00 | 20.60 |
| 26.460 | 33.82 | L | 1.53 | 0.27 | 35.62 | 60.00 | 24.38 |
| 28.280 | 26.44 | L | 1.66 | 0.28 | 28.38 | 60.00 | 31.62 |
| AVERAGE DATA | | | | | | | |
| 0.160 | 27.44 | L | 0.12 | 0.01 | 27.57 | 55.46 | 27.89 |
| 0.180 | 26.65 | N | 0.13 | 0.01 | 26.79 | 54.49 | 27.70 |
| 0.590 | 21.64 | L | 0.17 | 0.02 | 21.83 | 46.00 | 24.17 |
| 0.615 | 27.42 | L | 0.17 | 0.02 | 27.61 | 46.00 | 18.39 |
| 0.635 | 19.05 | L | 0.17 | 0.02 | 19.24 | 46.00 | 26.76 |
| 18.245 | 21.65 | L | 0.91 | 0.22 | 22.78 | 50.00 | 27.22 |
| 20.055 | 20.84 | N | 1.00 | 0.23 | 22.07 | 50.00 | 27.93 |
| 20.970 | 23.32 | N | 1.05 | 0.24 | 24.61 | 50.00 | 25.39 |
| 22.790 | 25.91 | N | 1.14 | 0.25 | 27.30 | 50.00 | 22.70 |
| 22.810 | 35.22 | L | 1.27 | 0.25 | 36.74 | 50.00 | 13.26 |
| 23.720 | 26.24 | L | 1.33 | 0.25 | 27.82 | 50.00 | 22.18 |
| 24.635 | 34.60 | L | 1.40 | 0.26 | 36.26 | 50.00 | 13.74 |
| 26.460 | 29.54 | L | 1.53 | 0.27 | 31.34 | 50.00 | 18.66 |
| 28.280 | 23.66 | L | 1.66 | 0.28 | 25.60 | 50.00 | 24.40 |

Margin (dB) = Limit – Actual

[Actual = Reading + CF + CL]

L/N = LINE / NEUTRAL

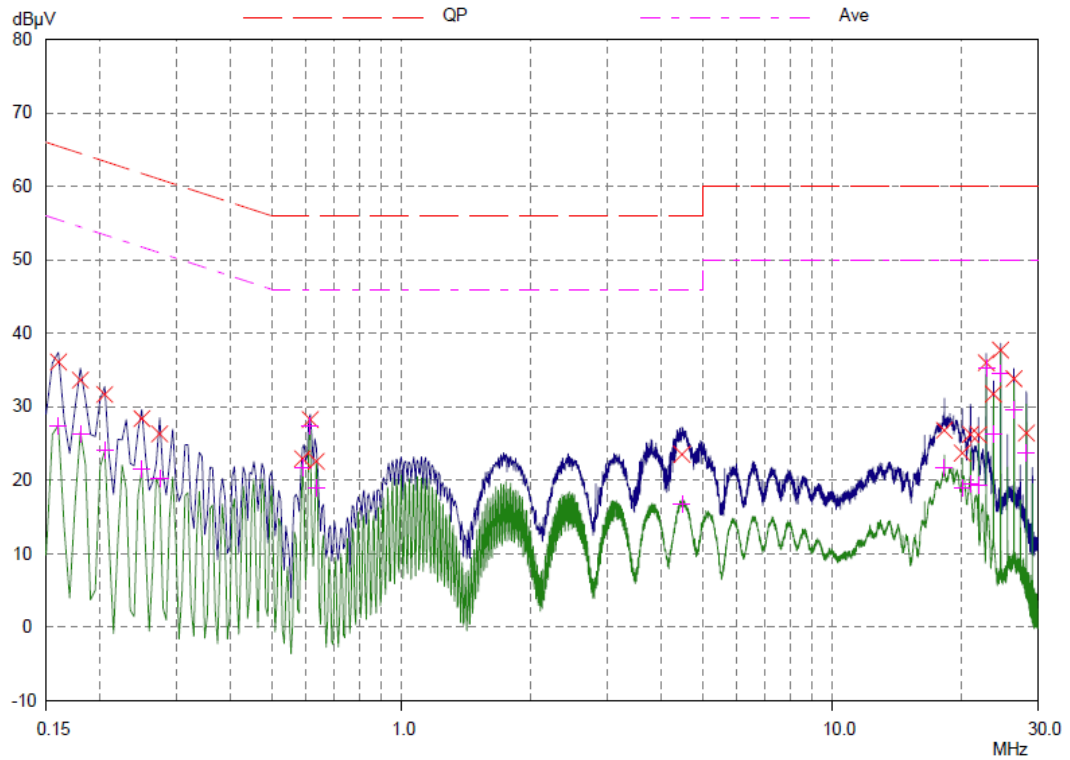
CF/CL = Correction Factor and Cable Loss

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.



Figure 7. Plot of the AC Power Line Conducted Emissions

Line – PE (Peak and Average detector used)



Neutral – PE (Peak and Average detector used)

