

A RADIO TEST REPORT
FOR
ICON RESEARCH LTD
ON
WIFI 802.11 SDIO module
DOCUMENT NO. TRA-011510-05-47-01-B

HULL

Unit E, South Orbital Trading Park, Hedon Road, Hull, HU9 1NJ, UK.
T +44 (0)1482 801801 **F** +44 (0)1482 801806 **E** test@tracglobal.com
www.tracglobal.com

TRaC Wireless Test Report : TRA-011510-05-47-01-B

Applicant : Icon Research Ltd

Apparatus : WIFI 802.11 SDIO module

Specification(s) : CFR47 Part 15.247& RSS-210 Annex 8

FCCID : RO7-WMS30

Certification Number : 12031A-WMS30

Purpose of Test : **Certification**

Authorised by :



: Radio Product Manager

Issue Date : 11th July 2014

Authorised Copy Number : PDF

Contents

| | |
|--|----|
| Section 1: Introduction | 4 |
| 1.1 General | 4 |
| 1.2 Tests Requested By | 5 |
| 1.3 Manufacturer | 5 |
| 1.4 Apparatus Assessed | 5 |
| 1.5 Test Result Summary | 6 |
| 1.6 Notes Relating To The Assessment | 7 |
| 1.7 Deviations from Test Standards | 7 |
| Section 2: Measurement Uncertainty | 8 |
| 2.1 Measurement Uncertainty Values | 8 |
| Section 3: Modifications | 10 |
| 3.1 Modifications Performed During Assessment | 10 |
| Appendix A: Formal Emission Test Results | 11 |
| A1 6 dB Bandwidth | 12 |
| A2 Transmitter Peak Output Power | 14 |
| A3 Transmitter Power Spectral Density | 16 |
| A4 RF Antenna Conducted Spurious Emissions | 18 |
| A5 Radiated Electric Field Emissions within the Restricted Bands of 15.205 | 20 |
| A6 Power Line Conducted Emissions | 23 |
| A7 Antenna Gain | 25 |
| A8 Unintentional Radiated Electric Field Emissions - 15.109 | 26 |
| Appendix B: Supporting Graphical Data | 30 |
| Appendix C: Additional Test and Sample Details | 75 |
| Appendix D: Additional Information | 81 |
| Appendix E: Calculation of the duty cycle correction factor | 82 |
| Appendix F: Photographs and Figures | 83 |
| Appendix G: MPE Calculation | 87 |

Section 1:**Introduction****1.1 General**

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

Test performed at: TRaC Global []
Unit E
South Orbital Trading Park
Hedon Road
Hull, HU9 1NJ.
United Kingdom.

Telephone: +44 (0) 1482 801801
Fax: +44 (0) 1482 801806

TRaC Global [X]
Unit 1
Pendle Place
Skelmersdale
West Lancashire, WN8 9PN
United Kingdom

Telephone: +44 (0) 1695 556666
Fax: +44 (0) 1695 577077

Email: test@tracglobal.com
Web site: <http://www.tracglobal.com>

Tests performed by: D Winstanley

Report author: D Winstanley

This report must not be reproduced except in full without prior written permission from TRaC Global.

1.2 Tests Requested By

This testing in this report was requested by :

Icon Research Ltd
3 Raw Holdings
East Calder
West Lothian
GB
EH53 0HY

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed in February and March 2014:

WIFI 802.11 SDIO module

The above a Wifi module for use in SD card slots and uses 802.11 b,g and n modulations.

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

| Test Type | Regulation | | Measurement standard | Result |
|--|--|---|----------------------|--------|
| Radiated spurious emissions (Restricted bands) | RSS-210 Issue 8 December 2010 Annex 8, A8.5 | Title 47 of the CFR: Part 15 Subpart C; 15.247 | ANSI C63.10:2009 | Pass |
| Conducted spurious emissions (Non-restricted bands) | RSS-210 Issue 8 December 2010 Annex 8.A4(4) | Title 47 of the CFR: Part 15 Subpart C; 15.247 | ANSI C63.10:2009 | N/A |
| AC Power conducted emissions | RSS-GEN Issue 3 December 2010 Annex 7, 7.2.4 | Title 47 of the CFR: Part 15 Subpart C; 15.207 | ANSI C63.10:2009 | N/A |
| Occupied Bandwidth | RSS-210 Issue 8 December 2010 Annex 8.A8.2a | Title 47 of the CFR : Part 15 Subpart C; 15.247(a)(2) | ANSI C63.10:2009 | Pass |
| Conducted Carrier Power | RSS-210 Issue 8 December 2010 Annex 8.A4(4). | Title 47 of the CFR : Part 15 Subpart C; 15.247(b) | ANSI C63.10:2009 | N/A |
| Power Spectral Density | RSS-210 Issue 8 December 2010 Annex 8.A8.2b | Title 47 of the CFR : Part 15 Subpart C; 15.247(d) | ANSI C63.10:2009 | Pass |
| Unintentional Radiated Spurious Emissions | RSS-GEN Issue 3 December 2010 7.2.2(c) | Title 47 of the CFR: Part 15 Subpart B; 15.109 | ANSI C63.10:2009 | Pass |
| RF Safety | RSS-102 | Title 47 of the CFR : Part 15 Subpart C; 15.247(b)(5) | - | Pass |
| Digital Modulation | - | Title 47 of the CFR: Part 15 Subpart C; 15.403 | - | Pass |

Abbreviations used in the above table:

ANSI C 63.10:2009 is outside the scope of the laboratories UKAS accreditation.

| | | | |
|------|-------------------------------------|------|---|
| Mod | : Modification | ANSI | : American National Standards Institution |
| CFR | : Code of Federal Regulations | PLCE | : Power Line Conducted Emissions |
| REFE | : Radiated Electric Field Emissions | | |

1.6 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, "Pass" indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

| | |
|---------------------|-----------------|
| Temperature | : 17 to 23 °C |
| Humidity | : 45 to 75 % |
| Barometric Pressure | : 86 to 106 kPa |

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2:**Measurement Uncertainty****2.1 Measurement Uncertainty Values**

For the test data recorded the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**

Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Frequency Counter) = **0.113ppm**

Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,

Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**

Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%**,
Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A:**Formal Emission Test Results**

Abbreviations used in the tables in this appendix:

| | | | |
|------|---------------------------------|------|--------------------------------|
| Spec | : Specification | ALSR | : Absorber Lined Screened Room |
| Mod | : Modification | OATS | : Open Area Test Site |
| EUT | : Equipment Under Test | ATS | : Alternative Test Site |
| SE | : Support Equipment | Ref | : Reference |
| L | : Live Power Line | Freq | : Frequency |
| N | : Neutral Power Line | MD | : Measurement Distance |
| E | : Earth Power Line | SD | : Spec Distance |
| Pk | : Peak Detector | Pol | : Polarisation |
| QP | : Quasi-Peak Detector | H | : Horizontal Polarisation |
| Av | : Average Detector | V | : Vertical Polarisation |
| CDN | : Coupling & decoupling network | | |

A1 6 dB Bandwidth

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2) and RSS-210 Issue 8 December 2010 requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum.

| Test Details: | |
|------------------------|--|
| Regulation | Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A8.2b |
| Measurement standard | ANSI C63.10, KDB Document: 558074 |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |

| 802.11b Tx mode | | | | | |
|-------------------------|--------------------|---------------------|--------------------------------|-----------|--------|
| Channel Frequency (MHz) | F _{lower} | F _{Higher} | Measured 20 dB Bandwidth (kHz) | Limit | Result |
| 2412 | 2406.95192 | 2417.04808 | 10096.15 | > 500 kHz | Pass |
| 2437 | 2431.95391 | 2442.04167 | 10087.76 | > 500 kHz | Pass |
| 2462 | 2456.93231 | 2467.06853 | 10136.22 | > 500 kHz | Pass |

| 802.11g Tx mode | | | | | |
|-------------------------|--------------------|---------------------|--------------------------------|-----------|--------|
| Channel Frequency (MHz) | F _{lower} | F _{Higher} | Measured 20 dB Bandwidth (kHz) | Limit | Result |
| 2412 | 2403.73077 | 2420.28526 | 16554.49 | > 500 kHz | Pass |
| 2437 | 2428.71474 | 2445.26923 | 16554.49 | > 500 kHz | Pass |
| 2462 | 2453.76282 | 2470.20513 | 16442.31 | > 500 kHz | Pass |

| 802.11n HT20 Tx mode | | | | | |
|-------------------------|--------------------|---------------------|--------------------------------|-----------|--------|
| Channel Frequency (MHz) | F _{lower} | F _{Higher} | Measured 20 dB Bandwidth (kHz) | Limit | Result |
| 2412 | 2403.18118 | 2420.77878 | 17597.60 | > 500 kHz | Pass |
| 2437 | 2428.22623 | 2445.79379 | 17567.57 | > 500 kHz | Pass |
| 2462 | 2453.20120 | 2470.76877 | 17567.57 | > 500 kHz | Pass |

| 802.11n HT40 Tx mode | | | | | |
|-----------------------------|--------------------------|---------------------------|--------------------------------|-----------|--------|
| Channel Frequency (MHz) | F_{lower} | F_{Higher} | Measured 20 dB Bandwidth (kHz) | Limit | Result |
| 2422 | 2403.78231 | 2440.18000 | 36397.692 | > 500 kHz | Pass |
| 2432 | 2413.80231 | 2450.14000 | 36337.692 | > 500 kHz | Pass |
| 2442 | 2423.79231 | 2460.19000 | 36397.692 | > 500 kHz | Pass |

Plots of the 6 dB bandwidth are contained in Appendix B of this test report.

A2 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on all operating frequencies in turn.

| Test Details: | |
|------------------------|--|
| Regulation | Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8 A4(4) |
| Measurement standard | ANSI C63.10, KDB Document: 558074 |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |

| 802.11b Tx mode | | | | |
|-------------------------|------------------------------|-------|-----------|--------|
| Channel Frequency (MHz) | Peak Conducted Carrier Power | | Limit (W) | Result |
| | dBm | mW | | |
| 2412 | 10.39 | 10.94 | 1 | Pass |
| 2437 | 9.14 | 8.20 | 1 | Pass |
| 2462 | 8.86 | 7.69 | 1 | Pass |

| 802.11g Tx mode | | | | |
|-------------------------|------------------------------|-------|-----------|--------|
| Channel Frequency (MHz) | Peak Conducted Carrier Power | | Limit (W) | Result |
| | dBm | mW | | |
| 2412 | 15.48 | 35.32 | 1 | Pass |
| 2437 | 15.02 | 31.77 | 1 | Pass |
| 2462 | 15.07 | 32.14 | 1 | Pass |

| 802.11n HT20 Tx mode | | | | |
|--------------------------------|-------------------------------------|-----------|------------------|---------------|
| Channel Frequency (MHz) | Peak Conducted Carrier Power | | Limit (W) | Result |
| | dBm | mW | | |
| 2412 | 15.70 | 37.15 | 1 | Pass |
| 2437 | 15.79 | 37.93 | 1 | Pass |
| 2462 | 15.34 | 34.20 | 1 | Pass |

| 802.11n HT40 Tx mode | | | | |
|--------------------------------|-------------------------------------|-----------|------------------|---------------|
| Channel Frequency (MHz) | Peak Conducted Carrier Power | | Limit (W) | Result |
| | dBm | mW | | |
| 2422 | 15.86 | 38.55 | 1 | Pass |
| 2432 | 15.44 | 34.99 | 1 | Pass |
| 2442 | 15.86 | 38.55 | 1 | Pass |

Notes:

1. Measured peak output power does not include the gain of any antenna being used
2. Measurements were performed as per section 5.2.1.2 of the OET guidance notes

A3 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

| Test Details: | |
|------------------------|--|
| Regulation | Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A8.2b |
| Measurement standard | ANSI C63.10, KDB Document: 558074 |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |

| 802.11b Tx mode | | | |
|--------------------------------|--|-------------------------|---------------|
| Channel Frequency (MHz) | Conducted Peak Power Spectral Density | Limit (dBm/3kHz) | Result |
| 2412 | -2.78 | 8 | Pass |
| 2437 | -2.92 | 8 | Pass |
| 2462 | -3.20 | 8 | Pass |

| 802.11g Tx mode | | | |
|--------------------------------|--|-------------------------|---------------|
| Channel Frequency (MHz) | Conducted Peak Power Spectral Density | Limit (dBm/3kHz) | Result |
| 2412 | -3.98 | 8 | Pass |
| 2437 | -4.34 | 8 | Pass |
| 2462 | -4.72 | 8 | Pass |

| 802.11n HT20 Tx mode | | | |
|--------------------------------|--|-------------------------|---------------|
| Channel Frequency (MHz) | Conducted Peak Power Spectral Density | Limit (dBm/3kHz) | Result |
| 2412 | -4.51 | 8 | Pass |
| 2437 | -4.92 | 8 | Pass |
| 2462 | -5.27 | 8 | Pass |

| 802.11n HT40 Tx mode | | | |
|--------------------------------|--|-------------------------|---------------|
| Channel Frequency (MHz) | Conducted Peak Power Spectral Density | Limit (dBm/3kHz) | Result |
| 2422 | -6.79 | 8 | Pass |
| 2432 | -7.27 | 8 | Pass |
| 2442 | -6.74 | 8 | Pass |

Notes:

1. Measured Power Spectral Density does not include the gain of any antenna being used
2. Measurements were performed as per section 5.3.1 of the OET guidance notes

A4 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 100kHz and the VBW>RBW. Frequencies were scanned up through to the 10th harmonic with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

| Test Details: | |
|------------------------|---|
| Regulation | Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5 |
| Measurement standard | ANSI C63.10, KDB Document: 558074 |
| Frequency range | 9 kHz to 25 GHz |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |

The worst case conducted emission measurements at the antenna port are listed below:

| 802.11b Tx mode | | | | | | |
|--|---------------------|------|------------------------|------------------------------------|-----------------------|---------|
| Ref No. | Emission Freq (MHz) | Det. | Restricted band? (Y/N) | Emission power (RBW =100kHz) (dBm) | 15.247(d) Limit (dBm) | Summary |
| No emissions detected within 20dB of the limit | | | | | | |

| 802.11g Tx mode | | | | | | |
|--|---------------------|------|------------------------|------------------------------------|-----------------------|---------|
| Ref No. | Emission Freq (MHz) | Det. | Restricted band? (Y/N) | Emission power (RBW =100kHz) (dBm) | 15.247(d) Limit (dBm) | Summary |
| No emissions detected within 20dB of the limit | | | | | | |

| 802.11n HT20 Tx mode | | | | | | |
|--|---------------------|------|------------------------|------------------------------------|-----------------------|---------|
| Ref No. | Emission Freq (MHz) | Det. | Restricted band? (Y/N) | Emission power (RBW =100kHz) (dBm) | 15.247(d) Limit (dBm) | Summary |
| No emissions detected within 20dB of the limit | | | | | | |

| 802.11n HT40 Tx mode | | | | | | |
|--|---------------------|------|------------------------|------------------------------------|-----------------------|---------|
| Ref No. | Emission Freq (MHz) | Det. | Restricted band? (Y/N) | Emission power (RBW =100kHz) (dBm) | 15.247(d) Limit (dBm) | Summary |
| No emissions detected within 20dB of the limit | | | | | | |

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47CFR15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance 15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst varying the supply voltage between 85% and 105% of the nominal supply voltage as required by 15.31(e). No variation in carrier level was observed.
5. The plots for modulation type producing the highest output power can be found in Appendix B

The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

$$\text{The limit in 100 kHz RBW} = (\text{Maximum Peak Conducted Carrier}) - 20\text{dB}$$

A5 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : 3m alternative test site :

The effect of the EUT set-up on the measurements is summarised in note (c) below.

| Test Details: | |
|--------------------------|---|
| Regulation | Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5 |
| Measurement standard | ANSI C63.10, KDB Document: 558074 |
| Frequency range | 30MHz – 25GHz |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |
| Photographs (Appendix F) | 1 & 2 |

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

| 802.11b Tx mode | | | | | | | | | |
|--|-------------|----------------|-----------------|------------------|--------------|----------------------|------------------|--------------------|--------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dBµV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBµV/m) | EXTRAP FACT (dB) | FIELD ST'GH (µV/m) | LIMIT (µV/m) |
| No significant Emissions Within 20 dB of the limit | | | | | | | | | |

| 802.11g Tx mode | | | | | | | | | |
|--|-------------|----------------|-----------------|------------------|--------------|----------------------|------------------|--------------------|--------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dBµV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBµV/m) | EXTRAP FACT (dB) | FIELD ST'GH (µV/m) | LIMIT (µV/m) |
| No significant Emissions Within 20 dB of the limit | | | | | | | | | |

| 802.11n HT20 Tx mode | | | | | | | | | |
|--|-------------|----------------|-----------------|------------------|--------------|----------------------|------------------|--------------------|--------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dBμV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBμV/m) | EXTRAP FACT (dB) | FIELD ST'GH (μV/m) | LIMIT (μV/m) |
| No significant Emissions Within 20 dB of the limit | | | | | | | | | |

| 802.11n HT40 Tx mode | | | | | | | | | |
|--|-------------|----------------|-----------------|------------------|--------------|----------------------|------------------|--------------------|--------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dBμV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBμV/m) | EXTRAP FACT (dB) | FIELD ST'GH (μV/m) | LIMIT (μV/m) |
| No significant Emissions Within 20 dB of the limit | | | | | | | | | |

Notes:

- 1 Any emissions not related directly to the transmitter are recorded under unintentional radiated emissions testing in section A8
- 2 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1
- 3 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 4 Measurements at 2400 & 2483.5 MHz were made to ensure band edge compliance.
- 5 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 6 For Frequencies below 1 GHz, RBW= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:
 Peak RBW=VBW= 1MHz
 Average RBW=VBW= 1MHz

These settings as per ANSI C63.10

The plots for worst case emissions on all modulation types can be found in Appendix B

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15 Clause 15.33(a) and 15.33(a)(1) and RSS-Gen 4.3.

Radiated emission limits (47 CFR Part 15: Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a) and RSS-Gen 7.2.2:

| Frequency of emission (MHz) | Field strength μV/m | Measurement Distance m | Field strength dBμV/m |
|-----------------------------|---------------------|------------------------|-----------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 | 67.6/F (kHz) |
| 0.490-1.705 | 24000/F(kHz) | 30 | 87.6/F (kHz) |
| 1.705-30 | 30 | 30 | 29.5 |
| 30-88 | 100 | 3 | 40.0 |
| 88-216 | 150 | 3 | 43.5 |
| 216-960 | 200 | 3 | 46.0 |
| Above 960 | 500 | 3 | 54.0 |

Notes:

- (a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation (dB)} = 20 \log_{10} \left(\frac{\text{measurement distance}}{\text{specification distance}} \right)$$

The results displayed take into account applicable antenna factors and cable losses.

- (b) The levels may have been rounded for display purposes.
- (c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

| | See (i) | See (ii) | See (iii) | See (iv) |
|--|---------|----------|-----------|----------|
| Effect of EUT operating mode on emission levels | ✓ | | | |
| Effect of EUT internal configuration on emission levels | ✓ | | | |
| Effect of Position of EUT cables & samples on emission levels | ✓ | | | |
| (i) Parameter defined by standard and / or single possible, refer to Appendix D (ii) Parameter defined by client and / or single possible, refer to Appendix D (iii) Parameter had a negligible effect on emission levels, refer to Appendix D (iv) Worst case determined by initial measurement, refer to Appendix D | | | | |

A6 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

| Test Details: | |
|--------------------------|---|
| Regulation | Part 15 Subpart (c) Clause 15.207; RSS-GEN Annex 7, 7.2.4 |
| Measurement standard | ANSI C63.10 |
| Frequency range | 150kHz to 30MHz |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |
| Photographs (Appendix F) | Photograph 3 |

The worst-case power line conducted emission measurements are listed below:

Results measured using the average detector compared to the average limit

| Freq (MHz) | Conductor | Result (dBuV) | Spec Limit (dBuV) | Margin (dB) | EUT Operating Mode | Result Summary |
|------------|-----------|---------------|-------------------|-------------|--------------------|----------------|
| 0.186 | N | 34.5 | 54.2 | 19.7 | Transmit | Pass |
| 0.194 | N | 36.1 | 53.9 | 17.8 | Receive | Pass |
| 0.198 | N | 34.8 | 53.7 | 18.9 | Receive | Pass |
| 0.426 | N | 27.7 | 47.3 | 19.7 | Transmit | Pass |
| 0.490 | N | 27.4 | 46.2 | 18.8 | Transmit | Pass |
| 0.522 | N | 33.1 | 46.0 | 12.9 | Receive | Pass |
| 0.586 | N | 27.5 | 46.0 | 18.5 | Receive | Pass |
| 0.910 | N | 31.3 | 46.0 | 14.7 | Receive | Pass |
| 0.978 | N | 27.9 | 46.0 | 18.1 | Receive | Pass |
| 1.170 | N | 29.3 | 46.0 | 16.7 | Receive | Pass |
| 1.238 | N | 32.3 | 46.0 | 13.8 | Receive | Pass |
| 1.302 | N | 29.9 | 46.0 | 16.1 | Receive | Pass |
| 1.366 | N | 28.0 | 46.0 | 18.0 | Receive | Pass |
| 1.498 | N | 30.4 | 46.0 | 15.6 | Receive | Pass |
| 1.626 | N | 28.7 | 46.0 | 17.3 | Receive | Pass |
| 1.630 | N | 28.4 | 46.0 | 17.6 | Receive | Pass |
| 1.890 | N | 27.9 | 46.0 | 18.1 | Receive | Pass |
| 16.622 | L1 | 30.6 | 50.0 | 19.4 | Transmit | Pass |

Results measured using the quasi-peak detector compared to the quasi-peak limit

| Freq (MHz) | Conductor | Result (dBuV) | Spec Limit (dBuV) | Margin (dB) | EUT Operating Mode | Result Summary |
|---|-----------|---------------|-------------------|-------------|--------------------|----------------|
| No Significant Emissions Within 20dB of the Limit | | | | | | |

Specification limits :

Conducted emission limits (47 CFR Part 15: Clause 15.207):

Conducted disturbance at the mains ports.

| Frequency range MHz | Limits dB μ V | |
|---------------------|-----------------------|-----------------------|
| | Quasi-peak | Average |
| 0.15 to 0.5 | 66 to 56 ² | 56 to 46 ² |
| 0.5 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Notes:
 1. The lower limit shall apply at the transition frequency.
 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

- (a) The levels may have been rounded for display purposes.
- (b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

| | See (i) | See (ii) | See (iii) | See (iv) |
|---|---------|----------|-----------|----------|
| Effect of EUT operating mode on emission levels | ✓ | | | |
| Effect of EUT internal configuration on emission levels | ✓ | | | |

(i) Parameter defined by standard and / or single possible, refer to Appendix C
 (ii) Parameter defined by client and / or single possible, refer to Appendix C
 (iii) Parameter had a negligible effect on emission levels, refer to Appendix C
 (iv) Worst case determined by initial measurement, refer to Appendix C

A7 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 5 dBi.

A8 Unintentional Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to :

3m open area test site :

3m alternative test site :

| Test Details: | |
|--------------------------|--|
| Regulation | Part 15 Subpart (b) Clause 15.109, RSS – GEN Section 7.2.3 |
| Measurement standard | ANSI C63.10 |
| Frequency range | 30MHz to 25 GHz |
| EUT sample number | S09, S10, S11 |
| Modification state | 0 |
| SE in test environment | S01, S02, S19 |
| SE isolated from EUT | None |
| EUT set up | Refer to Appendix C |
| Photographs (Appendix F) | 1 & 2 |

The worst case radiated emission measurements for spurious emissions:

| Common Spurious Emissions | | | | | | | | | |
|---------------------------|-------------|----------------|-----------------|------------------|--------------|----------------------|------------------|--------------------|--------------|
| Det | FREQ. (MHz) | MEAS Rx (dBμV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBμV/m) | EXTRAP FACT (dB) | FIELD ST'GH (μV/m) | LIMIT (μV/m) |
| Qp | 50.0 | 27.9 | 0.9 | 7.7 | - | 36.5 | - | 66.83 | 100 |
| Qp | 74.7 | 17.2 | 1.2 | 5.9 | - | 24.3 | - | 16.41 | 100 |
| Qp | 83.3 | 31.0 | 1.2 | 7.4 | - | 39.5 | - | 94.41 | 100 |
| Qp | 99.9 | 15.0 | 1.3 | 10.3 | - | 26.6 | - | 21.38 | 150 |
| Qp | 116.6 | 19.1 | 1.5 | 11.5 | - | 32.1 | - | 40.27 | 150 |
| Qp | 149.3 | 30.0 | 1.7 | 10.1 | - | 41.8 | - | 123.03 | 150 |
| Qp | 166.2 | 15.4 | 1.8 | 9.2 | - | 26.4 | - | 20.89 | 150 |
| Qp | 182.8 | 27.7 | 1.9 | 8.2 | - | 37.8 | - | 77.62 | 150 |
| Qp | 199.1 | 14.4 | 2.0 | 8.7 | - | 25.1 | - | 17.99 | 150 |
| Qp | 215.7 | 24.9 | 2.0 | 8.2 | - | 35.1 | - | 56.89 | 150 |
| Qp | 249.4 | 17.9 | 2.3 | 12.0 | - | 32.2 | - | 40.74 | 200 |
| Qp | 282.6 | 15.0 | 2.4 | 12.7 | - | 30.0 | - | 31.62 | 200 |
| Qp | 299.3 | 16.2 | 2.4 | 13.1 | - | 31.7 | - | 38.46 | 200 |
| Qp | 315.8 | 19.3 | 2.4 | 13.5 | - | 35.2 | - | 57.54 | 200 |
| Qp | 332.5 | 15.5 | 2.7 | 13.9 | - | 32.1 | - | 40.27 | 200 |
| Qp | 349.2 | 14.3 | 2.6 | 14.3 | - | 31.2 | - | 36.31 | 200 |
| Qp | 365.7 | 13.2 | 2.7 | 14.7 | - | 30.6 | - | 33.88 | 200 |
| Qp | 382.2 | 18.5 | 2.7 | 15.0 | - | 36.2 | - | 64.57 | 200 |
| Qp | 393.2 | 17.9 | 2.8 | 15.6 | - | 36.2 | - | 64.57 | 200 |
| Qp | 415.7 | 8.0 | 3.0 | 16.7 | - | 27.6 | - | 23.99 | 200 |
| Qp | 448.8 | 10.6 | 2.9 | 16.3 | - | 29.8 | - | 30.90 | 200 |
| Qp | 465.4 | 8.6 | 3.1 | 16.8 | - | 28.4 | - | 26.30 | 200 |
| Qp | 481.9 | 8.5 | 3.2 | 17.2 | - | 28.8 | - | 27.54 | 200 |
| Qp | 498.7 | 9.2 | 3.2 | 17.4 | - | 29.8 | - | 30.90 | 200 |
| Qp | 515.1 | 12.2 | 3.3 | 17.6 | - | 33.1 | - | 45.19 | 200 |
| Qp | 523.8 | -3.3 | 3.3 | 17.6 | - | 17.6 | - | 7.59 | 200 |
| Qp | 531.9 | 6.4 | 3.4 | 17.6 | - | 27.4 | - | 23.44 | 200 |
| Qp | 548.4 | 11.3 | 3.4 | 18.9 | - | 33.6 | - | 47.86 | 200 |
| Qp | 565.0 | 8.7 | 3.3 | 18.7 | - | 30.7 | - | 34.28 | 200 |
| Qp | 581.8 | 13.1 | 3.4 | 18.8 | - | 35.3 | - | 58.21 | 200 |
| Qp | 598.4 | 7.3 | 3.6 | 18.7 | - | 29.6 | - | 30.20 | 200 |
| Qp | 615.1 | 9.5 | 3.7 | 18.6 | - | 31.8 | - | 38.90 | 200 |
| Qp | 631.4 | 2.1 | 3.7 | 19.0 | - | 24.8 | - | 17.38 | 200 |
| Qp | 648.3 | 6.8 | 3.7 | 19.1 | - | 29.6 | - | 30.20 | 200 |
| Qp | 665.0 | 13.9 | 3.7 | 19.0 | - | 36.6 | - | 67.61 | 200 |
| Qp | 681.4 | 3.8 | 3.8 | 19.0 | - | 26.6 | - | 21.38 | 200 |

| Common Spurious Emissions | | | | | | | | | |
|----------------------------------|------------------------|-------------------------------|--------------------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------------------|-----------------------------------|-------------------------|
| | FREQ. (MHz) | MEAS Rx (dBμV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBμV/m) | EXTRAP FACT (dB) | FIELD ST'GH (μV/m) | LIMIT (μV/m) |
| Pk | 1329.55 | 65.5 | 2.5 | 25.5 | 37.0 | 56.53 | -9.54 | 223.55 | 5000 |
| Av | 1329.55 | 40.1 | 2.5 | 25.5 | 37.0 | 31.07 | -9.54 | 11.92 | 500 |
| Pk | 1500.13 | 56.1 | 2.6 | 25.9 | 36.6 | 48.00 | -9.54 | 83.73 | 5000 |
| Av | 1500.13 | 43.2 | 2.6 | 25.9 | 36.6 | 35.12 | -9.54 | 19.01 | 500 |
| Pk | 1661.60 | 67.8 | 2.8 | 25.8 | 36.4 | 59.95 | -9.54 | 331.42 | 5000 |
| Av | 1661.60 | 42.5 | 2.8 | 25.8 | 36.4 | 34.65 | -9.54 | 18.00 | 500 |
| Pk | 3000.25 | 52.8 | 2.7 | 30.7 | 36.0 | 50.19 | -9.54 | 107.74 | 5000 |
| Av | 3000.25 | 44.3 | 2.7 | 30.7 | 36.0 | 41.65 | -9.54 | 40.31 | 500 |
| Pk | 4500.40 | 50.5 | 3.5 | 32.2 | 35.6 | 50.57 | -9.54 | 112.56 | 5000 |
| Av | 4500.40 | 43.6 | 3.5 | 32.2 | 35.6 | 43.70 | -9.54 | 51.04 | 500 |

| Bottom Channel | | | | | | | | | |
|-----------------------|------------------------|-------------------------------|--------------------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------------------|-----------------------------------|-------------------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dBμV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBμV/m) | EXTRAP FACT (dB) | FIELD ST'GH (μV/m) | LIMIT (μV/m) |
| Pk | 3216.00 | 55.9 | 2.8 | 30.9 | 36.0 | 53.57 | -9.54 | 159.04 | 5000 |
| Av | 3216.00 | 52.1 | 2.8 | 30.9 | 36.0 | 49.79 | -9.54 | 102.92 | 500 |
| Pk | 4824.01 | 49.8 | 3.6 | 32.8 | 35.6 | 50.59 | -9.54 | 112.85 | 5000 |
| Av | 4824.01 | 40.8 | 3.6 | 32.8 | 35.6 | 41.64 | -9.54 | 40.27 | 500 |
| Pk | 6432.01 | 49.6 | 3.9 | 34.4 | 35.9 | 52.01 | -9.54 | 132.89 | 5000 |
| Av | 6432.01 | 41.0 | 3.9 | 34.4 | 35.9 | 43.38 | -9.54 | 49.20 | 500 |

| Middle Channel | | | | | | | | | |
|-----------------------|------------------------|-------------------------------|--------------------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------------------|-----------------------------------|-------------------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dBμV) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dBμV/m) | EXTRAP FACT (dB) | FIELD ST'GH (μV/m) | LIMIT (μV/m) |
| Pk | 3249.34 | 54.0 | 2.8 | 31 | 36.0 | 51.77 | -9.54 | 129.27 | 5000 |
| Av | 3249.34 | 49.2 | 2.8 | 31 | 36.0 | 46.95 | -9.54 | 74.22 | 500 |
| Pk | 4874.01 | 49.1 | 3.6 | 33 | 35.6 | 50.08 | -9.54 | 106.41 | 5000 |
| Av | 4874.01 | 39.6 | 3.6 | 33 | 35.6 | 40.58 | -9.54 | 35.65 | 500 |
| Pk | 6498.67 | 50.3 | 4.1 | 34.4 | 35.9 | 52.90 | -9.54 | 147.23 | 5000 |
| Av | 6498.67 | 42.8 | 4.1 | 34.4 | 35.9 | 45.37 | -9.54 | 61.87 | 500 |

| Top Channel | | | | | | | | | |
|--------------------|-------------|----------------------|-----------------|------------------|--------------|----------------------------|------------------|--------------------------|--------------------|
| Ref No. | FREQ. (MHz) | MEAS Rx (dB μ V) | CABLE LOSS (dB) | ANT FACT. (dB/m) | PRE AMP (dB) | FIELD ST'GH (dB μ V/m) | EXTRAP FACT (dB) | FIELD ST'GH (μ V/m) | LIMIT (μ V/m) |
| Pk | 3282.67 | 53.9 | 2.9 | 31.0 | 36.0 | 51.78 | -9.54 | 129.42 | 5000 |
| Av | 3282.67 | 48.4 | 2.9 | 31.0 | 36.0 | 46.34 | -9.54 | 69.18 | 500 |
| Pk | 4924.00 | 48.9 | 3.6 | 33.1 | 35.6 | 50.00 | -9.54 | 105.44 | 5000 |
| Av | 4924.00 | 39.5 | 3.6 | 33.1 | 35.6 | 40.58 | -9.54 | 35.65 | 500 |
| Pk | 6565.34 | 50.5 | 4.2 | 34.6 | 35.9 | 53.44 | -9.54 | 156.68 | 5000 |
| Av | 6565.34 | 42.9 | 4.2 | 34.6 | 35.9 | 45.80 | -9.54 | 65.01 | 500 |

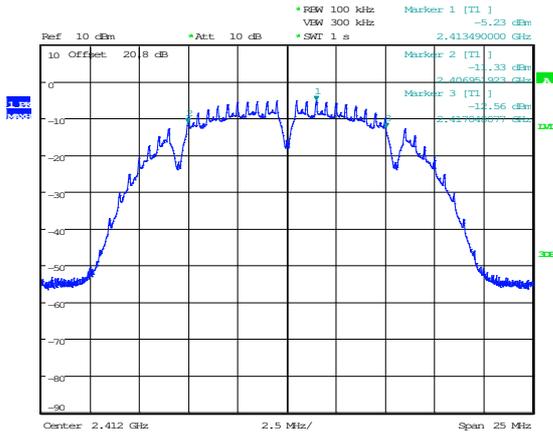
Appendix B:**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

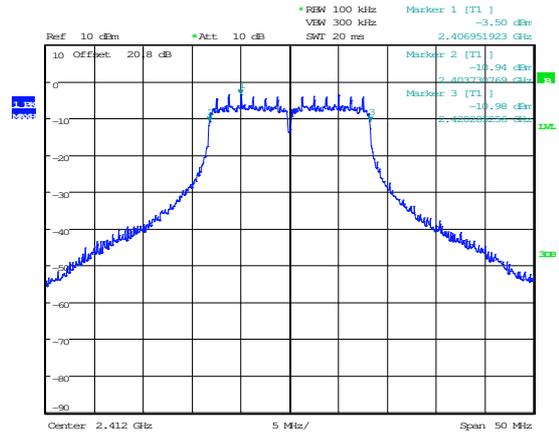
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.
- (d) Appendix C details the numbering system used to identify the sample and its modification state.
- (e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

6dB Bandwidth -



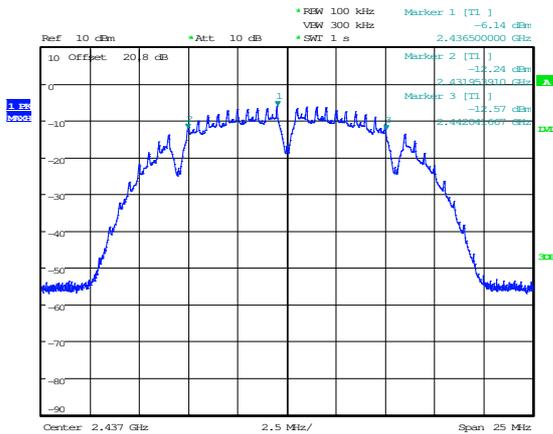
Date: 17.MAR.2014 11:37:03

802.11b Channel 1



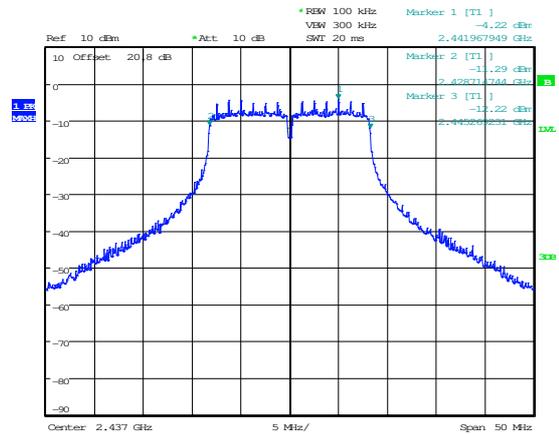
Date: 17.MAR.2014 17:07:02

802.11g Channel 1



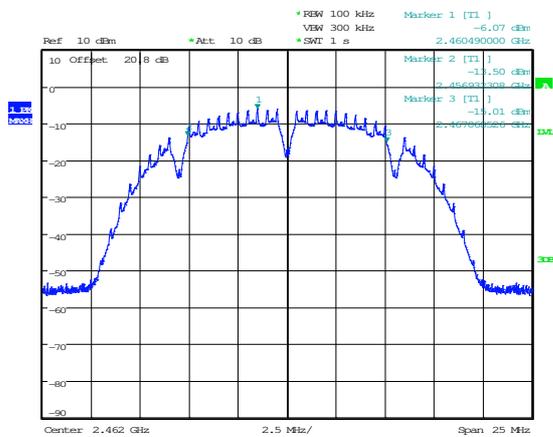
Date: 17.MAR.2014 11:39:44

802.11b Channel 6



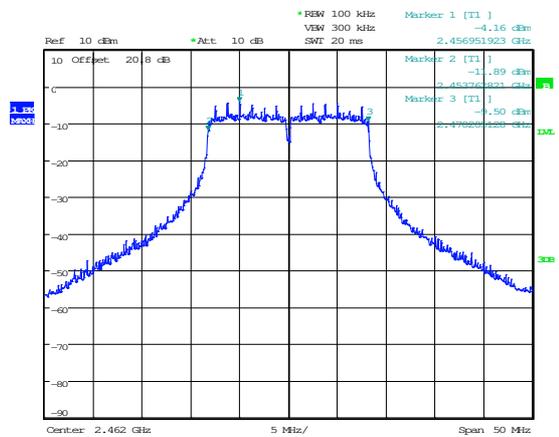
Date: 17.MAR.2014 17:09:19

802.11g Channel 6



Date: 17.MAR.2014 11:41:51

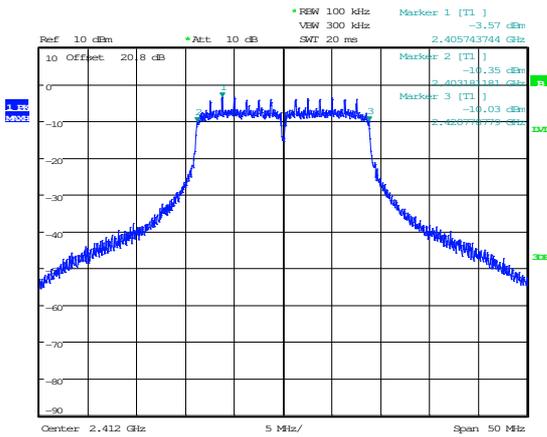
802.11b Channel 11



Date: 17.MAR.2014 17:11:38

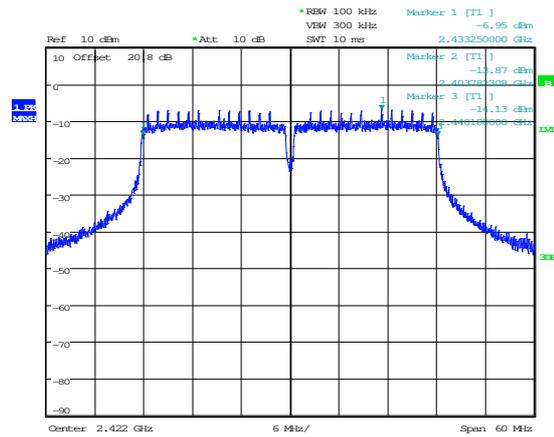
802.11g Channel 11

6dB Bandwidth



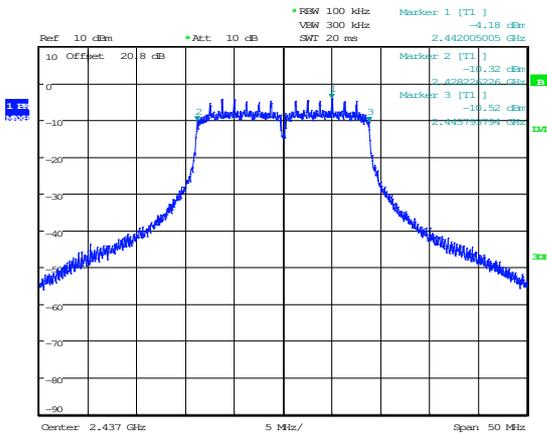
Date: 18.MAR.2014 09:26:56

802.11n HT20 Channel 1



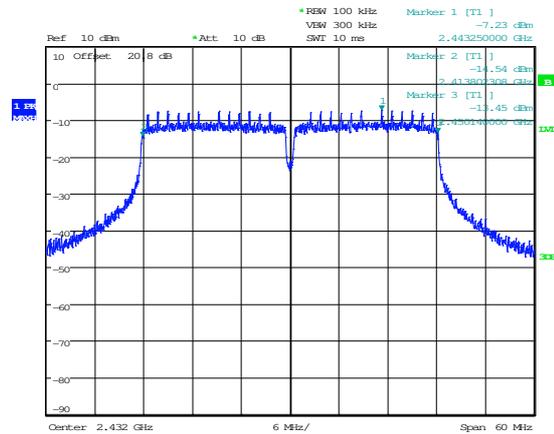
Date: 18.MAR.2014 11:21:08

802.11n HT40 Channel 3



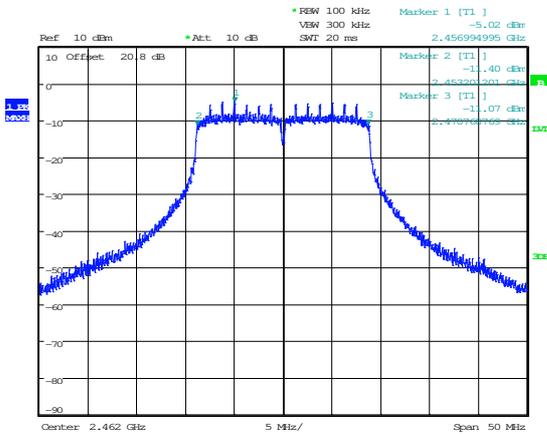
Date: 18.MAR.2014 09:30:33

802.11n HT20 Channel 6



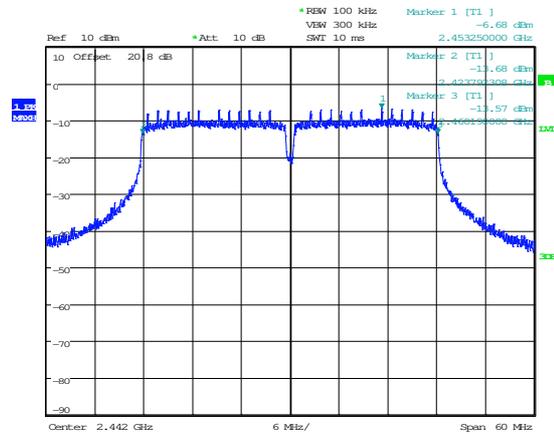
Date: 18.MAR.2014 11:22:54

802.11n HT40 Channel 5



Date: 18.MAR.2014 09:31:59

802.11n HT20 Channel 11

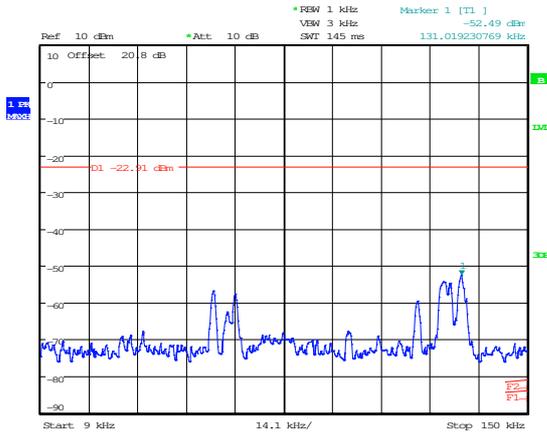


Date: 18.MAR.2014 11:28:48

802.11n HT40 Channel 7

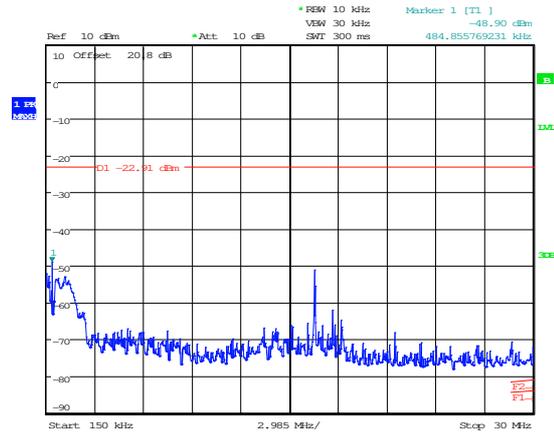
Conducted Spurious emissions

802.11b - 2412 MHz



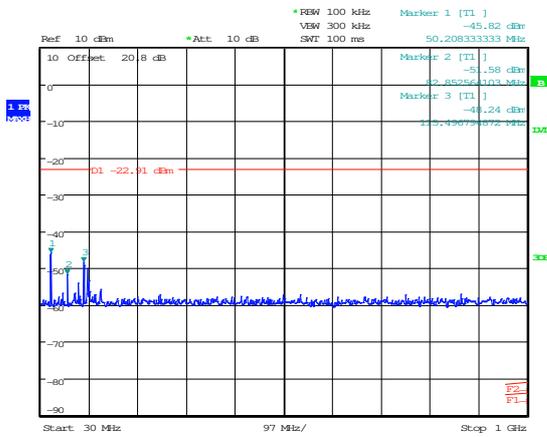
Date: 17.MAR.2014 15:21:02

9kHz – 150 kHz



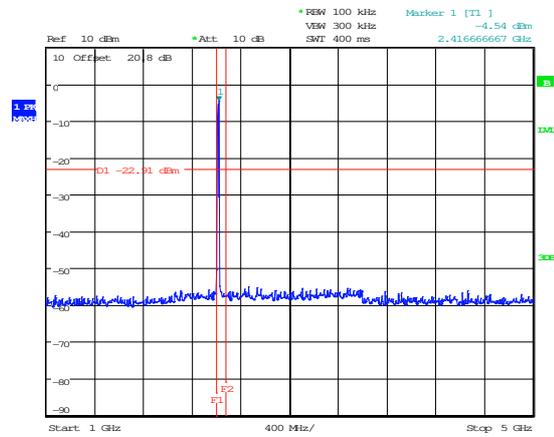
Date: 17.MAR.2014 15:21:26

150kHz – 30 MHz



Date: 17.MAR.2014 15:21:58

30 MHz to 1 GHz

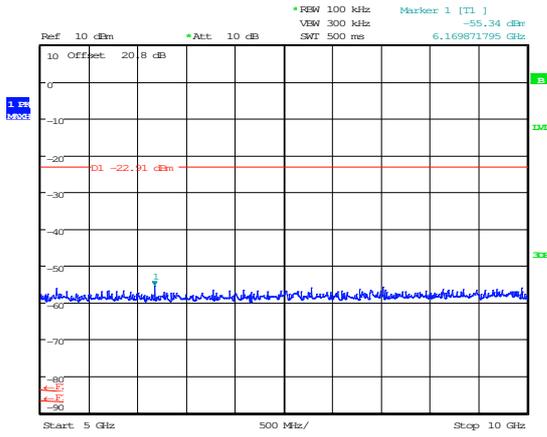


Date: 17.MAR.2014 15:19:24

1 GHz to 5 GHz

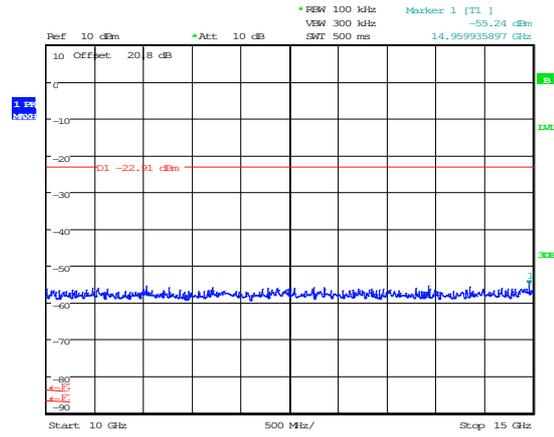
Conducted Spurious emissions

802.11b - 2412 MHz



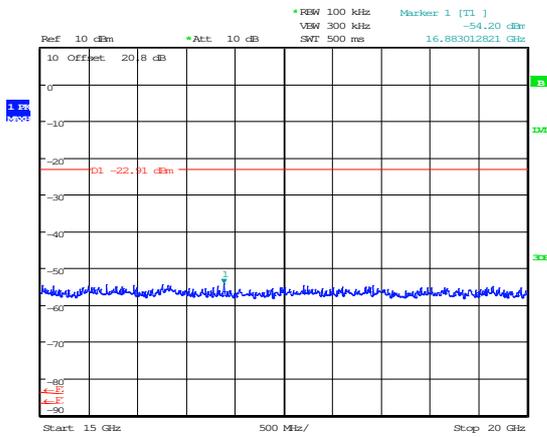
Date: 17.MAR.2014 15:19:38

5 GHz to 10 GHz



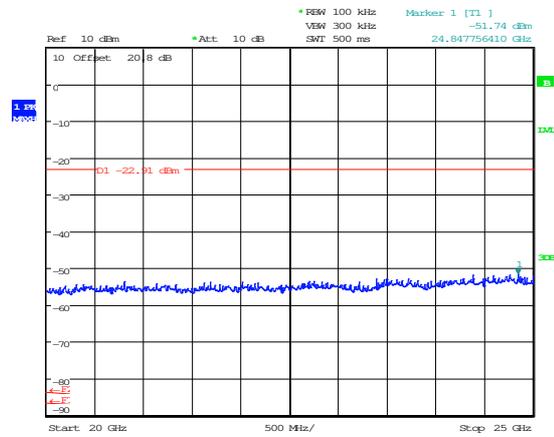
Date: 17.MAR.2014 15:19:54

10 GHz to 15 GHz



Date: 17.MAR.2014 15:20:14

15 GHz to 20 GHz

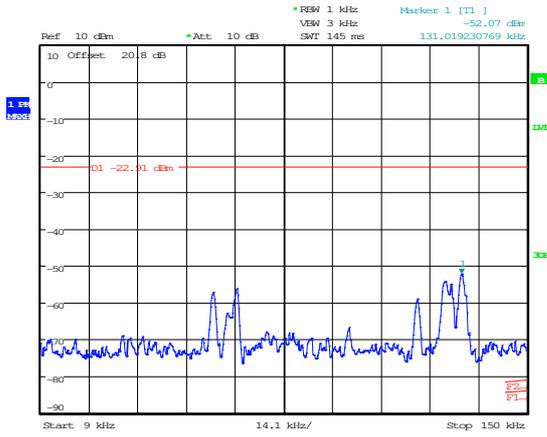


Date: 17.MAR.2014 15:20:40

20 GHz to 25 GHz

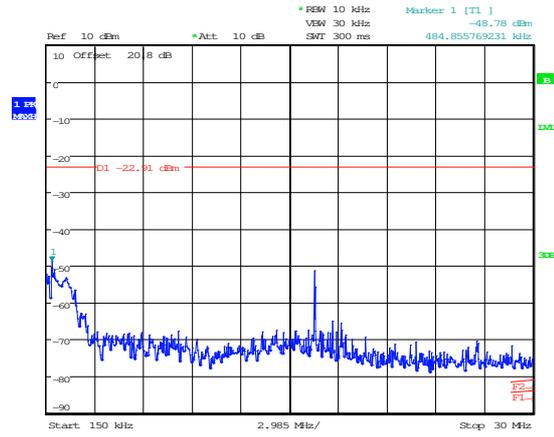
Conducted Spurious emissions

802.11b - 2437 MHz



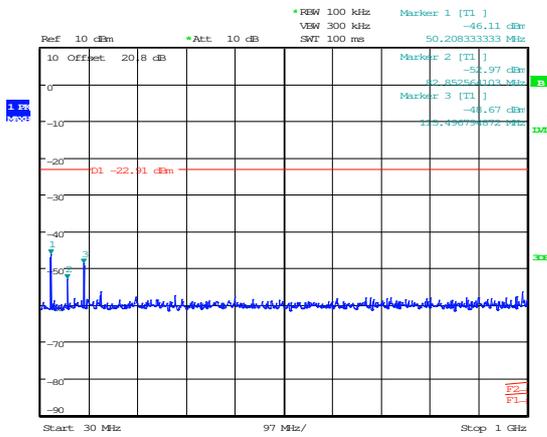
Date: 17.MAR.2014 15:22:55

9kHz – 150 kHz



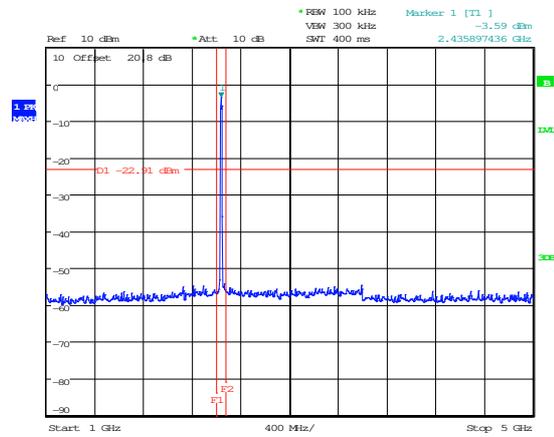
Date: 17.MAR.2014 15:23:14

150kHz – 30 MHz



Date: 17.MAR.2014 15:22:32

30 MHz to 1 GHz

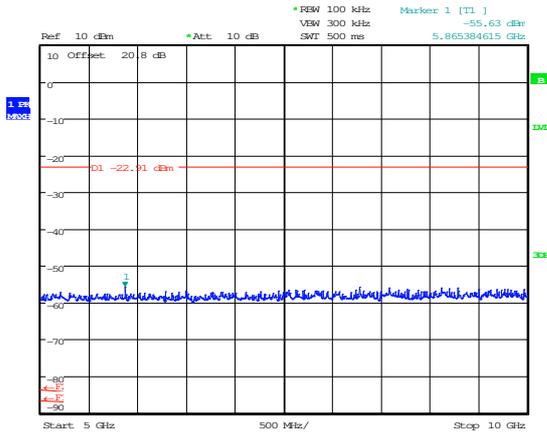


Date: 17.MAR.2014 15:23:40

1 GHz to 5 GHz

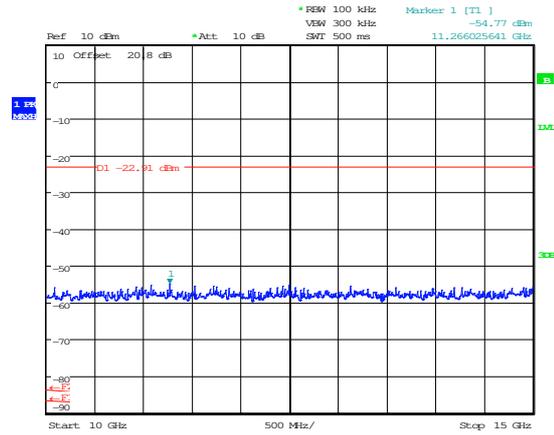
Conducted Spurious emissions

802.11b - 2437 MHz



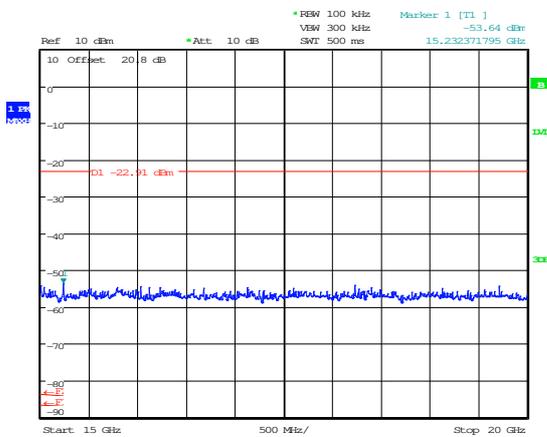
Date: 17.MAR.2014 15:23:56

5 GHz to 10 GHz



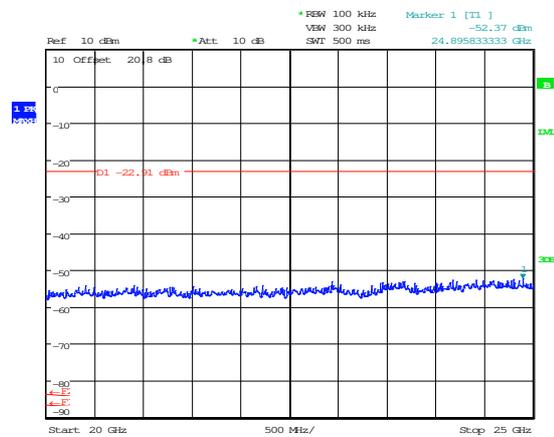
Date: 17.MAR.2014 15:24:09

10 GHz to 15 GHz



Date: 17.MAR.2014 15:24:24

15 GHz to 20 GHz

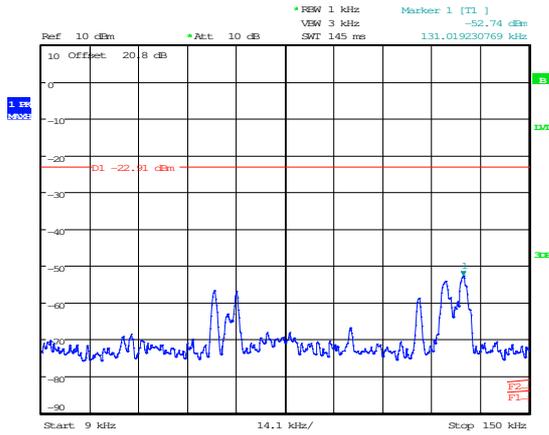


Date: 17.MAR.2014 15:24:38

20 GHz to 25 GHz

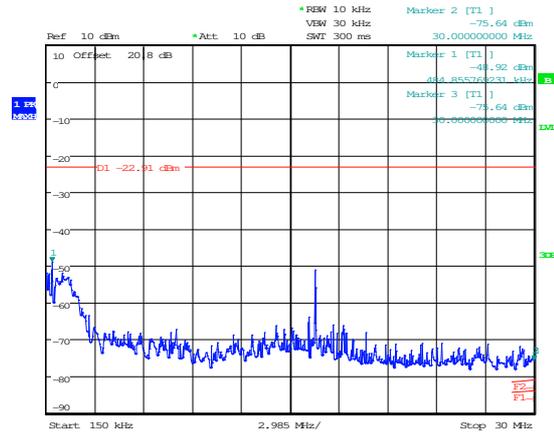
Conducted Spurious emissions

802.11b - 2462 MHz



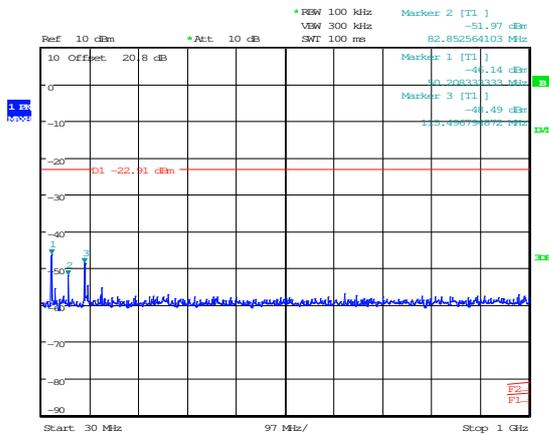
Date: 17.MAR.2014 15:27:55

9kHz – 150 kHz



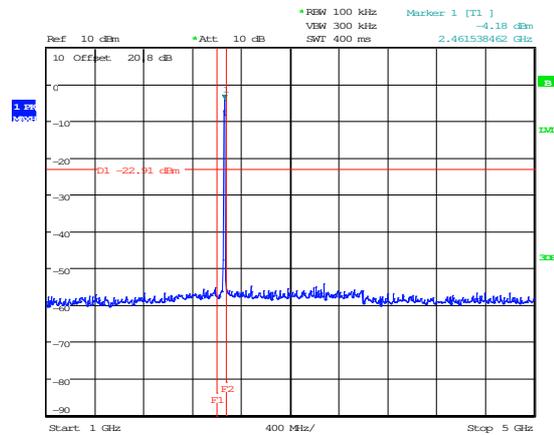
Date: 17.MAR.2014 15:27:24

150kHz – 30 MHz



Date: 17.MAR.2014 15:26:35

30 MHz to 1 GHz

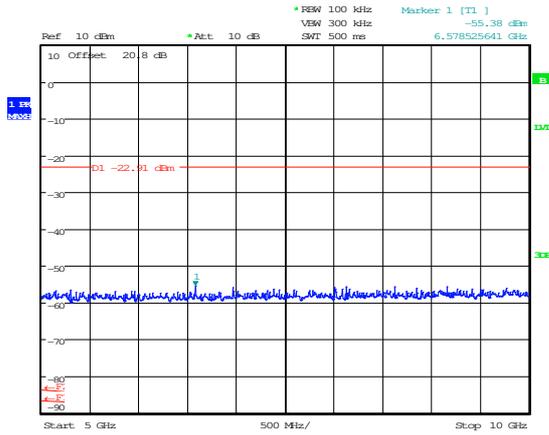


Date: 17.MAR.2014 15:26:06

1 GHz to 5 GHz

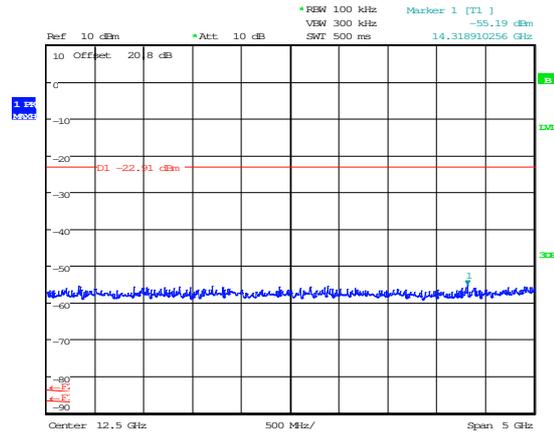
Conducted Spurious emissions

802.11b - 2462 MHz



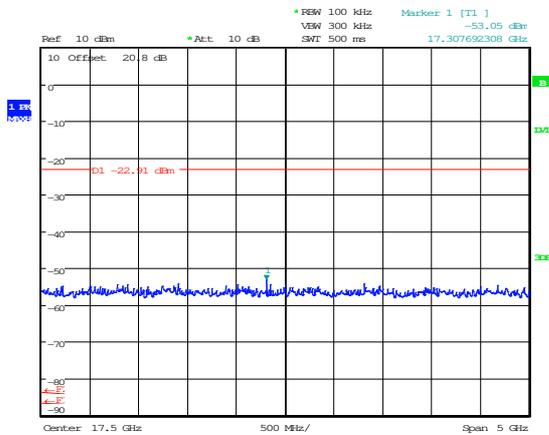
Date: 17.MAR.2014 15:25:52

5 GHz to 10 GHz



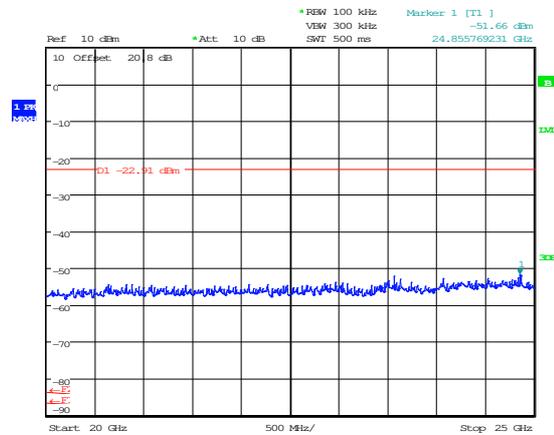
Date: 17.MAR.2014 15:25:34

10 GHz to 15 GHz



Date: 17.MAR.2014 15:25:24

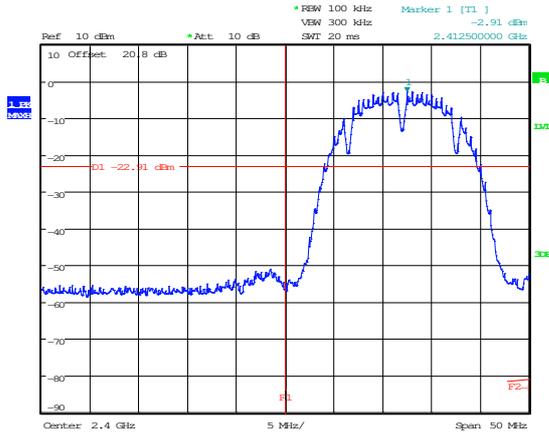
15 GHz to 20 GHz



Date: 17.MAR.2014 15:25:01

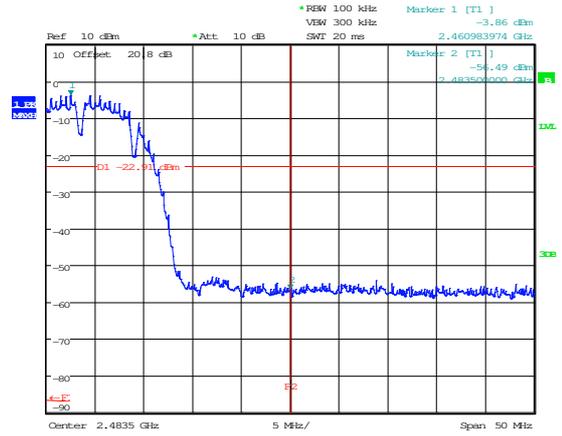
20 GHz to 25 GHz

Conducted band-edge compliance



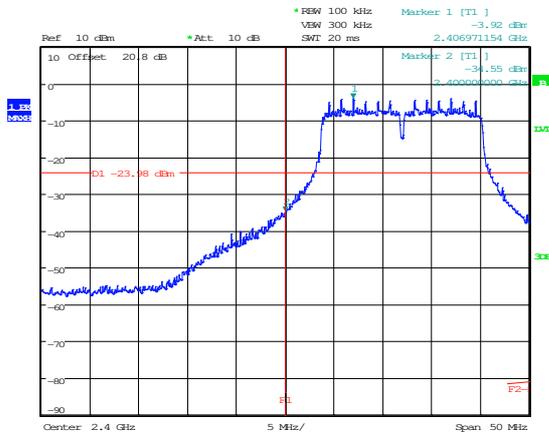
Date: 17.MAR.2014 15:18:38

lower band edge – 802.11b



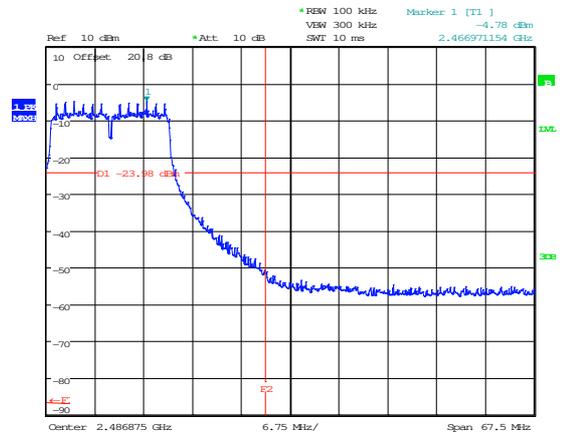
Date: 17.MAR.2014 15:28:35

upper band-edge– 802.11b



Date: 17.MAR.2014 17:44:41

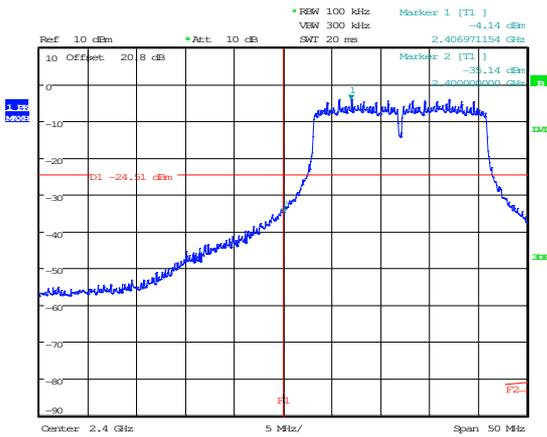
lower band edge – 802.11g



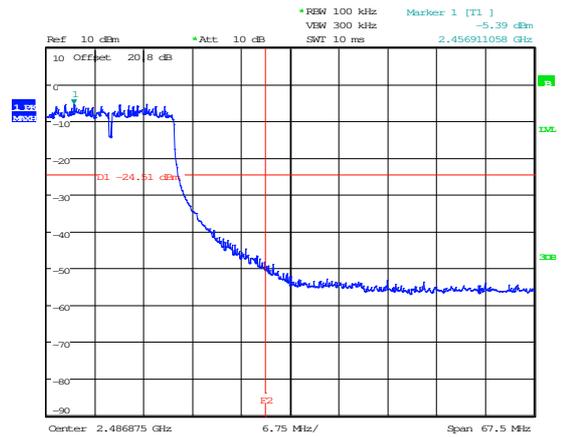
Date: 17.MAR.2014 17:35:49

upper band-edge– 802.11g

Conducted band-edge compliance



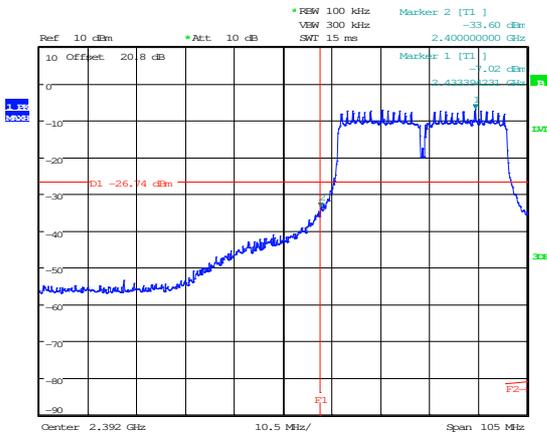
Date: 18.MAR.2014 10:42:24



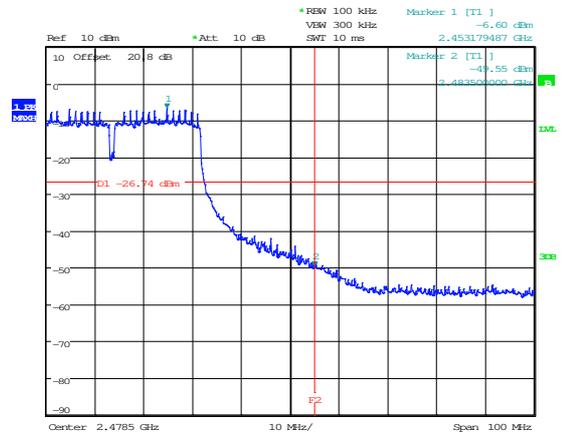
Date: 18.MAR.2014 10:16:05

lower band edge – 802.11n HT20

upper band-edge– 802.11n HT20



Date: 18.MAR.2014 12:09:50

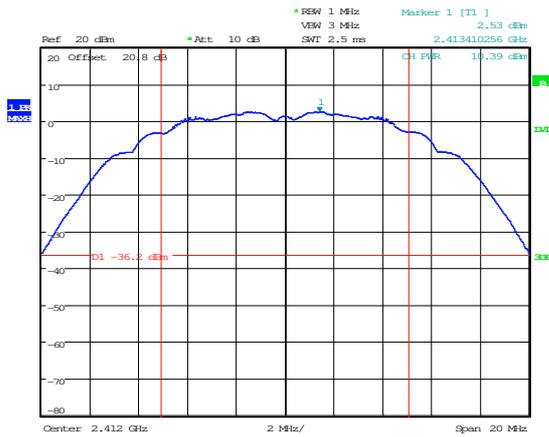


Date: 18.MAR.2014 11:51:58

lower band edge – 802.11n HT40

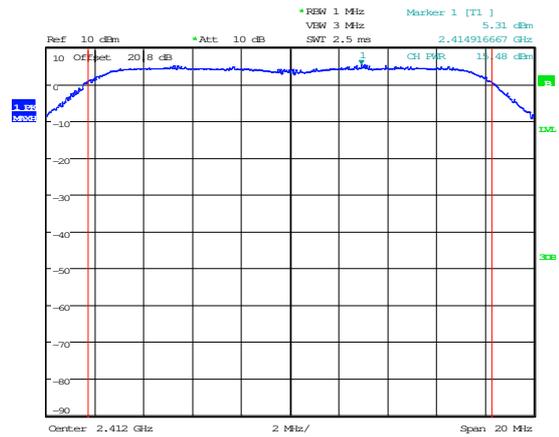
upper band-edge– 802.11n HT40

Conducted carrier power



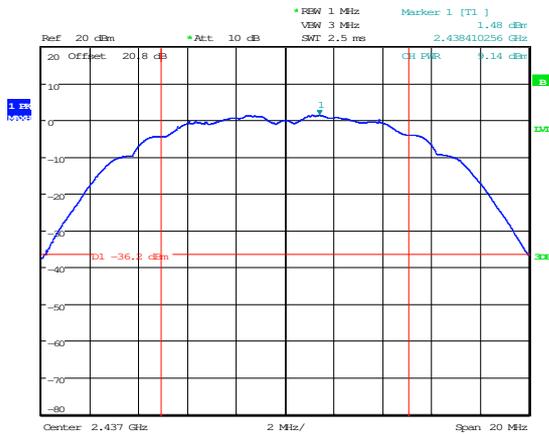
Date: 17.MAR.2014 15:12:18

802.11b Channel 1



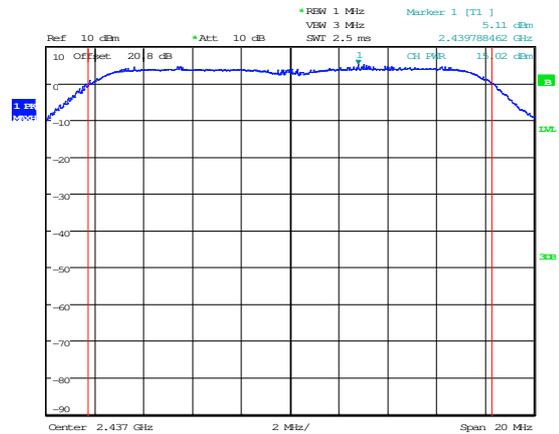
Date: 17.MAR.2014 17:24:27

802.11g Channel 1



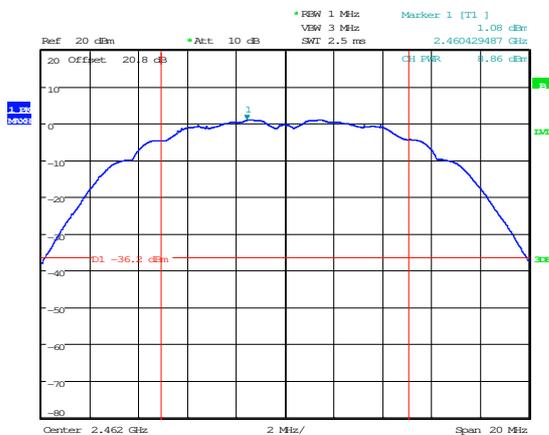
Date: 17.MAR.2014 15:13:13

802.11b Channel 6



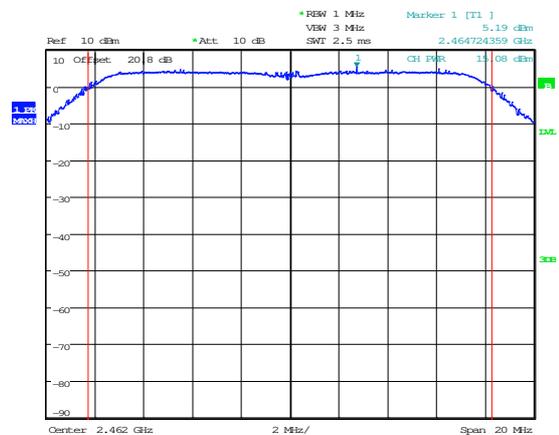
Date: 17.MAR.2014 17:20:05

802.11g Channel 6



Date: 17.MAR.2014 15:13:42

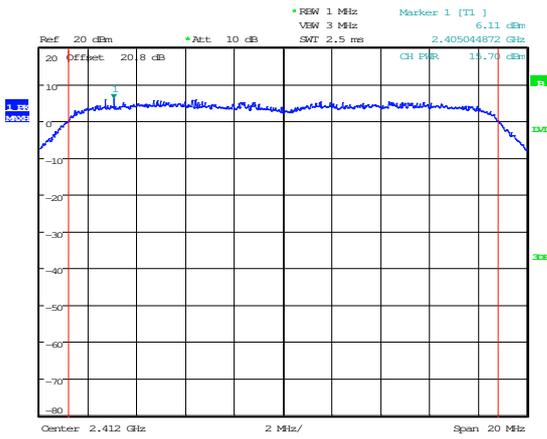
802.11b Channel 11



Date: 17.MAR.2014 17:16:40

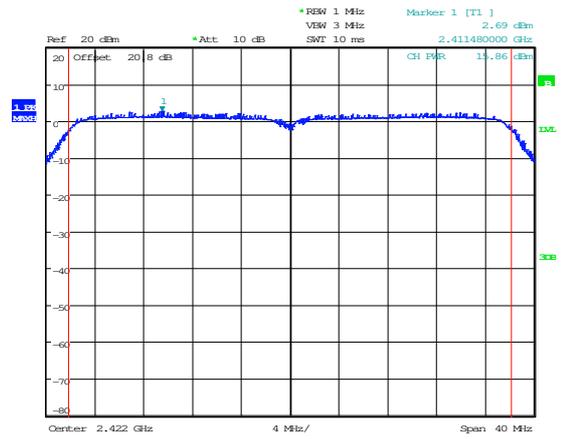
802.11g Channel 11

Conducted carrier power



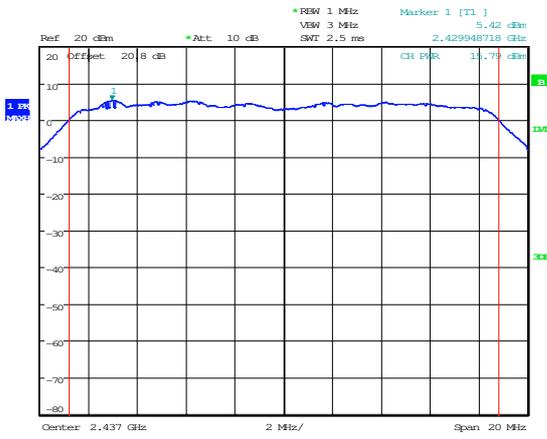
Date: 18.MAR.2014 09:40:08

802.11n HT20 Channel 1



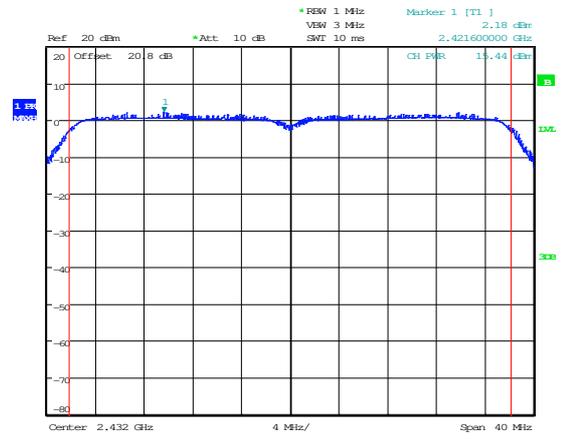
Date: 18.MAR.2014 11:41:12

802.11n HT40 Channel 3



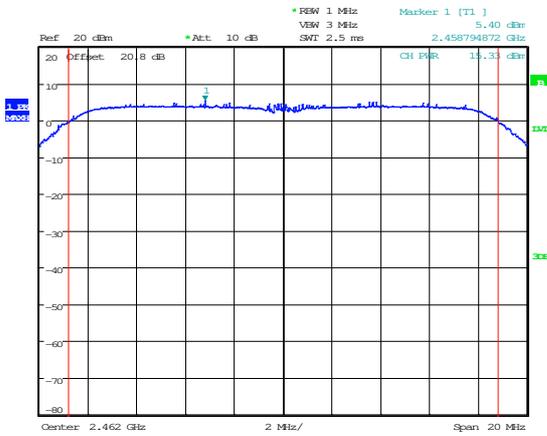
Date: 18.MAR.2014 09:56:07

802.11n HT20 Channel 6



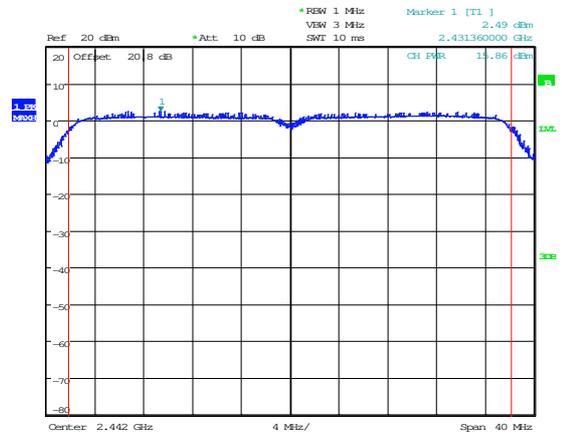
Date: 18.MAR.2014 11:37:06

802.11n HT20 Channel 5



Date: 18.MAR.2014 09:38:02

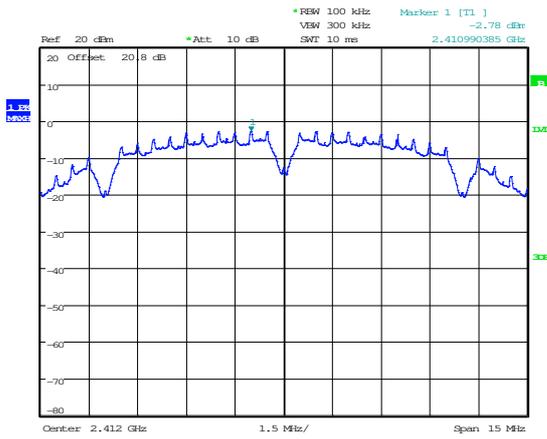
802.11n HT20 Channel 11



Date: 18.MAR.2014 11:32:49

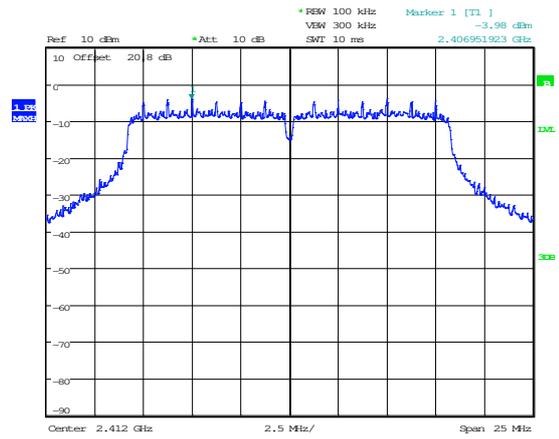
802.11n HT20 Channel 7

Conducted power spectral density



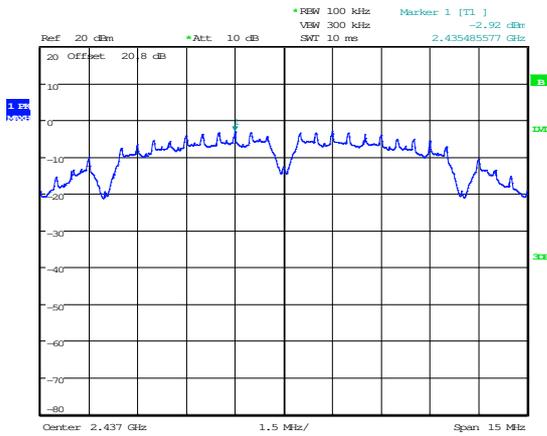
Date: 17.MAR.2014 15:16:13

802.11b Channel 1



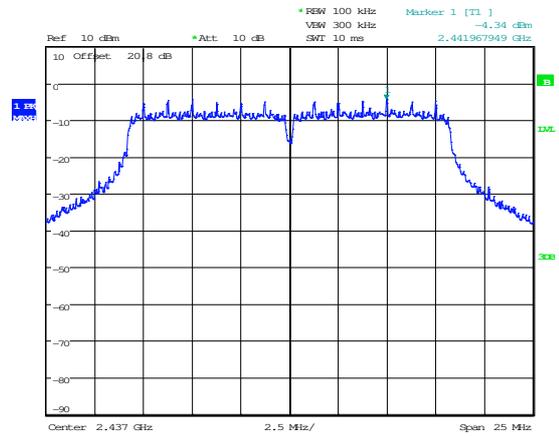
Date: 17.MAR.2014 17:26:37

802.11g Channel 1



Date: 17.MAR.2014 15:15:31

802.11b Channel 6



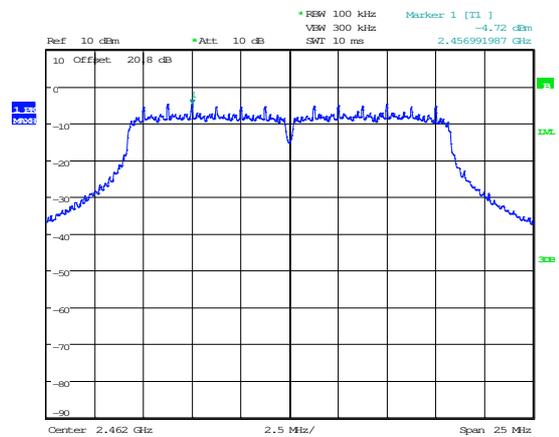
Date: 17.MAR.2014 17:27:14

802.11g Channel 6



Date: 17.MAR.2014 15:14:50

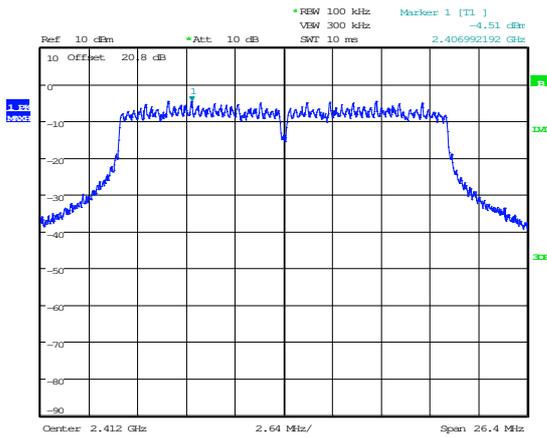
802.11b Channel 11



Date: 17.MAR.2014 17:32:41

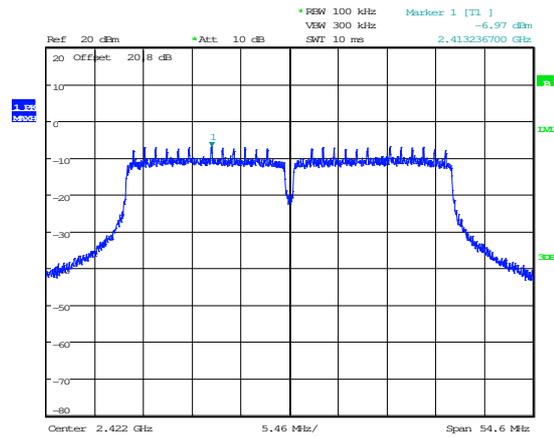
802.11g Channel 11

Conducted power spectral density



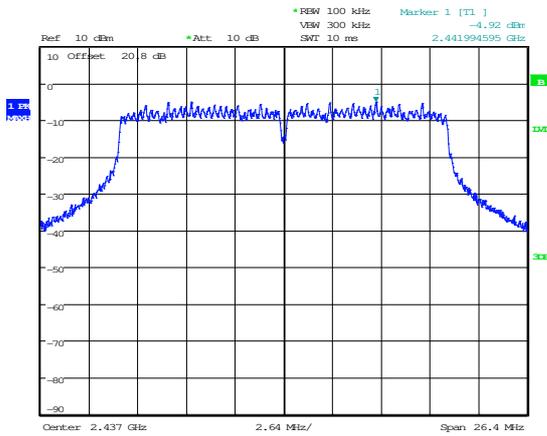
Date: 18.MAR.2014 10:03:49

802.11n HT20 Channel 1



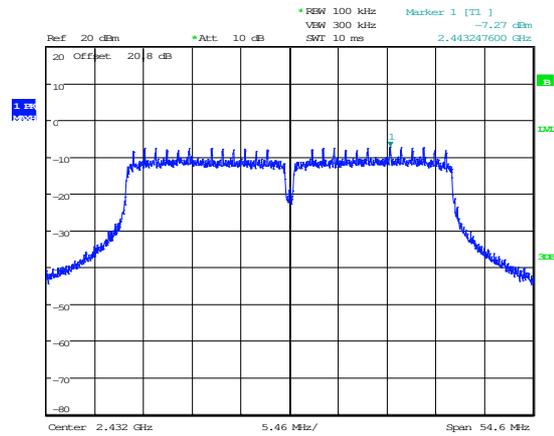
Date: 18.MAR.2014 11:45:21

802.11n HT40 Channel 3



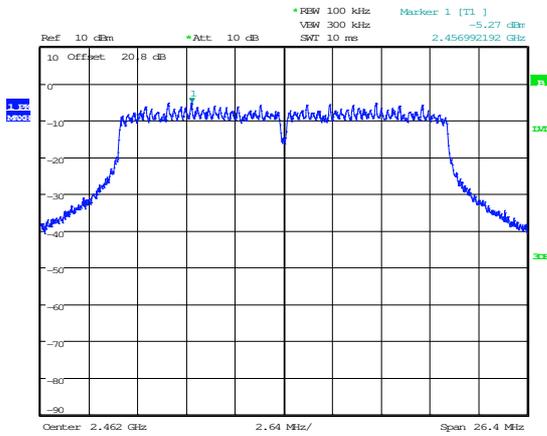
Date: 18.MAR.2014 10:01:06

802.11n HT20 Channel 6



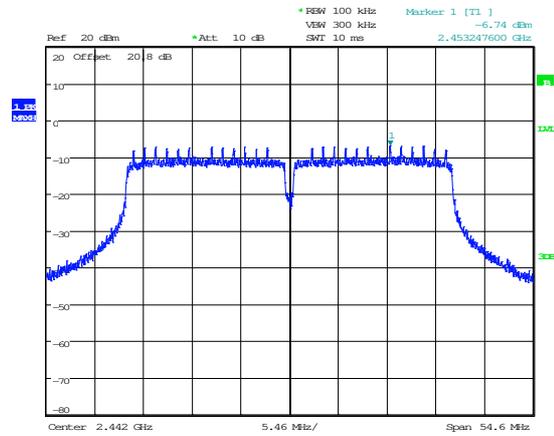
Date: 18.MAR.2014 11:47:41

802.11n HT20 Channel 5



Date: 18.MAR.2014 10:08:17

802.11n HT20 Channel 11

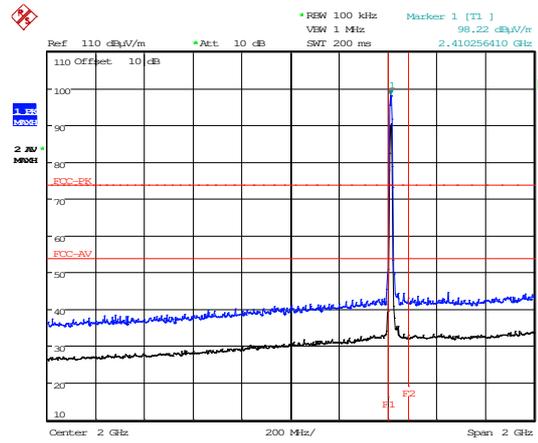
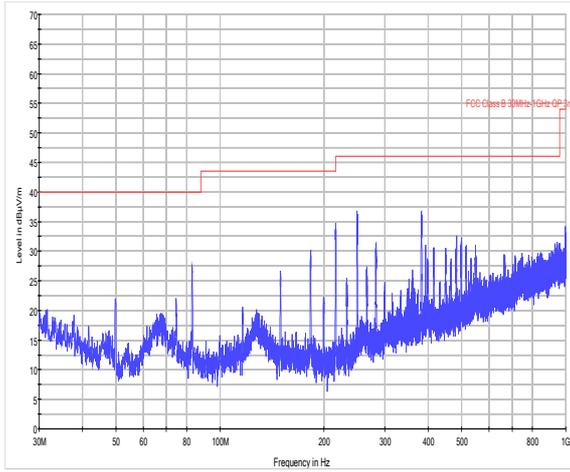


Date: 18.MAR.2014 11:48:58

802.11n HT20 Channel 7

Radiated Spurious emissions

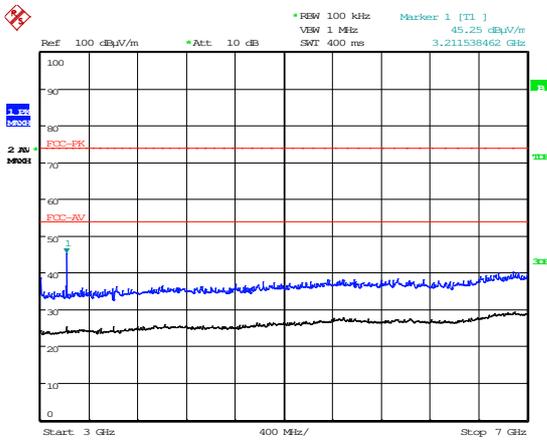
802.11b - 2412 MHz



Date: 25.FEB.2014 15:32:18

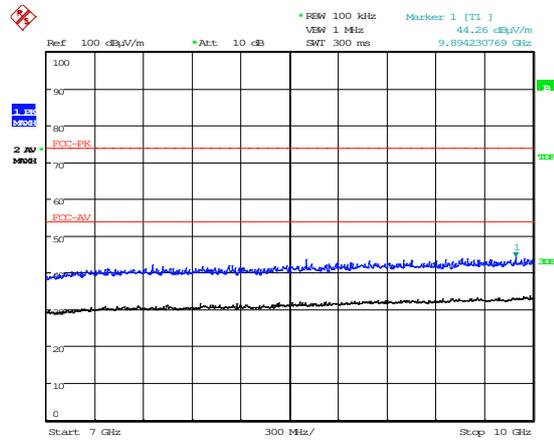
30 MHz to 1 GHz

1 GHz to 3 GHz



Date: 25.FEB.2014 11:39:01

3 GHz to 7 GHz

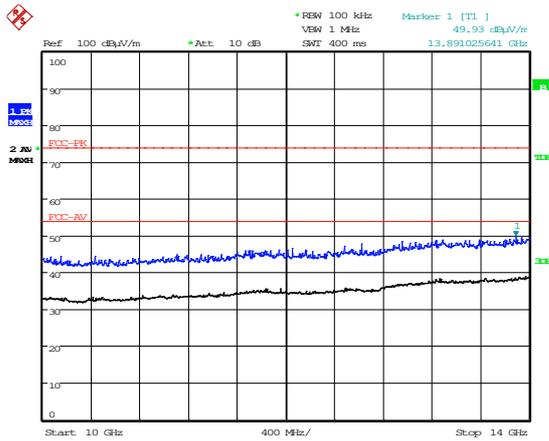


Date: 25.FEB.2014 11:40:06

7 GHz to 10 GHz

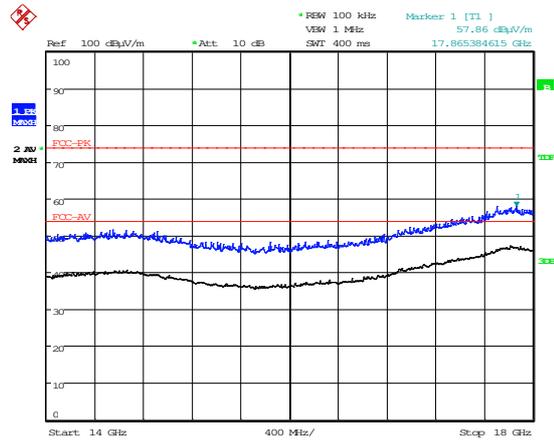
Radiated Spurious emissions

802.11b - 2412 MHz



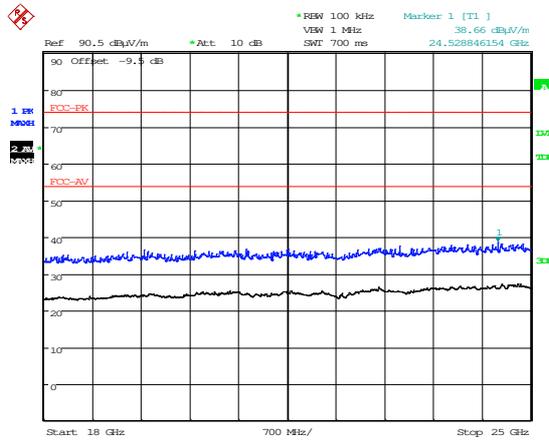
Date: 25.FEB.2014 11:40:55

10 GHz to 14 GHz



Date: 25.FEB.2014 11:41:45

14 GHz to 18 GHz

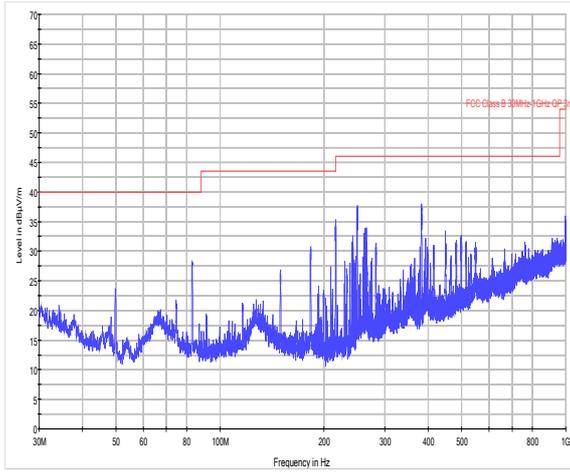


Date: 26.FEB.2014 16:55:56

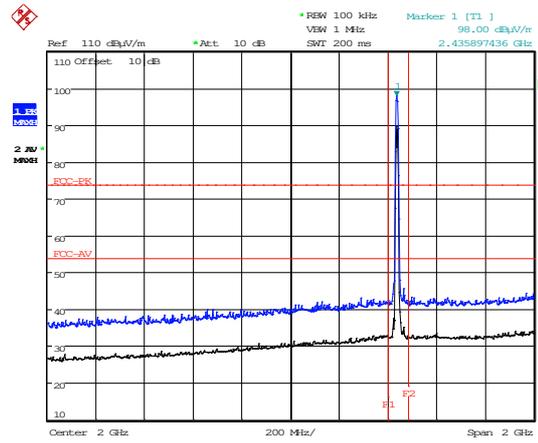
18 GHz to 25 GHz

Radiated Spurious emissions

802.11b - 2437 MHz

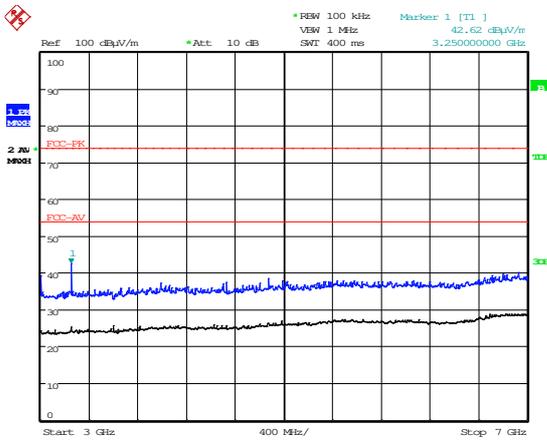


30 MHz to 1 GHz



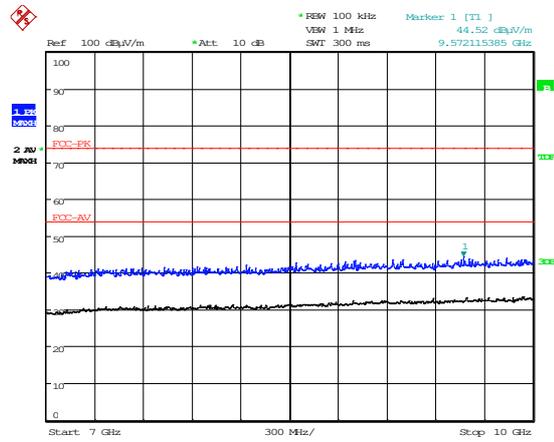
Date: 25.FEB.2014 15:29:53

1 GHz to 3 GHz



Date: 25.FEB.2014 12:15:13

3 GHz to 7 GHz

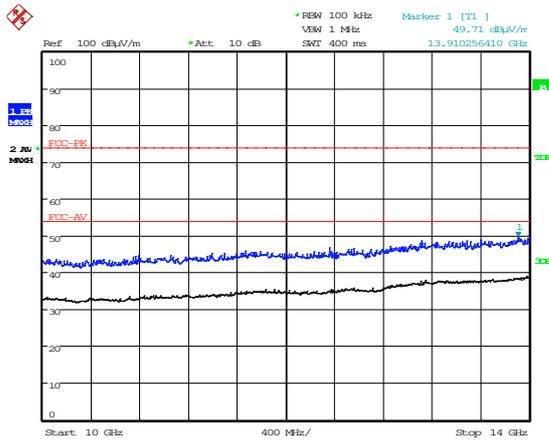


Date: 25.FEB.2014 12:14:14

7 GHz to 10 GHz

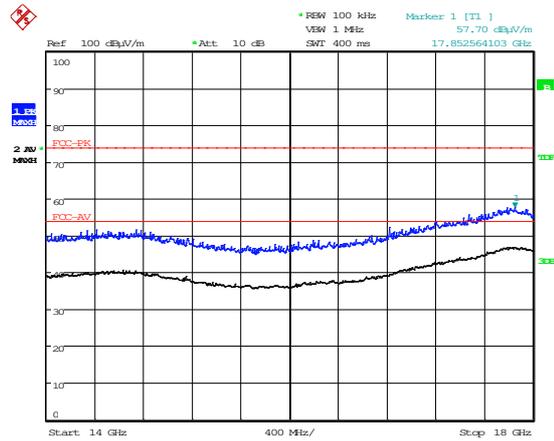
Radiated Spurious emissions

802.11b - 2437 MHz



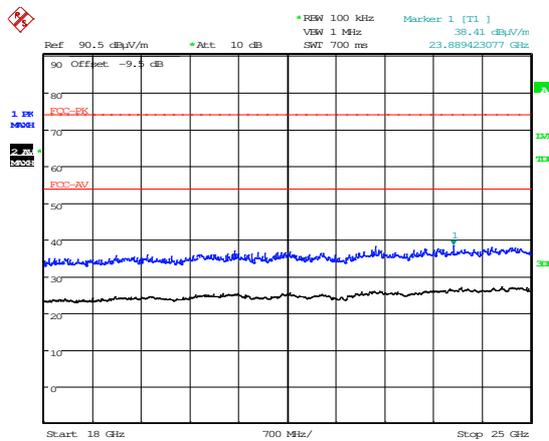
Date: 25.FEB.2014 12:13:17

10 GHz to 14 GHz



Date: 25.FEB.2014 12:12:24

14 GHz to 18 GHz

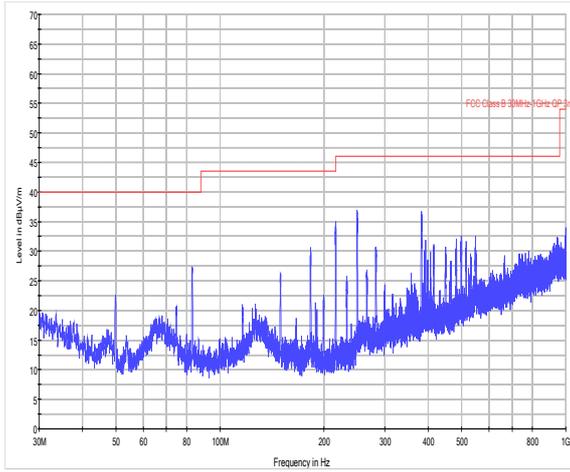


Date: 26.FEB.2014 16:56:53

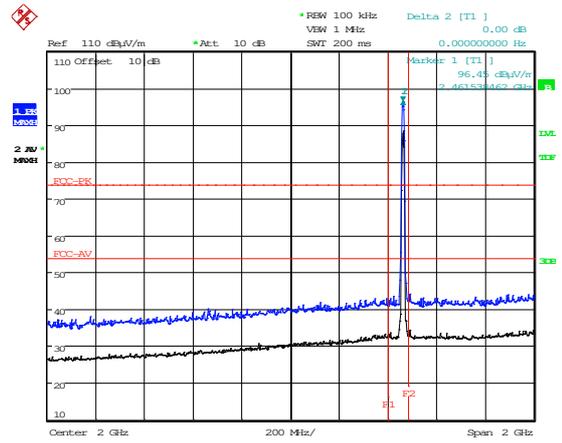
18 GHz to 25 GHz

Radiated Spurious emissions

802.11b - 2462 MHz

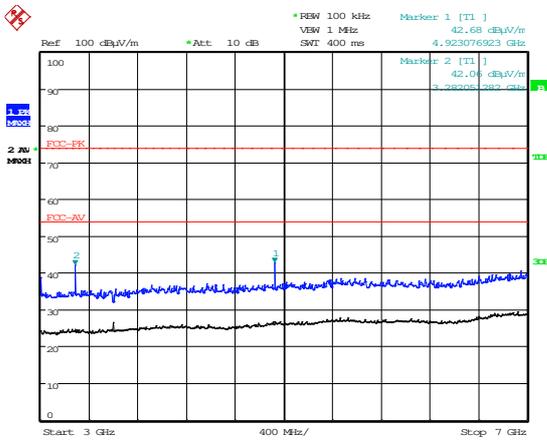


30 MHz to 1 GHz



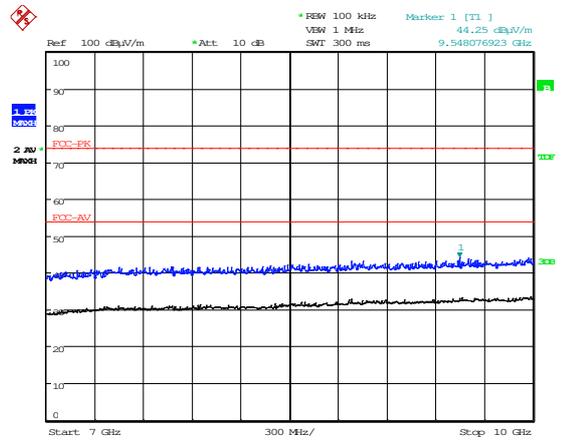
1 GHz to 3 GHz

Date: 25.FEB.2014 15:25:20



3 GHz to 7 GHz

Date: 25.FEB.2014 10:43:21

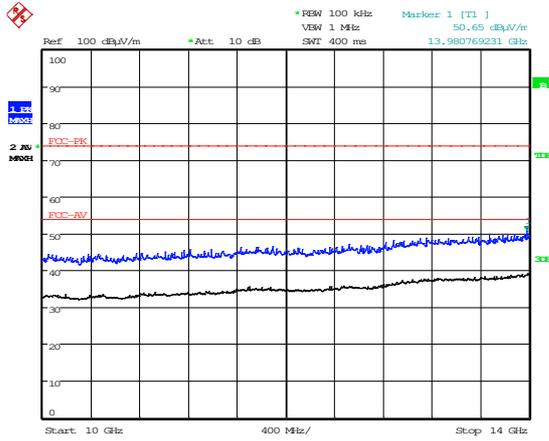


7 GHz to 10 GHz

Date: 25.FEB.2014 10:44:15

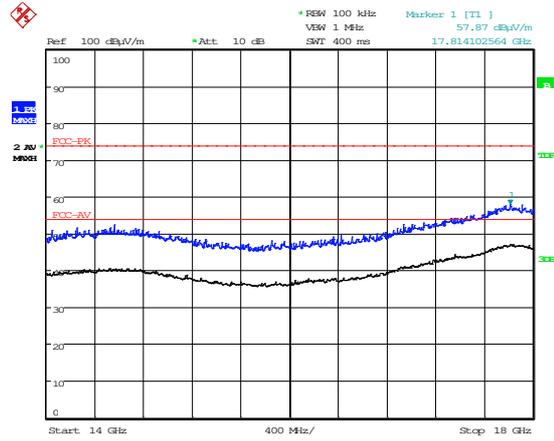
Radiated Spurious emissions

802.11b - 2462 MHz



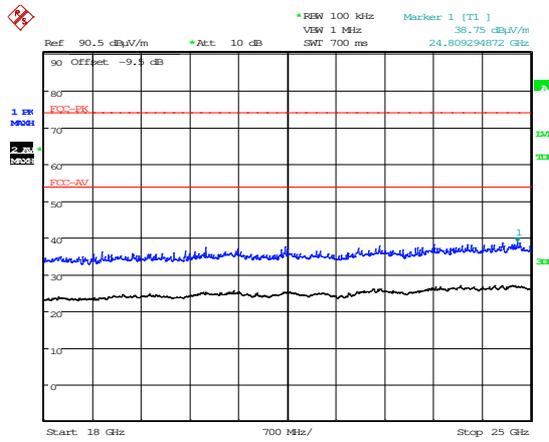
Date: 25.FEB.2014 10:46:31

10 GHz to 14 GHz



Date: 25.FEB.2014 10:47:34

14 GHz to 18 GHz

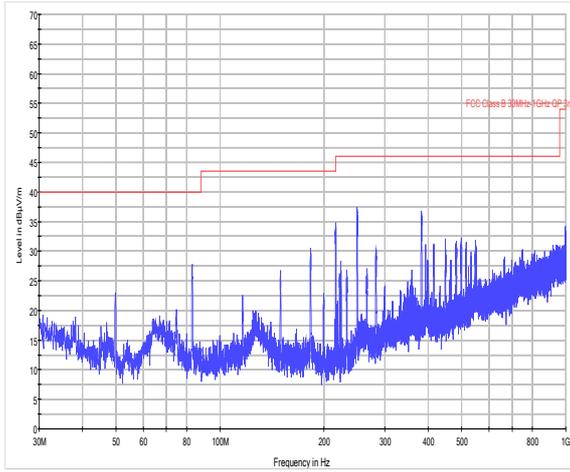


Date: 26.FEB.2014 16:57:44

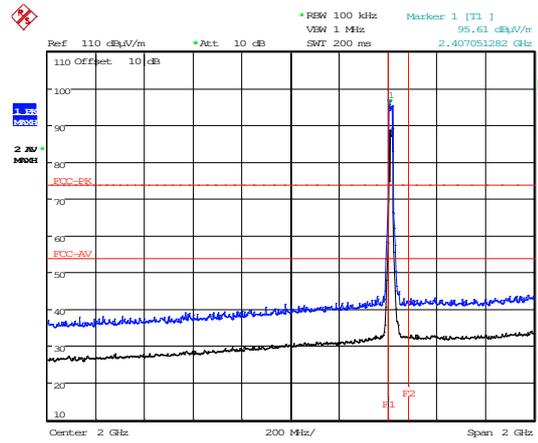
18 GHz to 25 GHz

Radiated Spurious emissions

802.11g - 2412 MHz

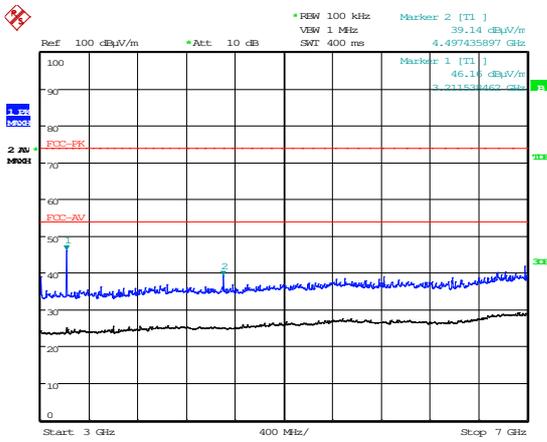


30 MHz to 1 GHz



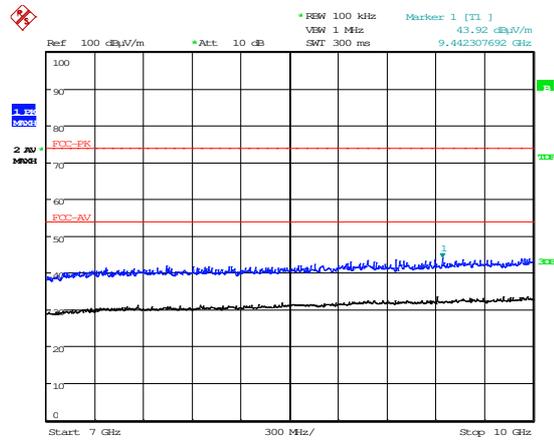
1 GHz to 3 GHz

Date: 25.FEB.2014 15:36:02



3 GHz to 7 GHz

Date: 25.FEB.2014 11:53:50

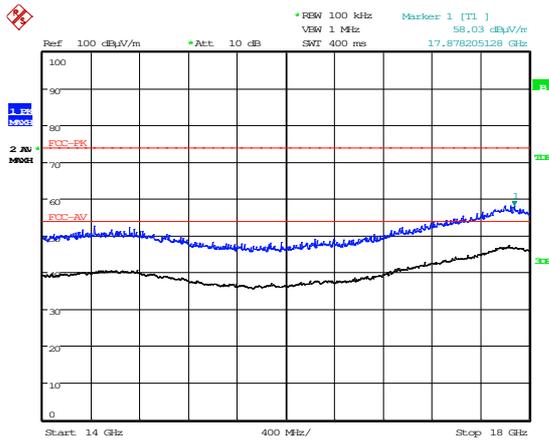


7 GHz to 10 GHz

Date: 25.FEB.2014 11:52:45

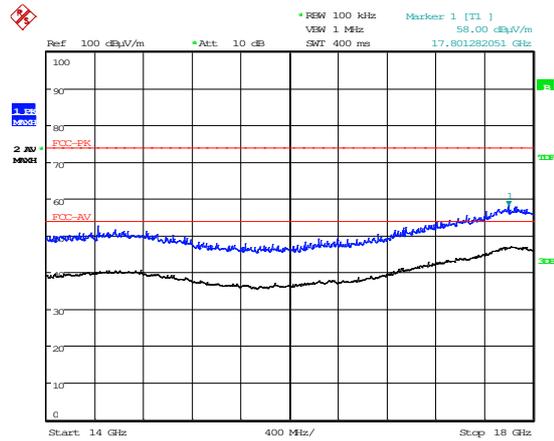
Radiated Spurious emissions

802.11g - 2412 MHz



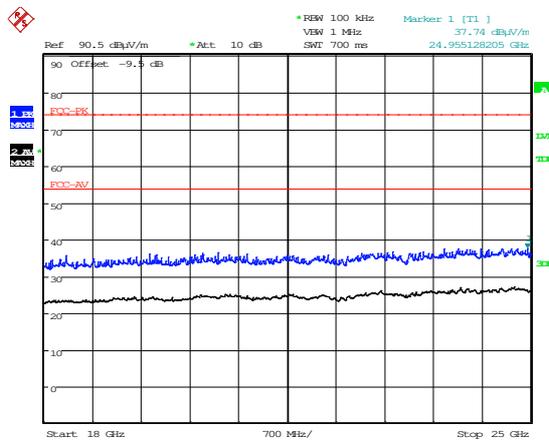
Date: 25.FEB.2014 11:51:56

10 GHz to 14 GHz



Date: 25.FEB.2014 11:51:08

14 GHz to 18 GHz

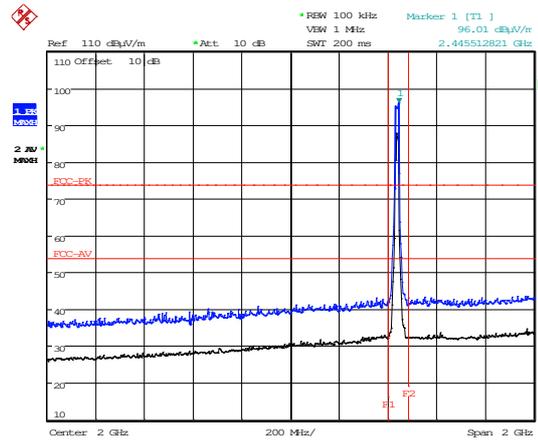
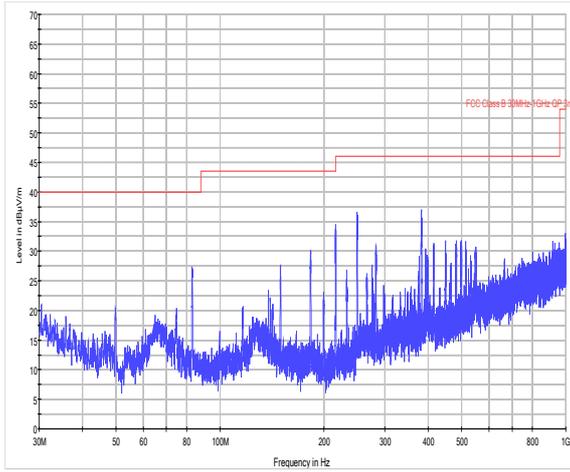


Date: 26.FEB.2014 16:48:23

18 GHz to 25 GHz

Radiated Spurious emissions

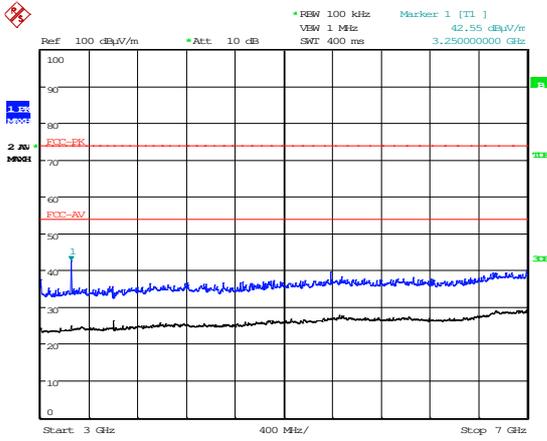
802.11g - 2437 MHz



Date: 25.FEB.2014 15:37:28

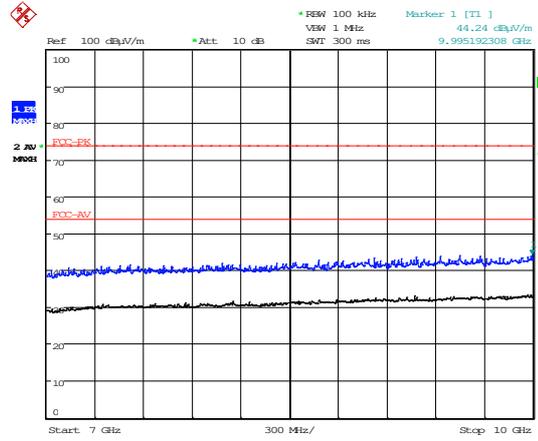
30 MHz to 1 GHz

1 GHz to 3 GHz



Date: 25.FEB.2014 12:16:14

3 GHz to 7 GHz

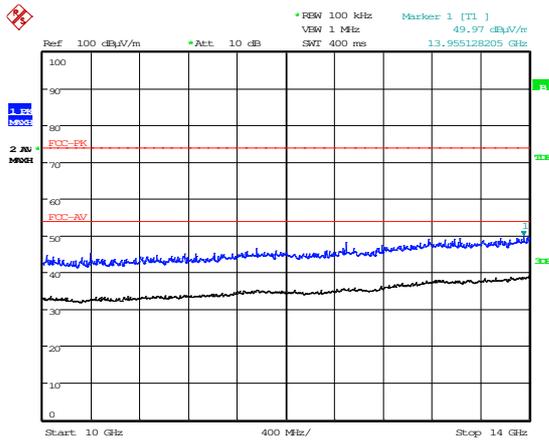


Date: 25.FEB.2014 12:17:00

7 GHz to 10 GHz

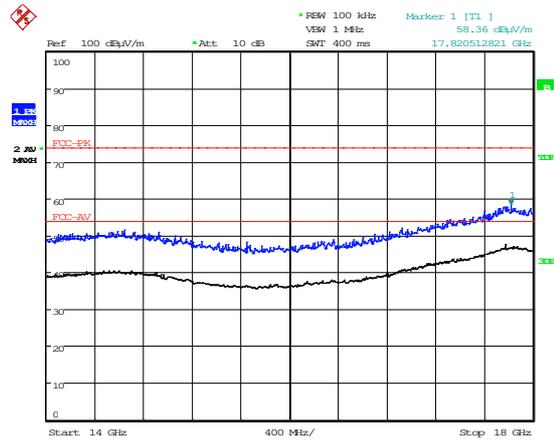
Radiated Spurious emissions

802.11g - 2437 MHz



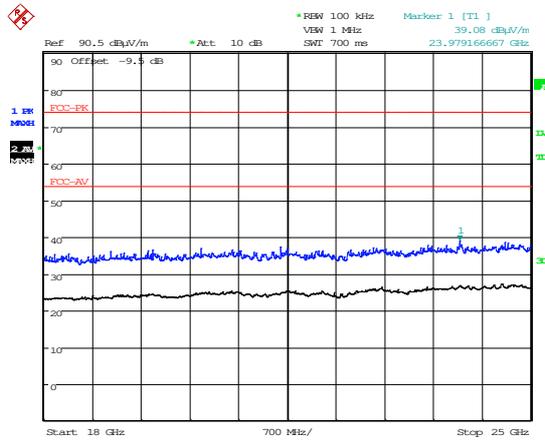
Date: 25.FEB.2014 12:17:46

10 GHz to 14 GHz



Date: 25.FEB.2014 12:18:31

14 GHz to 18 GHz

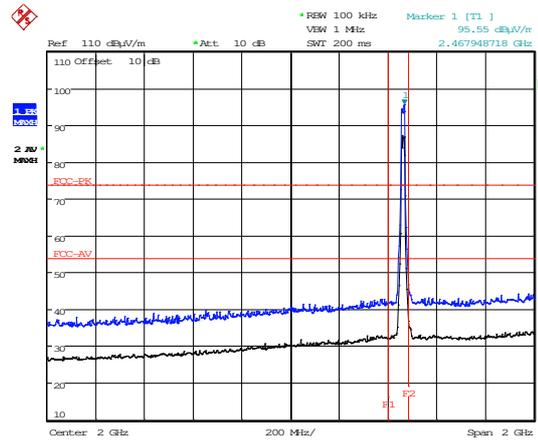
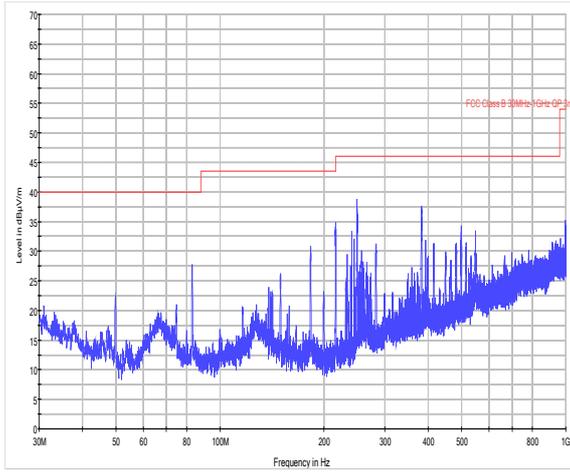


Date: 26.FEB.2014 16:54:30

18 GHz to 25 GHz

Radiated Spurious emissions

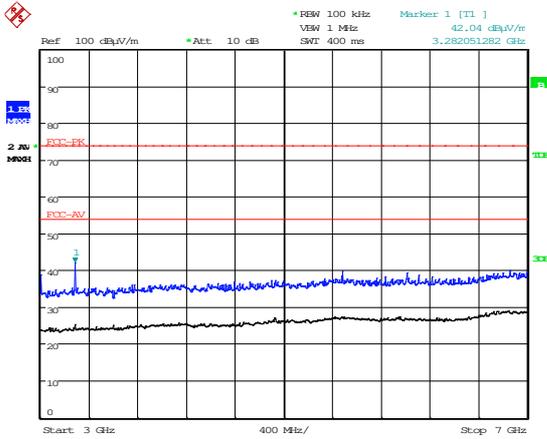
802.11g - 2462 MHz



Date: 25.FEB.2014 15:39:30

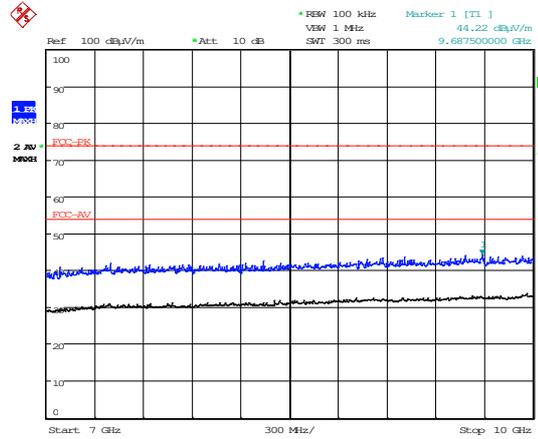
30 MHz to 1 GHz

1 GHz to 3 GHz



Date: 25.FEB.2014 11:05:25

3 GHz to 7 GHz

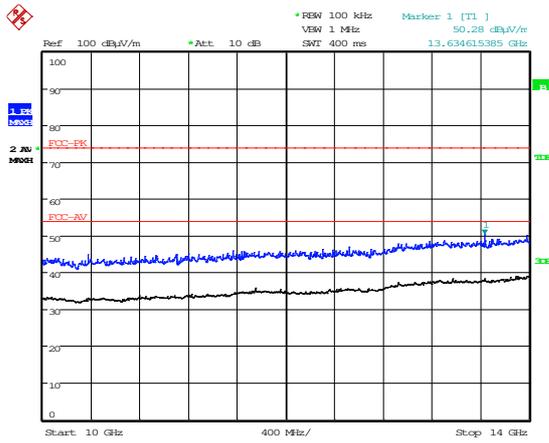


Date: 25.FEB.2014 11:04:30

7 GHz to 10 GHz

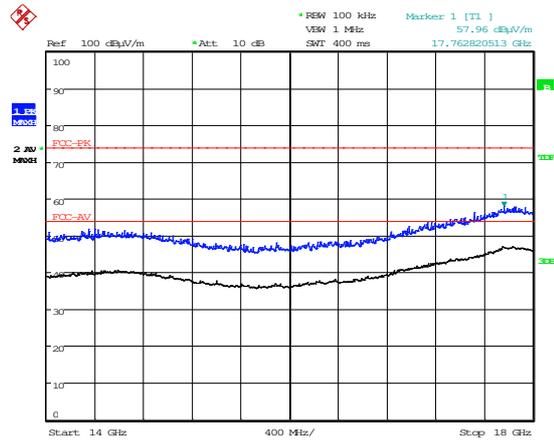
Radiated Spurious emissions

802.11g - 2462 MHz



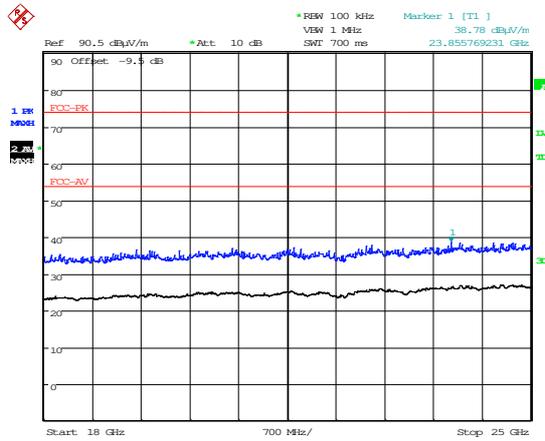
Date: 25.FEB.2014 11:03:38

10 GHz to 14 GHz



Date: 25.FEB.2014 11:02:45

14 GHz to 18 GHz

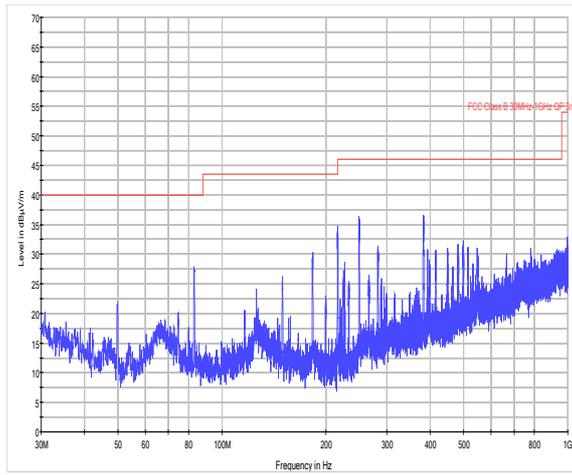


Date: 26.FEB.2014 16:53:35

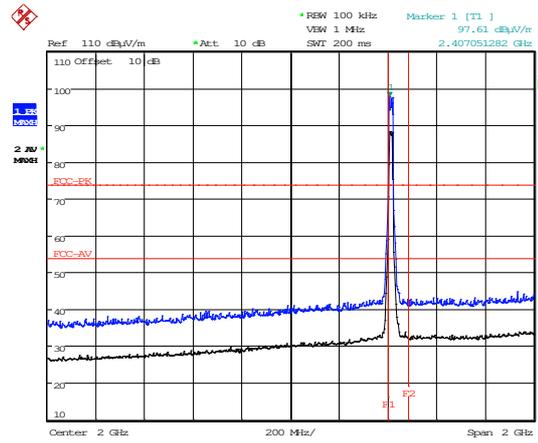
18 GHz to 25 GHz

Radiated Spurious emissions

802.11n HT20 - 2412 MHz

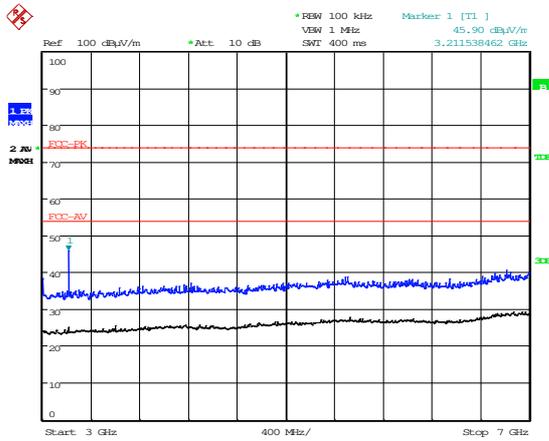


30 MHz to 1 GHz



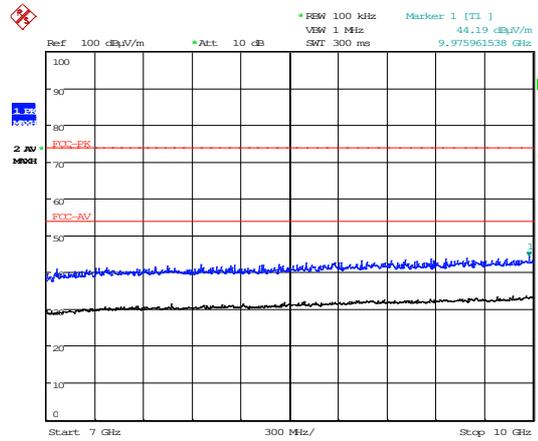
1 GHz to 3 GHz

Date: 25.FEB.2014 15:46:37



3 GHz to 7 GHz

Date: 25.FEB.2014 11:55:18

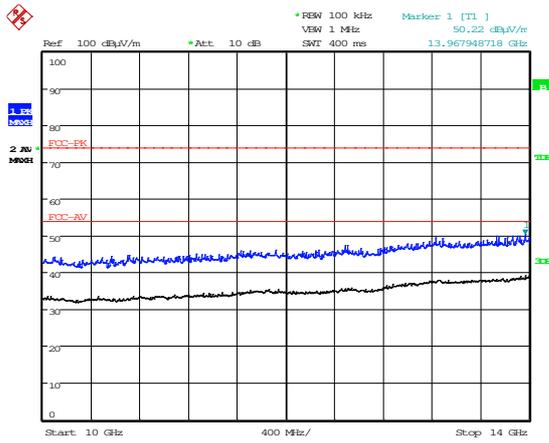


7 GHz to 10 GHz

Date: 25.FEB.2014 11:56:11

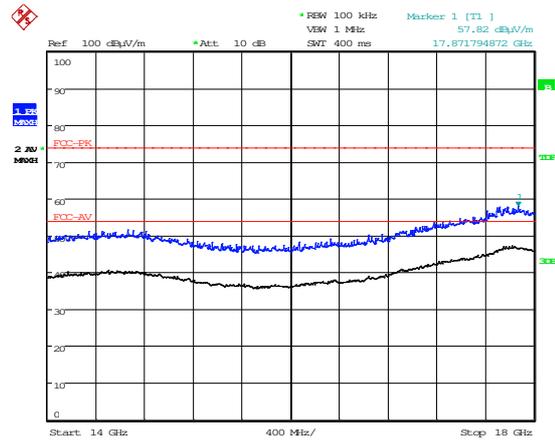
Radiated Spurious emissions

802.11n HT20 - 2412 MHz



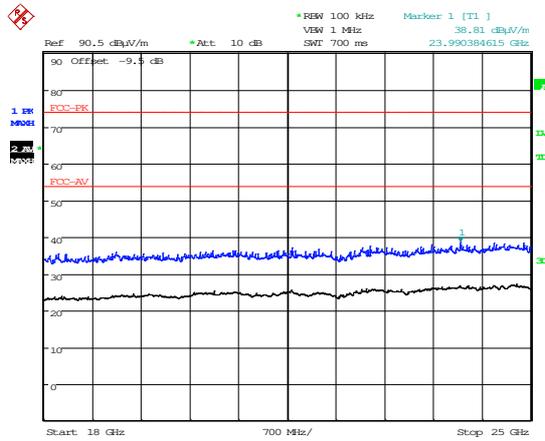
Date: 25.FEB.2014 11:56:59

10 GHz to 14 GHz



Date: 25.FEB.2014 11:57:50

14 GHz to 18 GHz

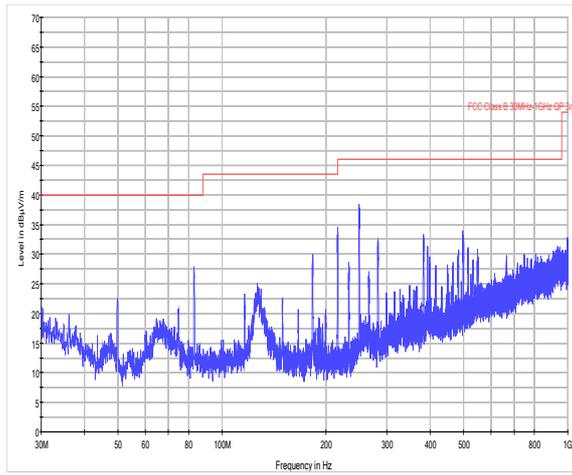


Date: 26.FEB.2014 17:10:57

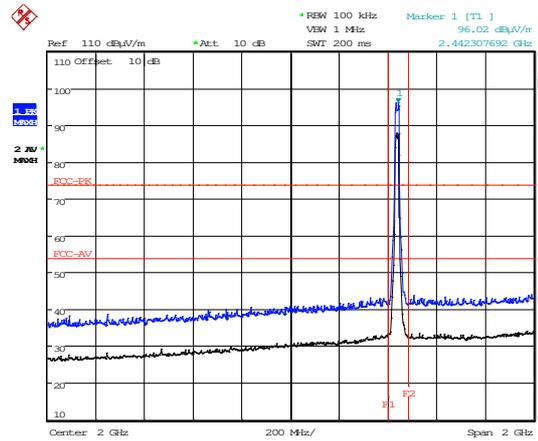
18 GHz to 25 GHz

Radiated Spurious emissions

802.11n HT20 - 2437 MHz

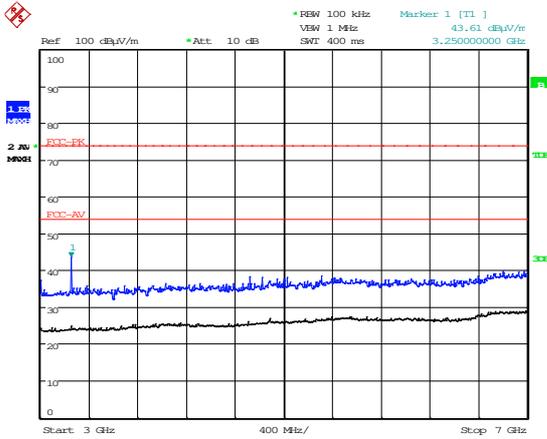


30 MHz to 1 GHz



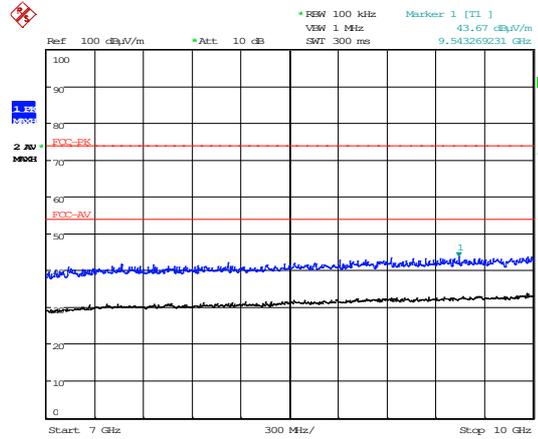
1 GHz to 3 GHz

Date: 25.FEB.2014 15:44:53



3 GHz to 7 GHz

Date: 25.FEB.2014 12:30:29

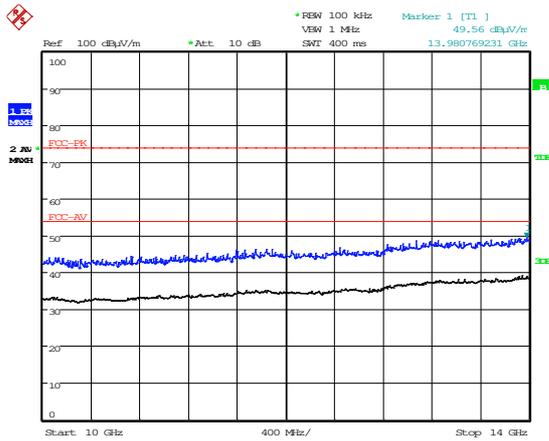


7 GHz to 10 GHz

Date: 25.FEB.2014 12:29:42

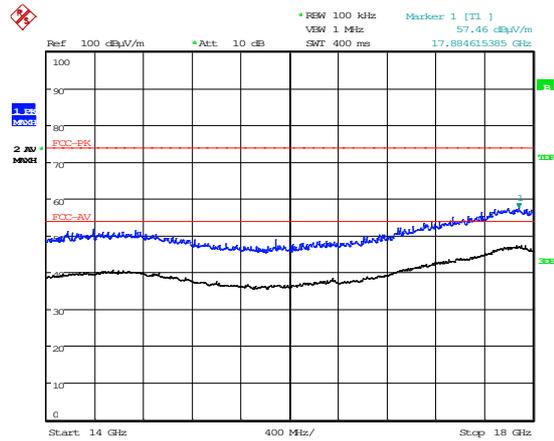
Radiated Spurious emissions

802.11n HT20 - 2437 MHz



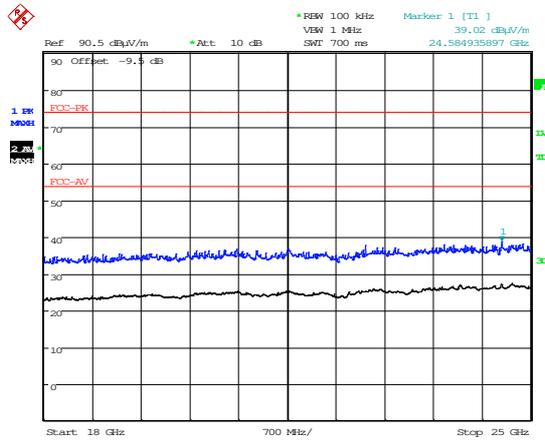
Date: 25.FEB.2014 12:28:55

10 GHz to 14 GHz



Date: 25.FEB.2014 12:28:07

14 GHz to 18 GHz

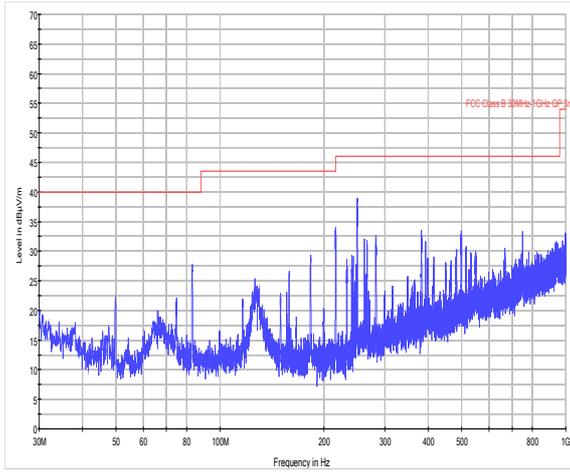


Date: 26.FEB.2014 17:10:12

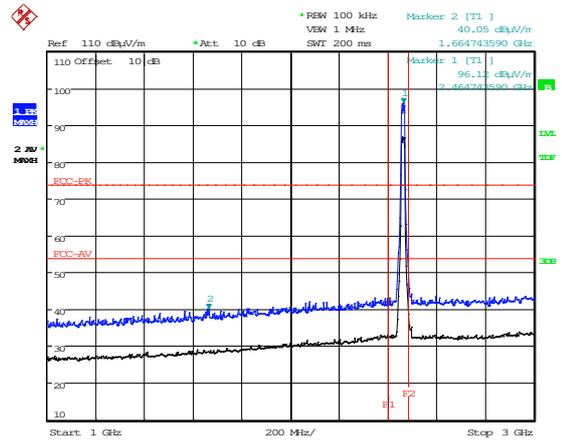
18 GHz to 25 GHz

Radiated Spurious emissions

802.11n HT40 - 2462 MHz

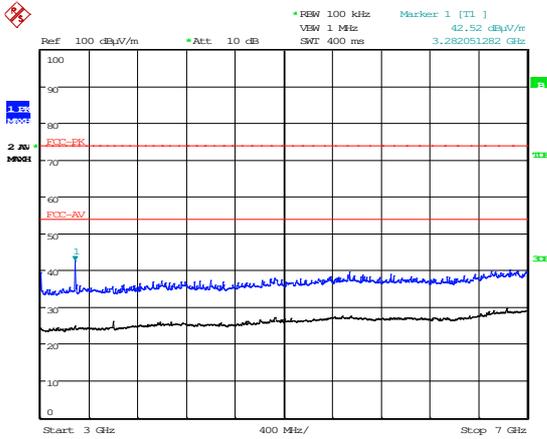


30 MHz to 1 GHz



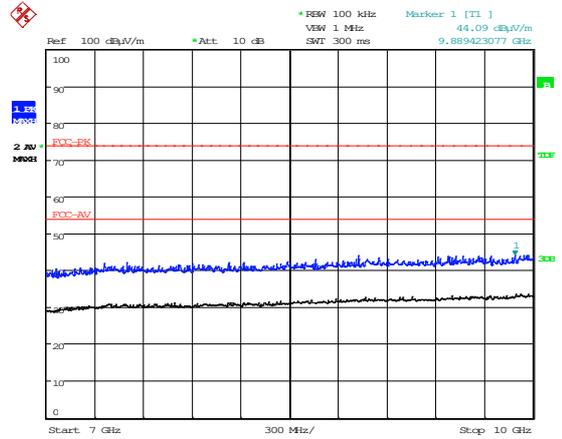
1 GHz to 3 GHz

Date: 25.FEB.2014 15:51:47



3 GHz to 7 GHz

Date: 25.FEB.2014 11:17:32

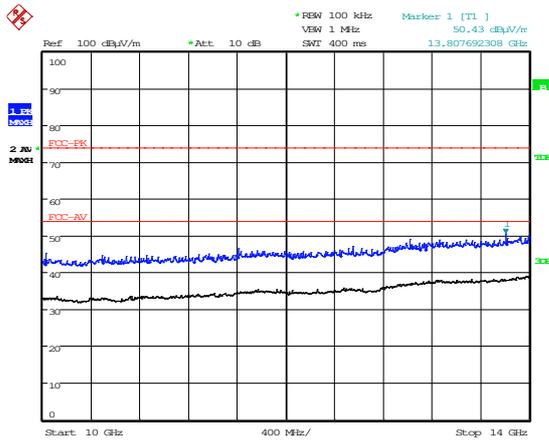


7 GHz to 10 GHz

Date: 25.FEB.2014 11:19:00

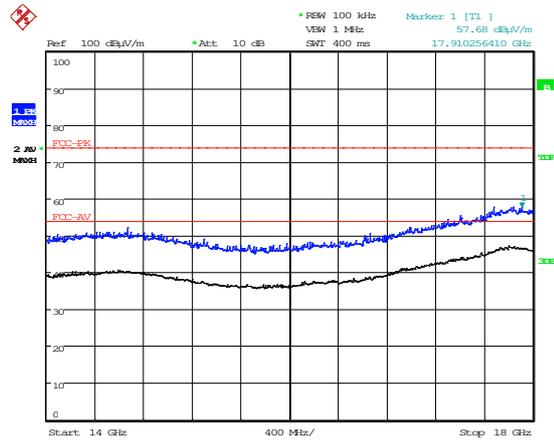
Radiated Spurious emissions

802.11n HT40 - 2462 MHz



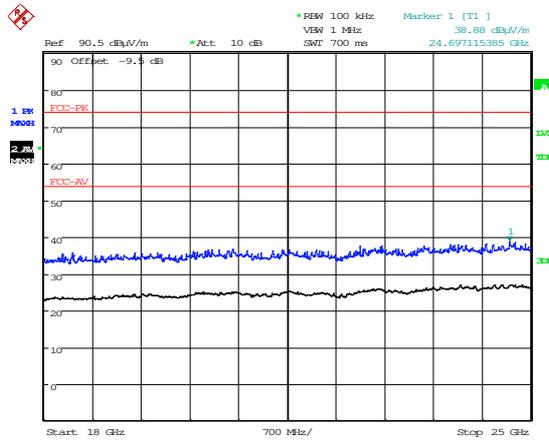
Date: 25.FEB.2014 11:19:53

10 GHz to 14 GHz



Date: 25.FEB.2014 11:20:50

14 GHz to 18 GHz

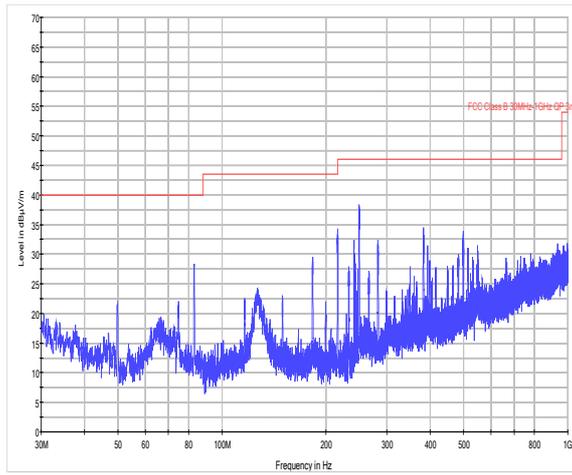


Date: 26.FEB.2014 17:09:26

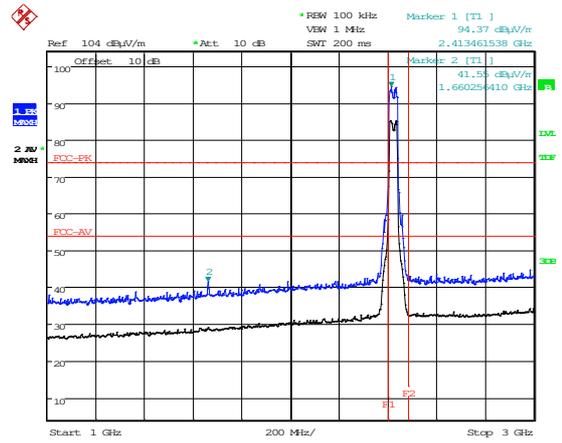
18 GHz to 25 GHz

Radiated Spurious emissions

802.11n HT40 - 2422 MHz

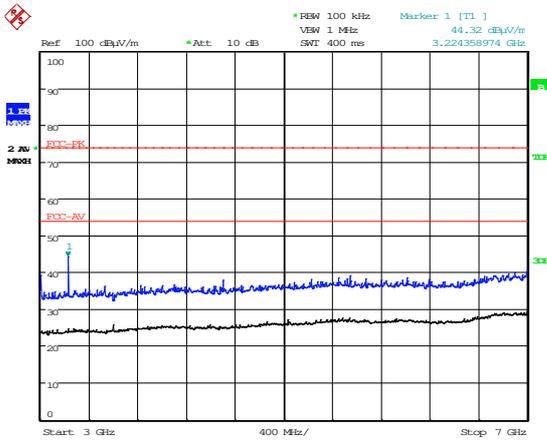


30 MHz to 1 GHz



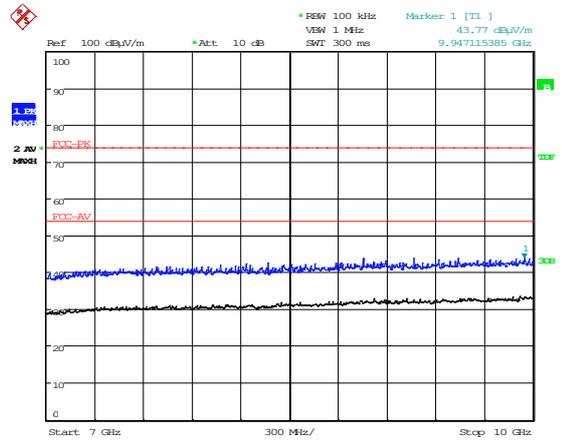
1 GHz to 3 GHz

Date: 25.FEB.2014 15:04:29



3 GHz to 7 GHz

Date: 25.FEB.2014 12:42:07

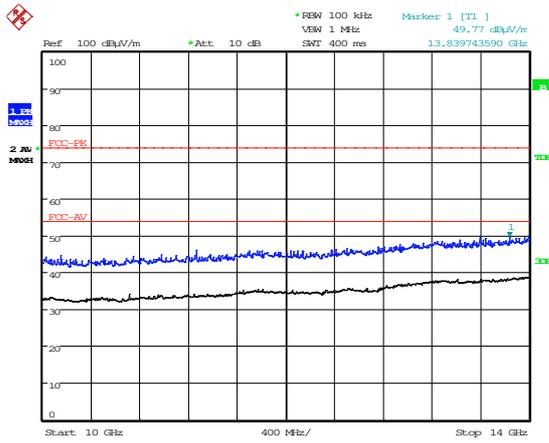


7 GHz to 10 GHz

Date: 25.FEB.2014 12:42:54

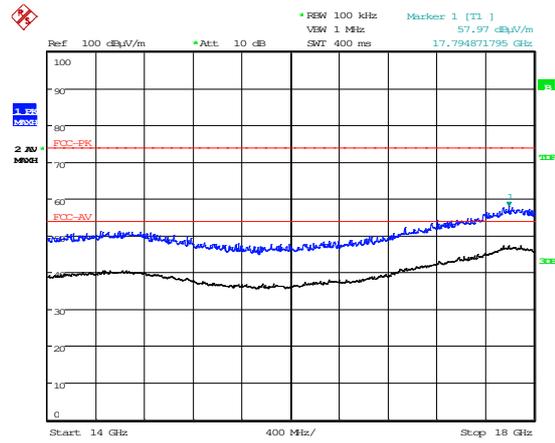
Radiated Spurious emissions

802.11n HT40 - 2422 MHz



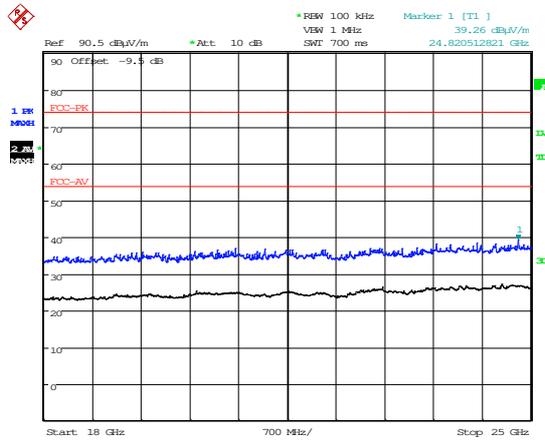
Date: 25.FEB.2014 12:43:48

10 GHz to 14 GHz



Date: 25.FEB.2014 12:44:37

14 GHz to 18 GHz

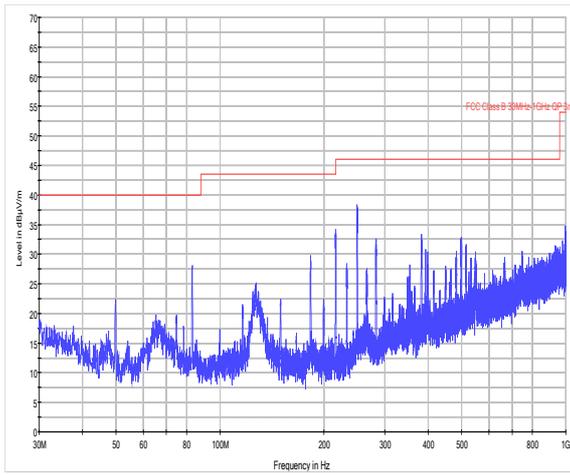


Date: 26.FEB.2014 17:12:18

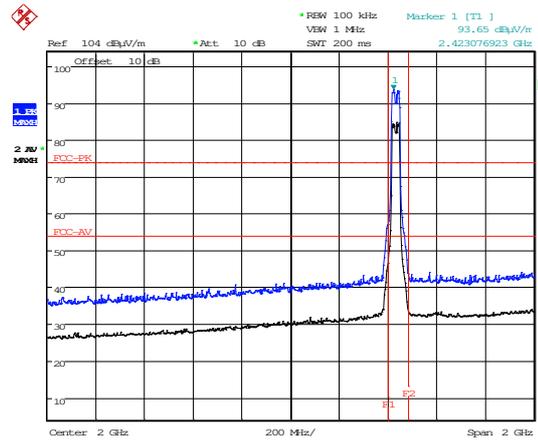
18 GHz to 25 GHz

Radiated Spurious emissions

802.11n HT40 - 2432 MHz

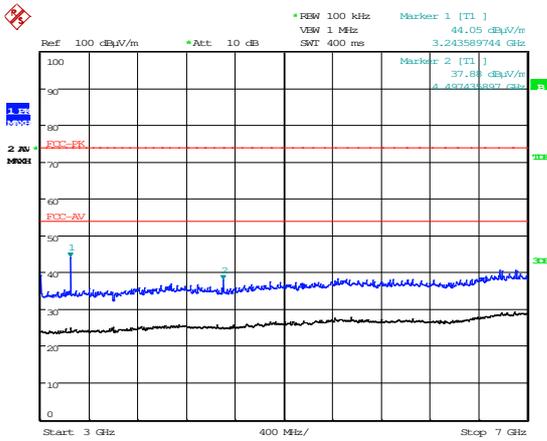


30 MHz to 1 GHz



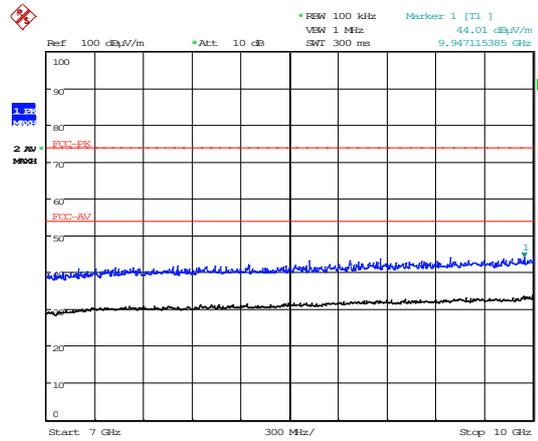
1 GHz to 3 GHz

Date: 25.FEB.2014 15:09:43



3 GHz to 7 GHz

Date: 25.FEB.2014 12:58:15

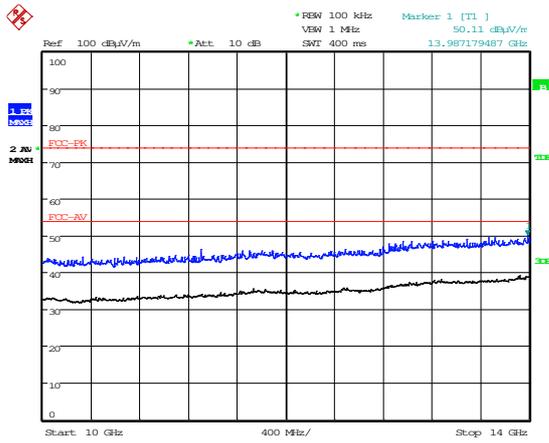


7 GHz to 10 GHz

Date: 25.FEB.2014 12:56:38

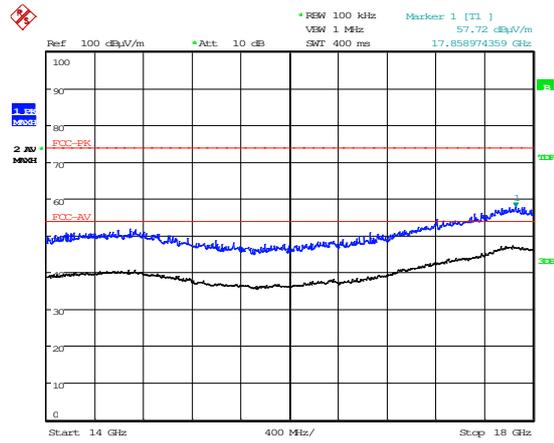
Radiated Spurious emissions

802.11n HT40 - 2432 MHz



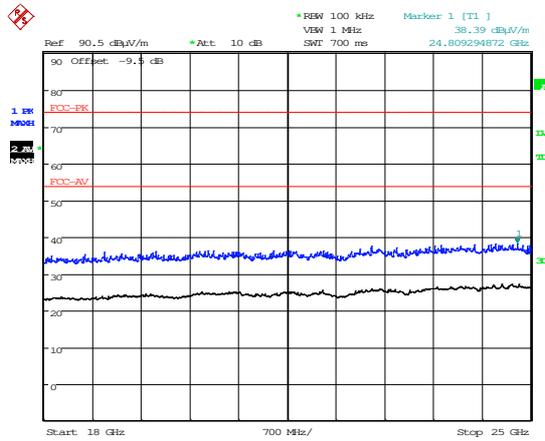
Date: 25.FEB.2014 12:55:51

10 GHz to 14 GHz



Date: 25.FEB.2014 12:54:59

14 GHz to 18 GHz

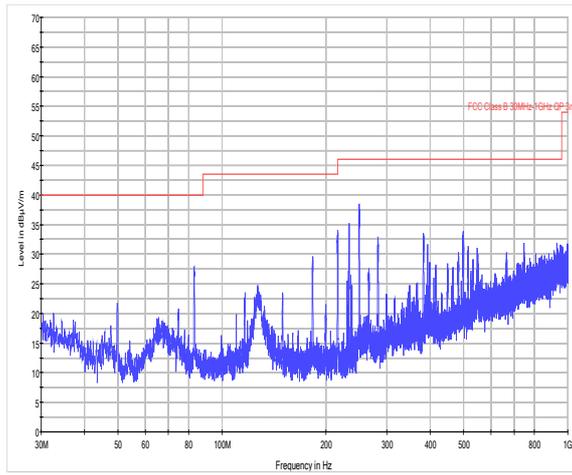


Date: 26.FEB.2014 17:13:04

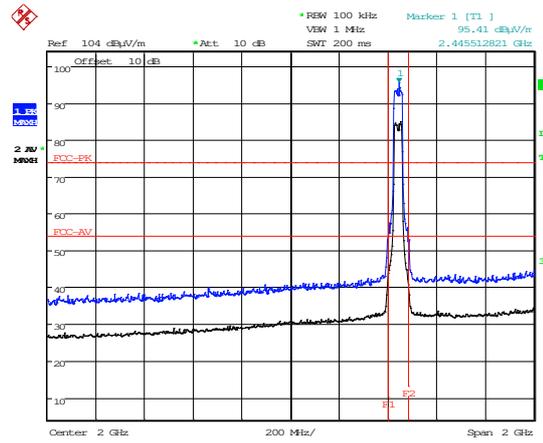
18 GHz to 25 GHz

Radiated Spurious emissions

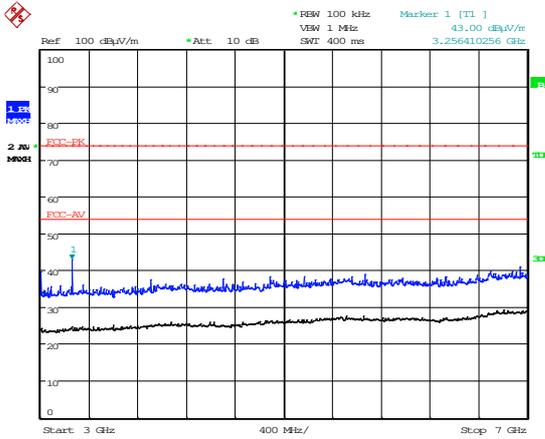
802.11n HT40 - 2442 MHz



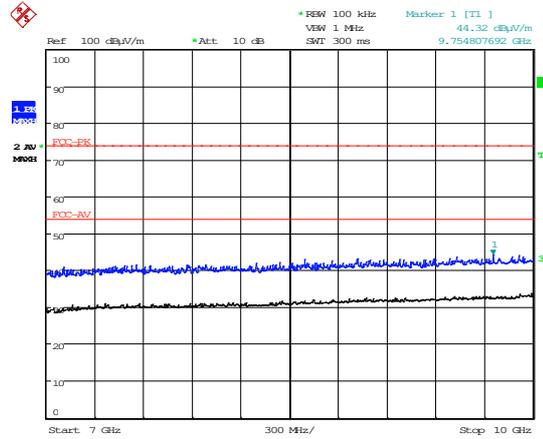
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz



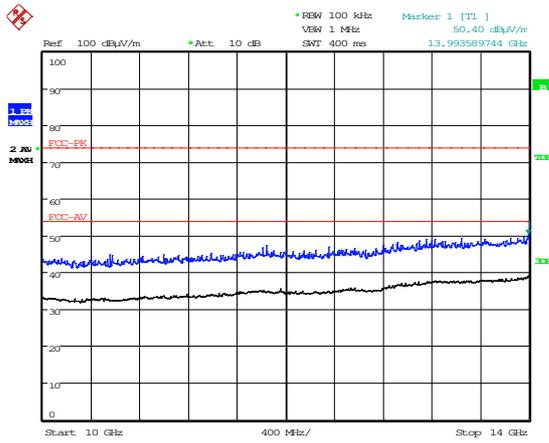
7 GHz to 10 GHz

Date: 25.FEB.2014 12:59:48

Date: 25.FEB.2014 13:00:35

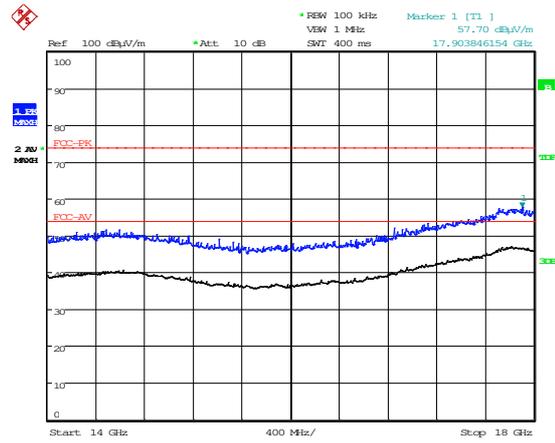
Radiated Spurious emissions

802.11n HT40 - 2442 MHz



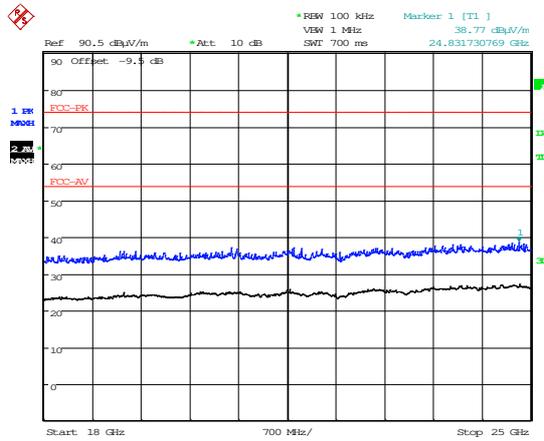
Date: 25.FEB.2014 13:01:22

10 GHz to 14 GHz



Date: 25.FEB.2014 13:03:07

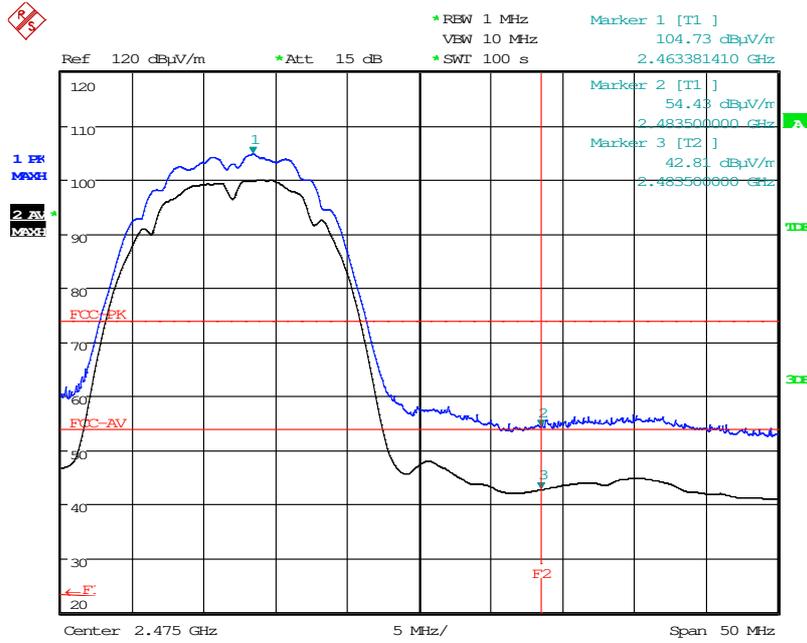
14 GHz to 18 GHz



Date: 26.FEB.2014 17:14:59

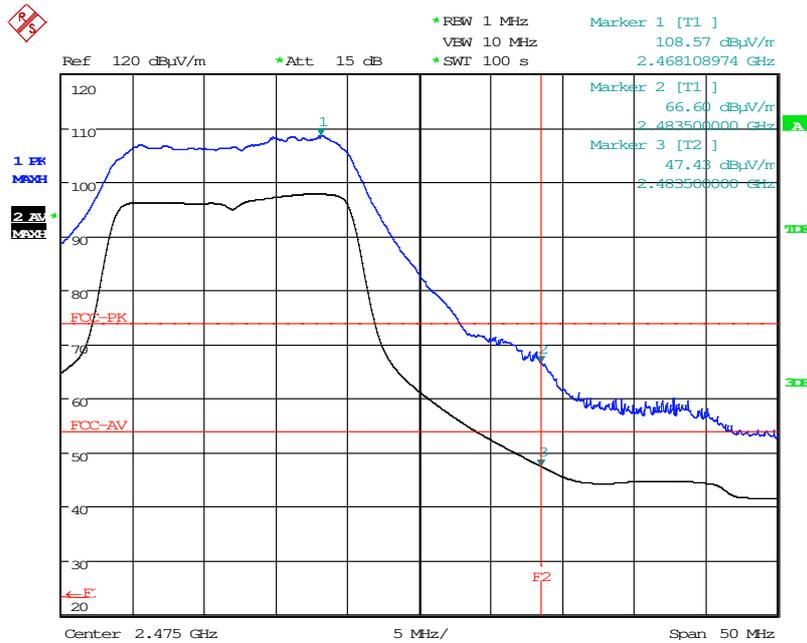
18 GHz to 25 GHz

Radiated band-edge compliance



Date: 24.FEB.2014 13:00:22

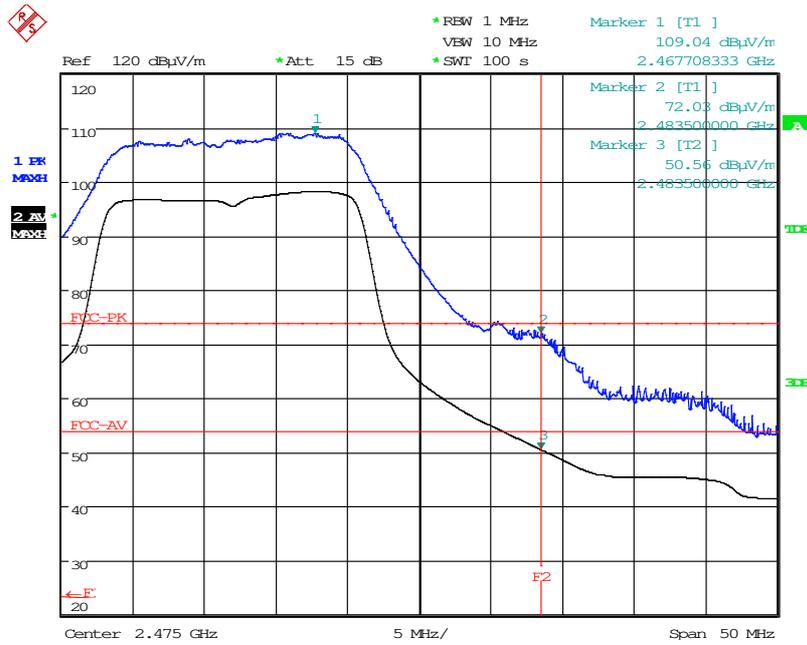
upper band-edge- 802.11b



Date: 24.FEB.2014 12:53:04

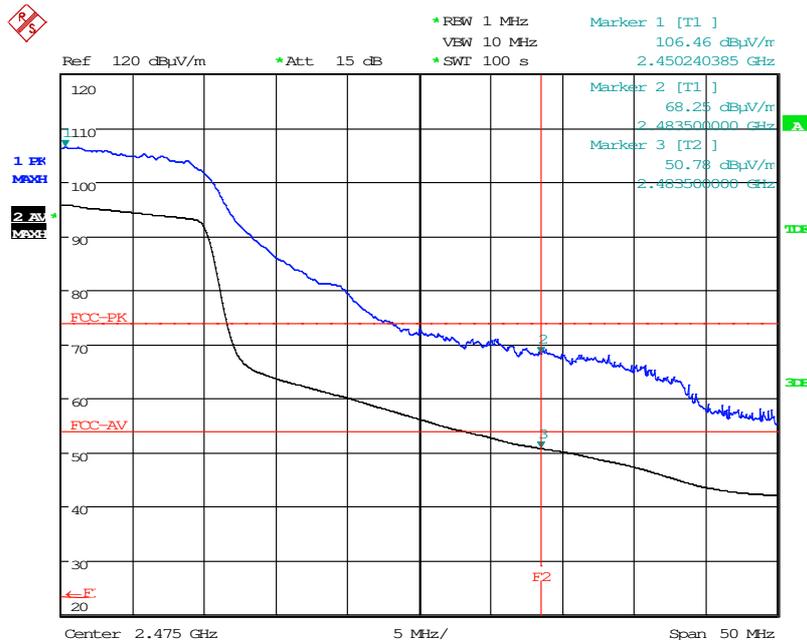
upper band-edge- 802.11g

Radiated band-edge compliance



Date: 24.FEB.2014 13:20:45

upper band-edge- 802.11n HT20

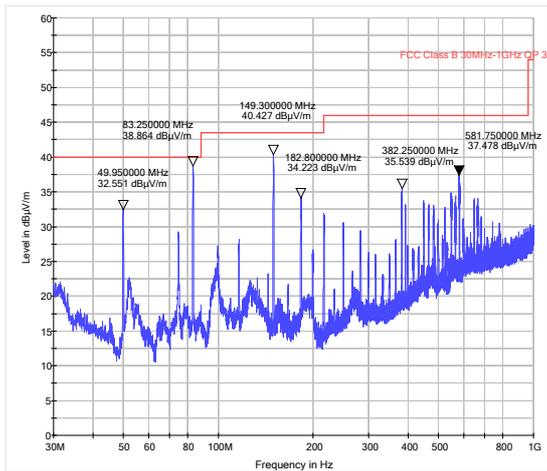


Date: 24.FEB.2014 14:00:02

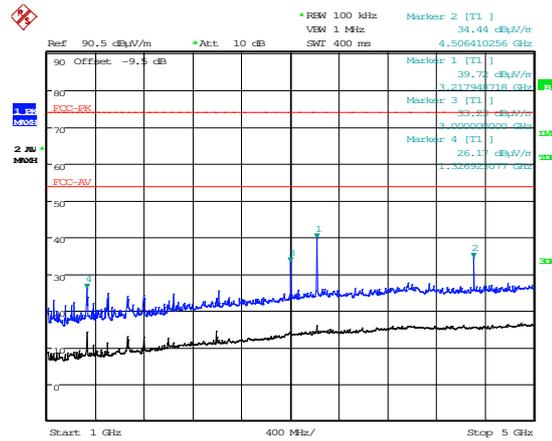
upper band-edge- 802.11n HT40

Unintentional Radiated Spurious emissions

2412 MHz

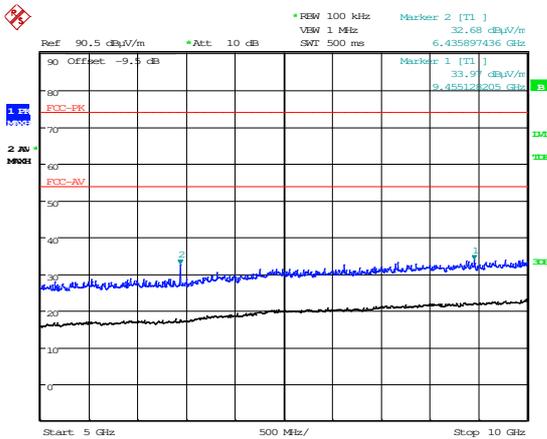


30 MHz to 1 GHz



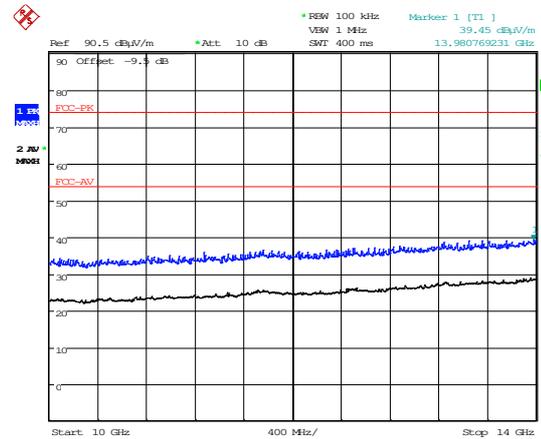
1 GHz to 5 GHz

Date: 25.FEB.2014 16:24:34



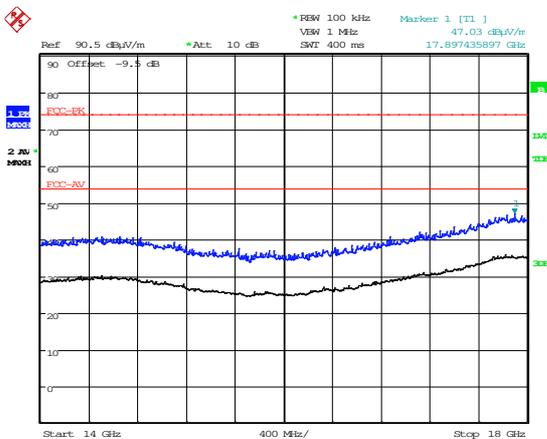
5 GHz to 10 GHz

Date: 25.FEB.2014 16:39:57



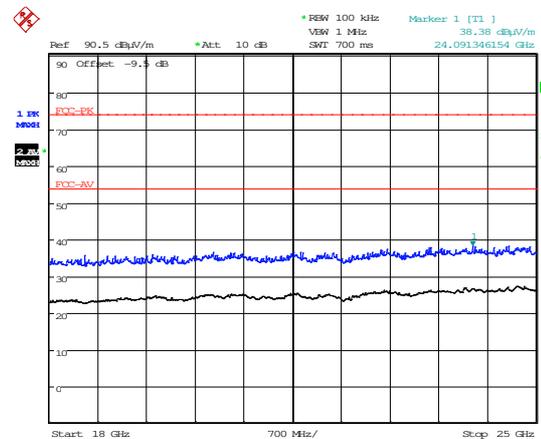
10 GHz to 14 GHz

Date: 25.FEB.2014 16:39:02



14 GHz to 18 GHz

Date: 25.FEB.2014 16:38:03

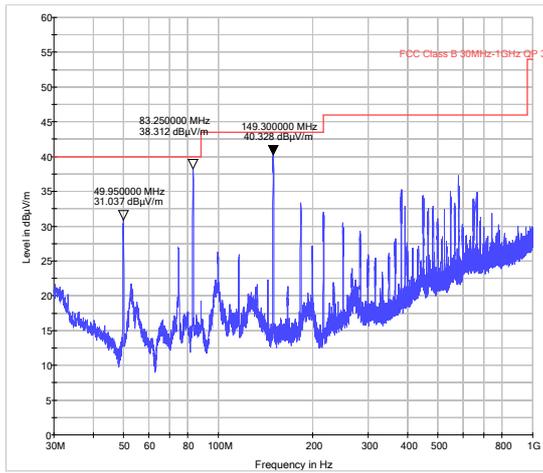


18 GHz to 25 GHz

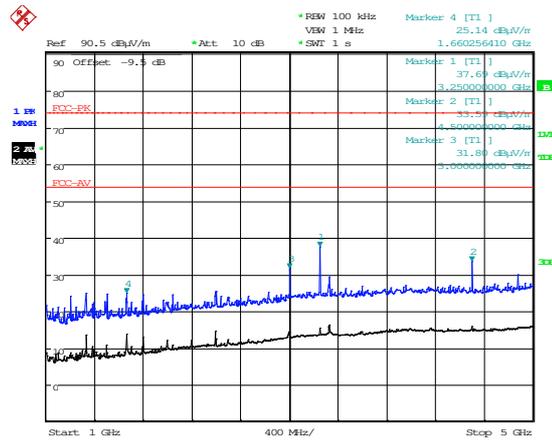
Date: 26.FEB.2014 17:28:52

Unintentional Radiated Spurious emissions

2437 MHz

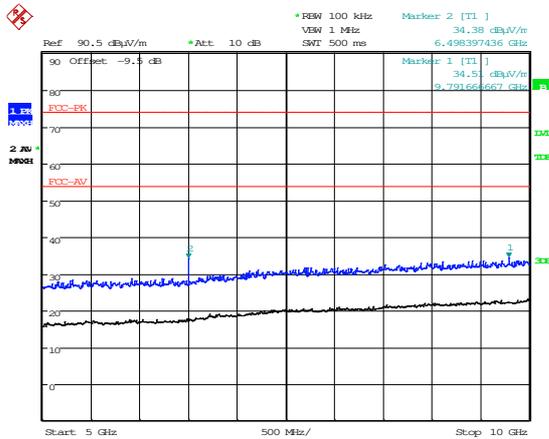


30 MHz to 1 GHz



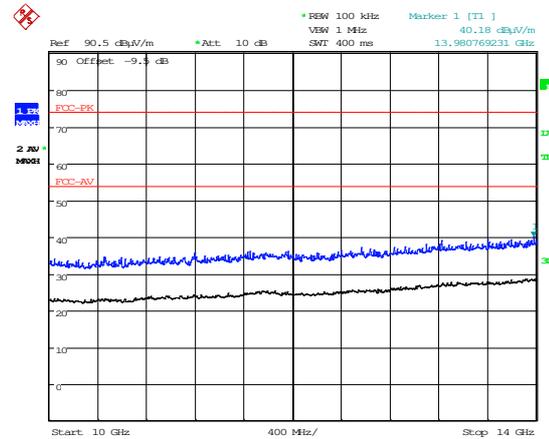
1 GHz to 5 GHz

Date: 26.FEB.2014 14:27:58



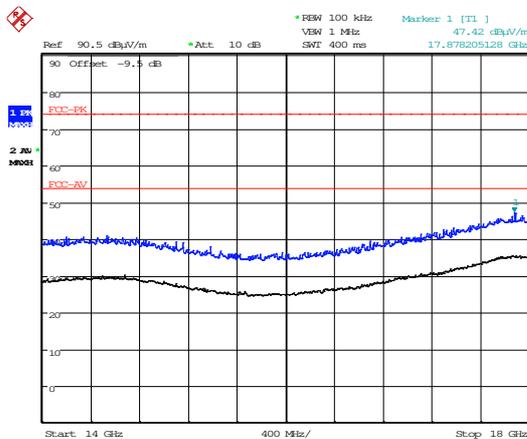
5 GHz to 10 GHz

Date: 25.FEB.2014 16:44:14



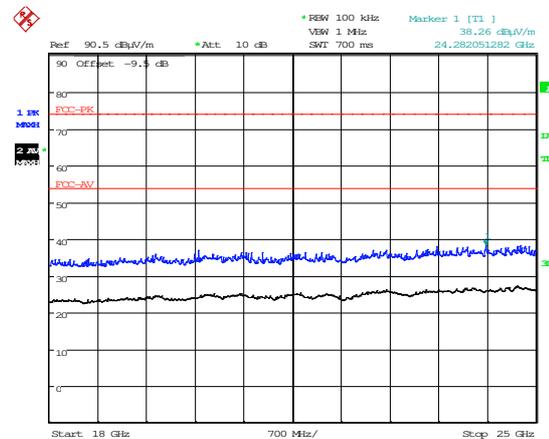
10 GHz to 14 GHz

Date: 25.FEB.2014 16:45:05



14 GHz to 18 GHz

Date: 25.FEB.2014 16:45:59

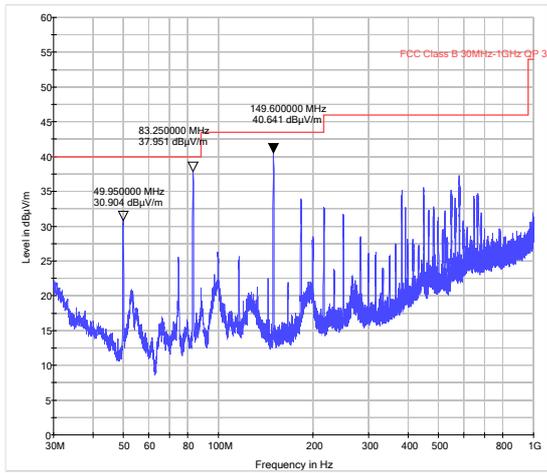


18 GHz to 25 GHz

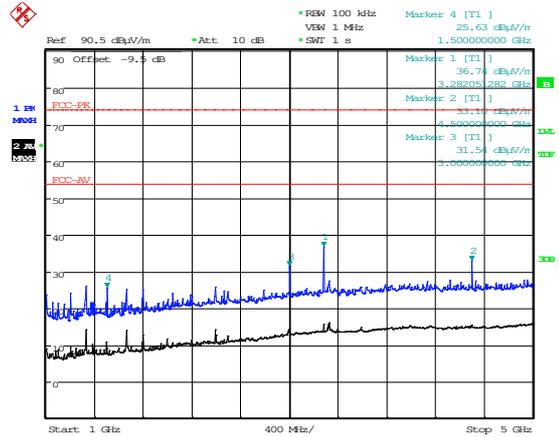
Date: 26.FEB.2014 17:27:50

Unintentional Radiated Spurious emissions

2462 MHz

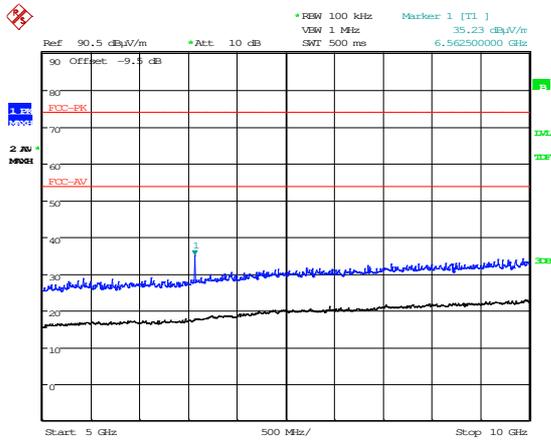


30 MHz to 1 GHz



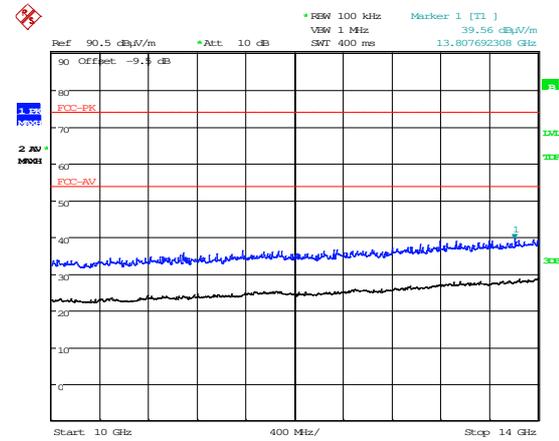
1 GHz to 5 GHz

Date: 26.FEB.2014 14:29:14



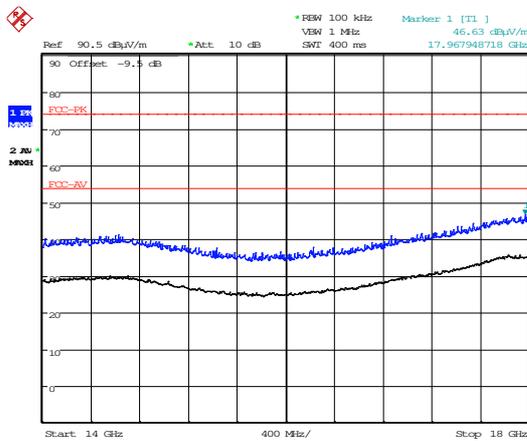
5 GHz to 10 GHz

Date: 25.FEB.2014 16:56:58



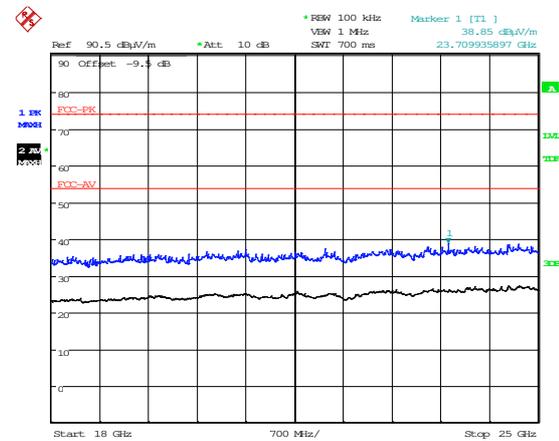
10 GHz to 14 GHz

Date: 25.FEB.2014 16:56:09



14 GHz to 18 GHz

Date: 25.FEB.2014 16:55:22

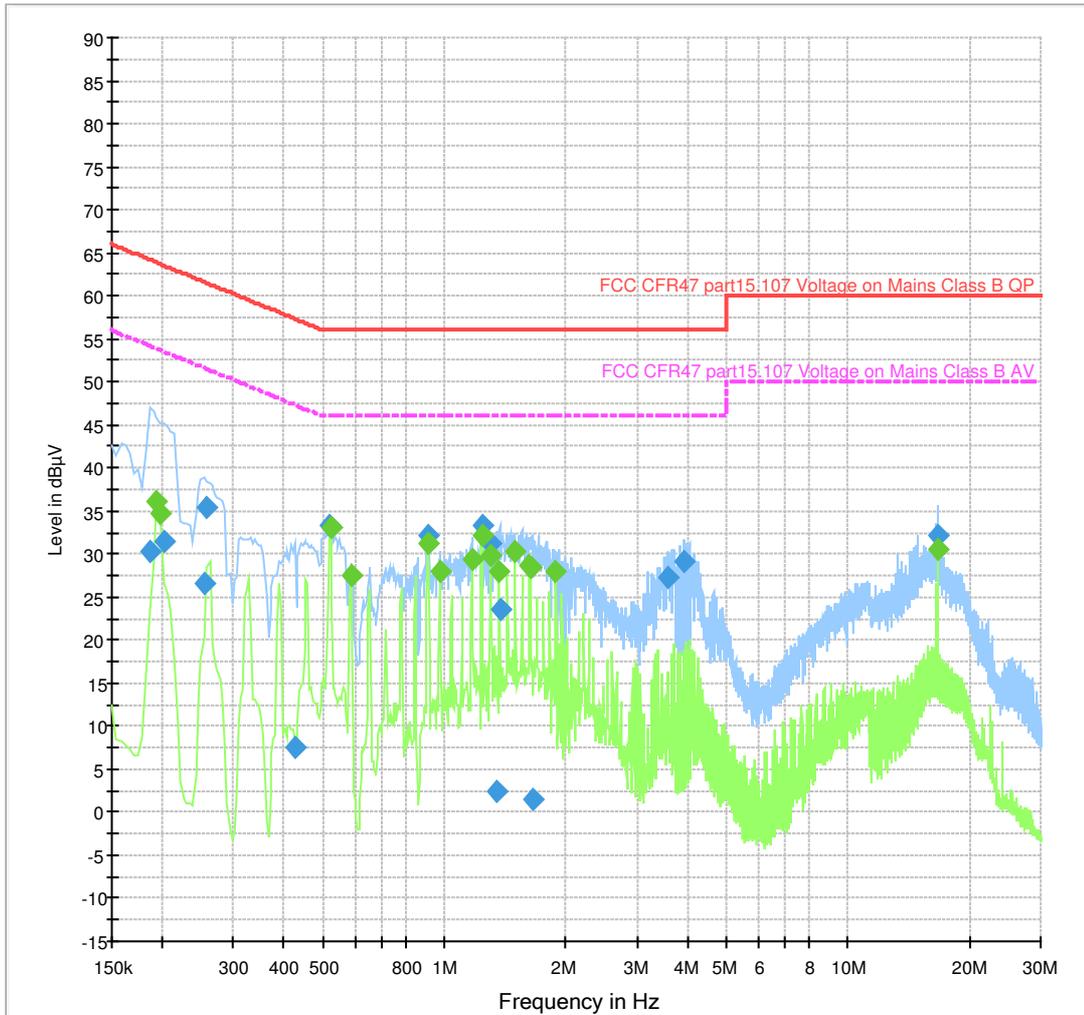


18 GHz to 25 GHz

Date: 26.FEB.2014 17:26:18

AC Powerline Conducted Emissions

Fcc Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH195 Rx prescans



Appendix C:**Additional Test and Sample Details**

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

Sample No: Sxx Mod w

where:

| | | |
|----|-----------------------|-----------|
| xx | = sample number | eg. S01 |
| w | = modification number | eg. Mod 2 |

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

- Positioning of cards in a chassis.
- Setting of any internal switches.
- Circuit board jumper settings.
- Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as "single possible configuration".

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

C1) Test samples

The following samples of the apparatus were submitted by the client for testing :

| Sample No. | Description | Identification |
|------------|-------------------------|----------------|
| S10 | SDIO Wi-Fi Module | None |
| S11 | Antenna | None |
| S09 | Module to Antenna Cable | None |

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

| Sample No. | Description | Identification |
|------------|-------------------|--------------------------|
| S01 | Dell Laptop | CH0OHN662-47890-535-A59A |
| S02 | Power Supply | 157-836-173-59 |
| S19 | SD Extender Cable | None |

The following samples of apparatus were supplied by TRaC Global as support or drive equipment (auxiliary equipment):

| Identification | Description |
|----------------|-------------|
| None | |
| | |
| | |

C2) EUT Operating Mode During Testing.

During testing, the EUT was exercised as described in the following tables :

| Test | Description of Operating Mode: |
|-----------------------|--|
| All Transmitter Tests | EUT active and transmitting at the required power level with the required data rate and modulation type. |

| Test | Description of Operating Mode: |
|--------------------------------------|----------------------------------|
| Receiver radiated spurious emissions | EUT active but non-transmitting. |

| Test | Description of Operating Mode: |
|------|--|
| PLCE | EUT transmitting a the data rate that produces highest output ower |

C3) EUT Configuration Information.

The EUT was submitted for testing in one single possible configuration.

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S10
Tests : Conducted

| Port | Description of Cable Attached | Cable length | Equipment Connected |
|--------------|-------------------------------|--------------|----------------------|
| Antenna | Coaxial | <1m | Measurement System |
| SD interface | SD extension (S09) | 10 cm | Support Laptop (S01) |

Sample : S01
Tests : Radiated Emissions

| Port | Description of Cable Attached | Cable length | Equipment Connected |
|--------------|-------------------------------|--------------|----------------------|
| Antenna | Coaxial | 10 cm | Antenna (S11) |
| SD interface | SD extension (S09) | 10 cm | Support Laptop (S01) |

* Only connected during setup.

C5 Details of Equipment Used

| Ref | Type | Description | Manufacturer | Date Calibrated |
|------------|---------------|-----------------------|---------------------|------------------------|
| REF940 | ATS | Ferrite Lined Chamber | Rainford EMC | 09/07/2013 |
| TRL138 | 3115 | 1-18GHz Horn Antenna | EMCO | 17/10/2013 |
| UH093 | CBL612B | Bilog Antenna | Chase | 08/07/2013 |
| UH281 | FSU46 | Spectrum Analyser | R&S | 26/03/2014 |
| TRL572 | 8449B | Pre-amplifier | Agilent | 11/02/2014 |
| UH004 | ESVS10 | E-field Receiver | R&S | 27/02/2014 |
| UH195 | ESH3-Z5.831.5 | LISN | R&S | 03/07/2013 |
| UH003 | ESHS10 | Receiver | R&S | 08/05/2013 |

Appendix D:

Additional Information

No additional information is included within this test report.

Appendix E: Calculation of the duty cycle correction factor

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB = $20 \times (\text{Log}_{10} \text{ Calculated Duty Cycle})$

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle = $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{100\text{ms}}$

e.g

$$= \frac{7.459\text{ms}}{100\text{ms}} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) = $20 \times (\text{Log}_{10} 0.07459) = -22.54\text{dB}$

Appendix F:

Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Overview.
2. Radiated electric field emissions arrangement: Close up.
3. AC Powerline Conducted Emissions Overview



Photograph 1



Photograph 3

Appendix G:**MPE Calculation**

KDB 447498

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1mW/cm² power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

Equation from KDB 447498

$$S = \frac{EIRP}{4\pi R^2} \text{ re - arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note:

The EIRP was calculated by addition of the maximum carrier power reported in A2 and the Antenna gain stated in A7.

Result

| Prediction Frequency (MHz) | Maximum EIRP (mW) | Power density limit (S) (mW/cm ²) | Distance (R) cm required to be less than 1mW/cm ² |
|----------------------------|-------------------|---|--|
| 2422 | 121.89 | 1 | 3.2 |

