A RADIO TEST REPORT

FOR

ICON RESEARCH LTD

ON

WIFI 802.11 SDIO module

DOCUMENT NO. TRA-011510-05-47-01-B

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UKAS TESTING
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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**
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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.

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1.2 Tests Requested By

This testing in this report was requested by :

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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
CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
ANSI : American National Standards Institution
PLCE : Power Line Conducted 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
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

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 accordance15.33 (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):

The limit in 100 kHz RBW = (Maximum Peak Conducted Carrier)-20dB

A5 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric filed 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 : [X]

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:

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

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 dBμV	
	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 : [X]

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 (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	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.

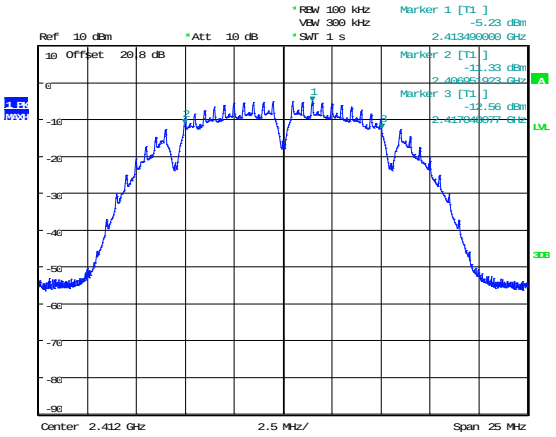
(b) The time and date on the plots do not necessarily equate to the time of the test.

(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

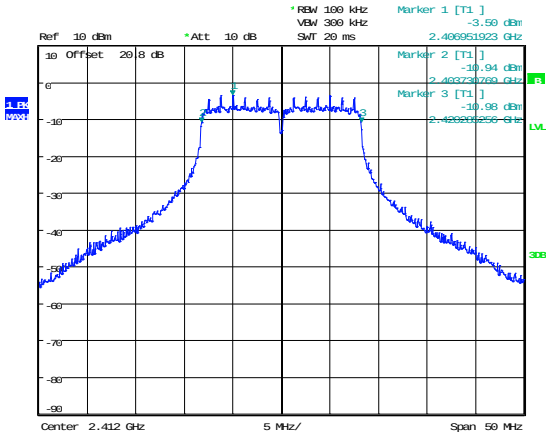
(d) Appendix C details the numbering system used to identify the sample and its modification state.

(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.

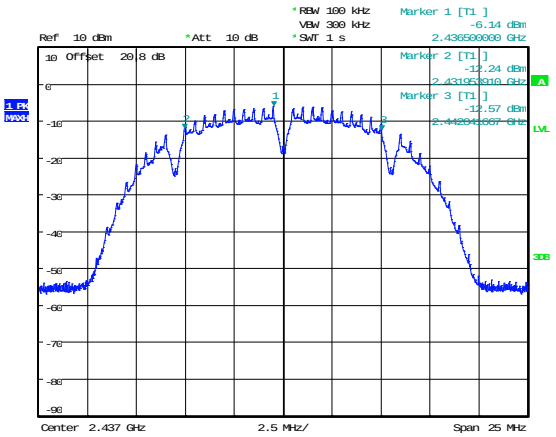
6dB Bandwidth -



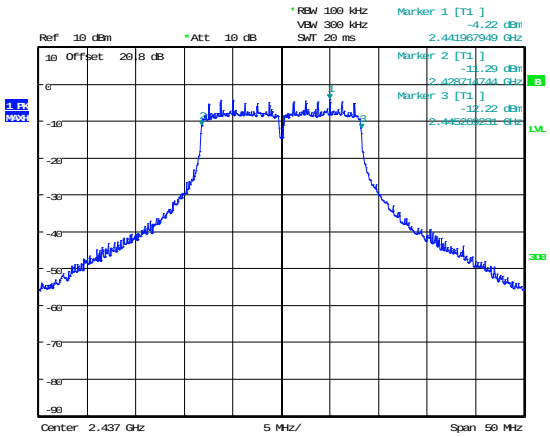
802.11b Channel 1



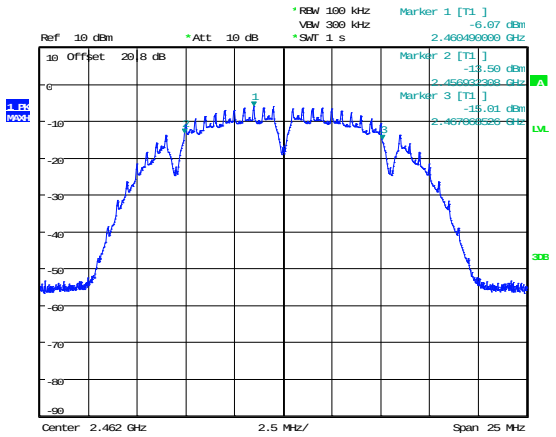
802.11g Channel 1



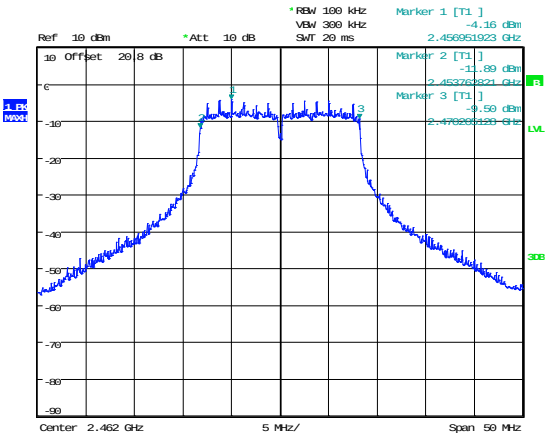
802.11b Channel 6



802.11g Channel 6

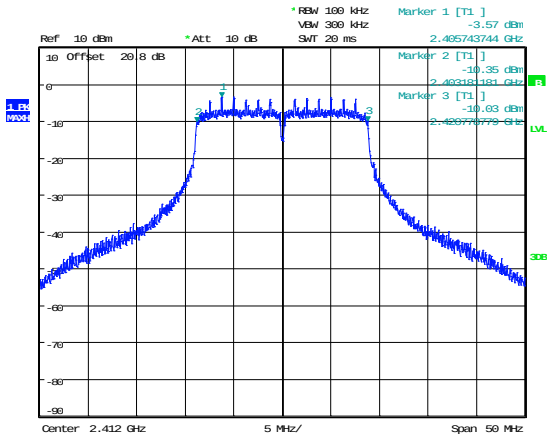


802.11b Channel 11

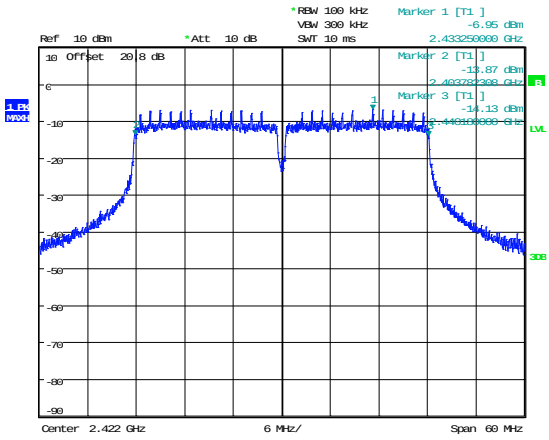


802.11g Channel 11

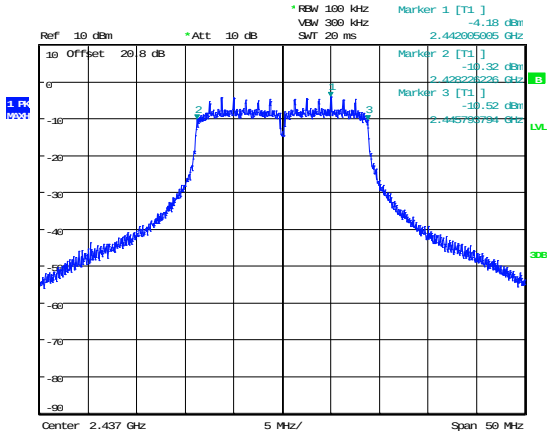
6dB Bandwidth



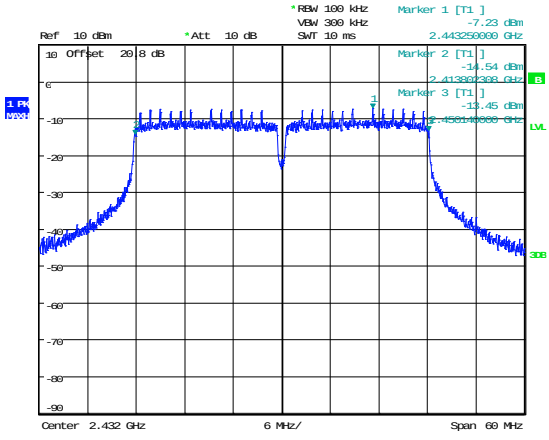
802.11n HT20 Channel 1



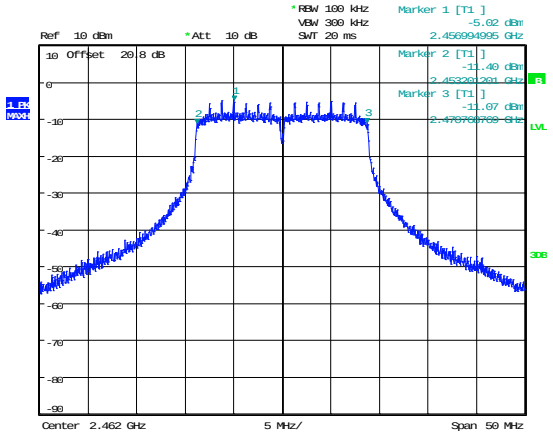
802.11n HT40 Channel 3



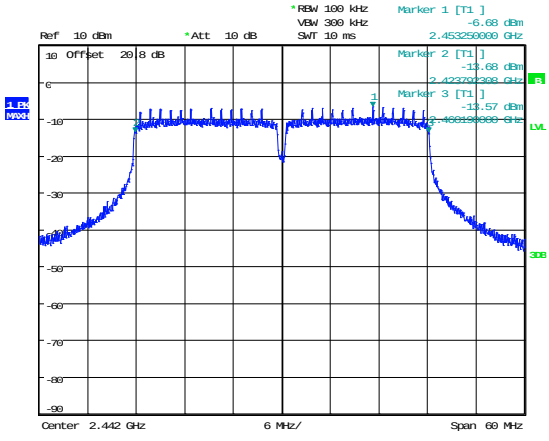
802.11n HT20 Channel 6



802.11n HT40 Channel 5

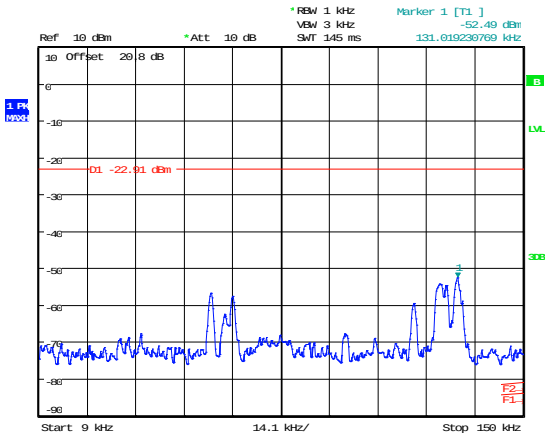


802.11n HT20 Channel 11



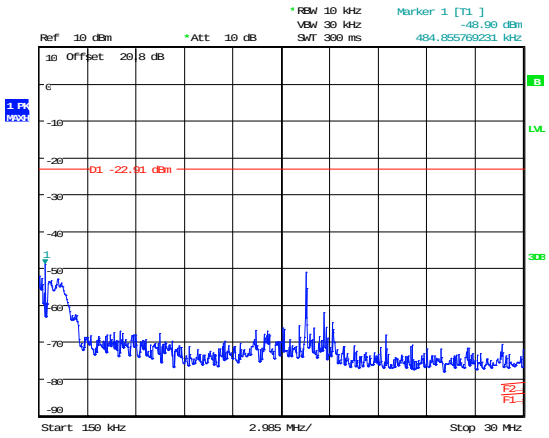
802.11n HT40 Channel 7

Conducted Spurious emissions 802.11b - 2412 MHz



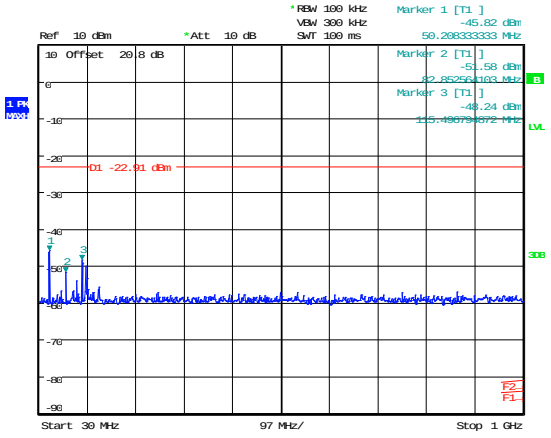
Date: 17.MAR.2014 15:21:02

9kHz – 150 kHz



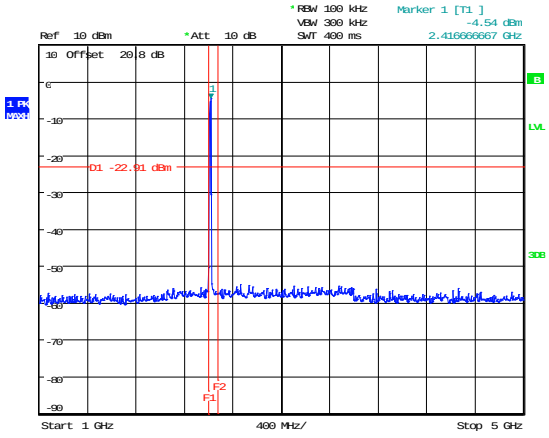
Date: 17.MAR.2014 15:21:26

150kHz – 30 MHz



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

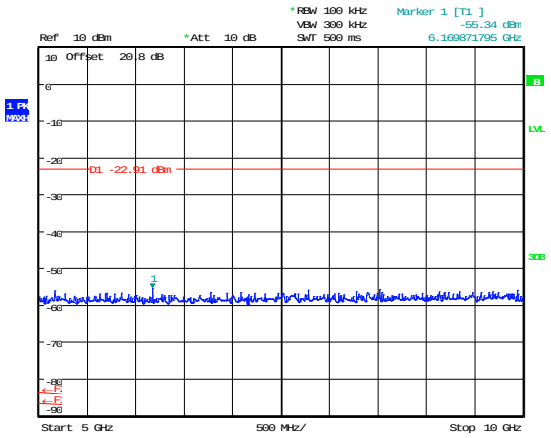
30 MHz to 1 GHz



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

1 GHz to 5 GHz

Conducted Spurious emissions 802.11b - 2412 MHz



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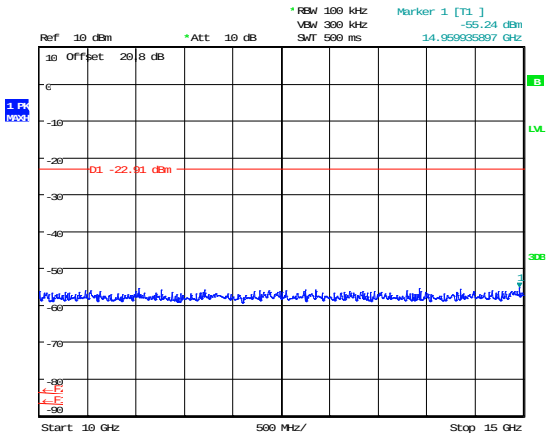
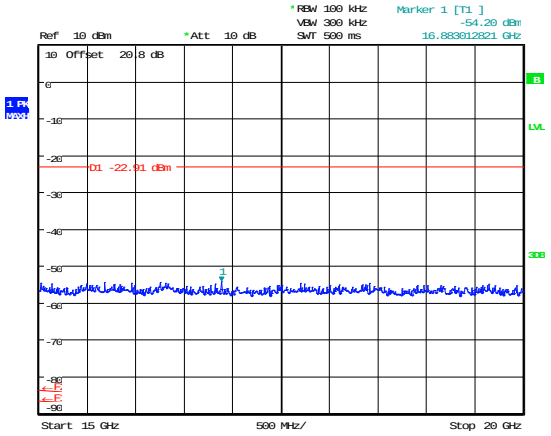
5 GHz to 10 GHz



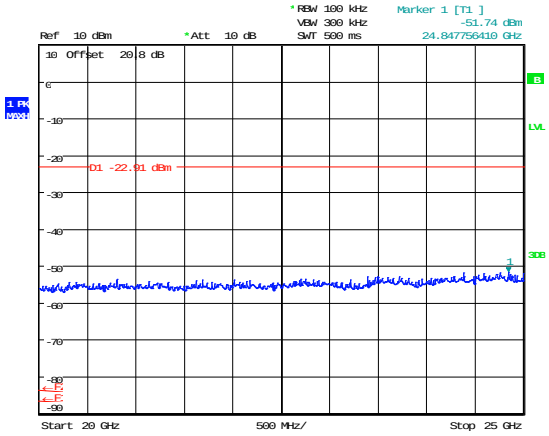
Date: 17.MAR.2014 15:19:54

10 GHz to 15 GHz



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

15 GHz to 20 GHz



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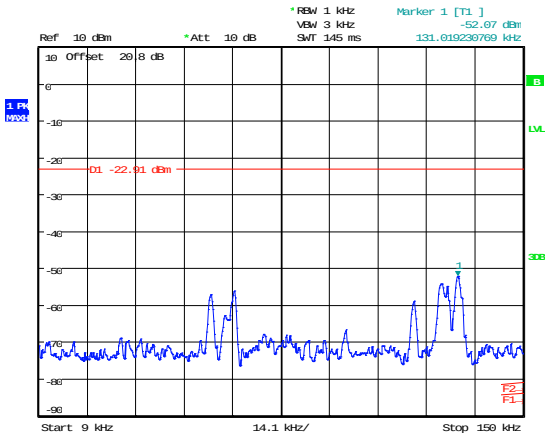
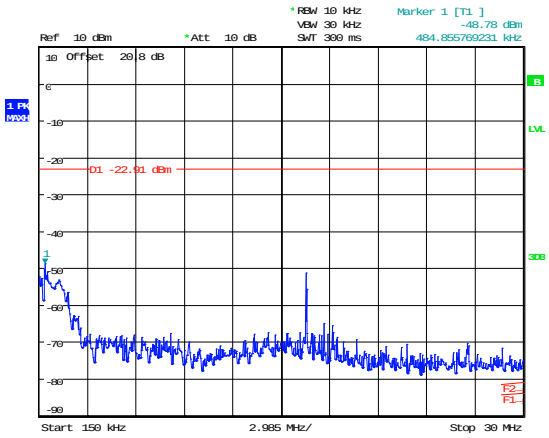
20 GHz to 25 GHz

Conducted Spurious emissions 802.11b - 2437 MHz



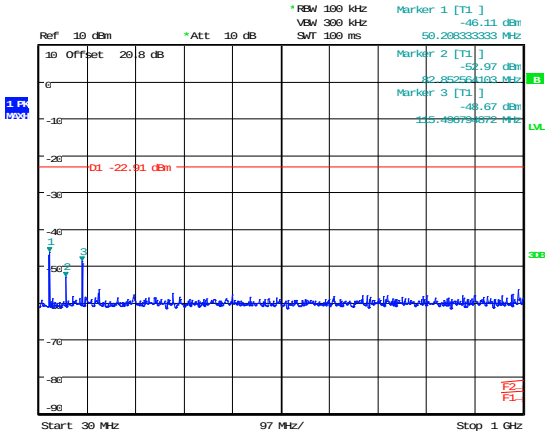
Date: 17.MAR.2014 15:22:55

9kHz – 150 kHz



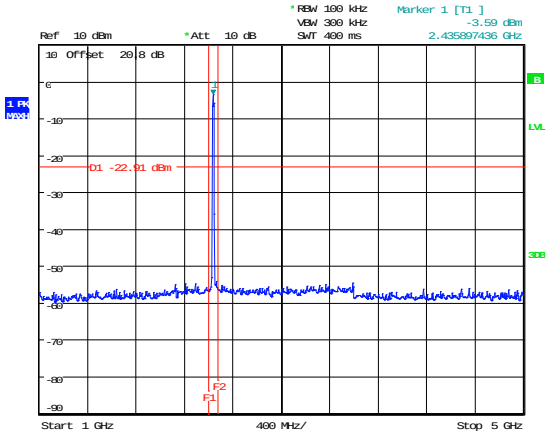
Date: 17.MAR.2014 15:23:14

150kHz – 30 MHz



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

30 MHz to 1 GHz



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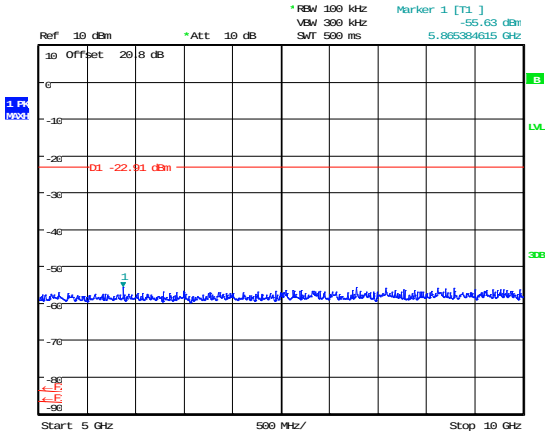
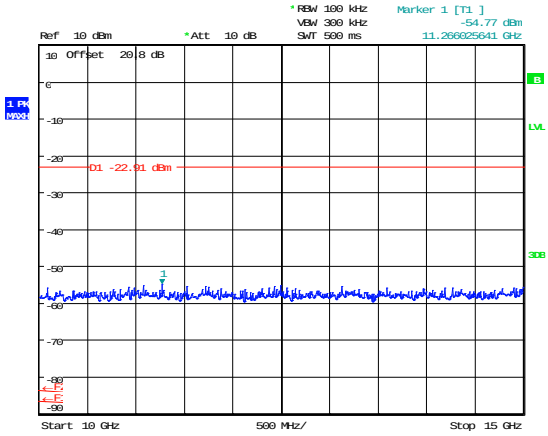
1 GHz to 5 GHz

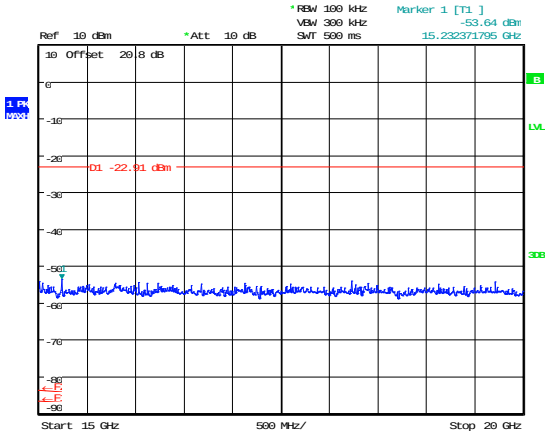
Conducted Spurious emissions 802.11b - 2437 MHz



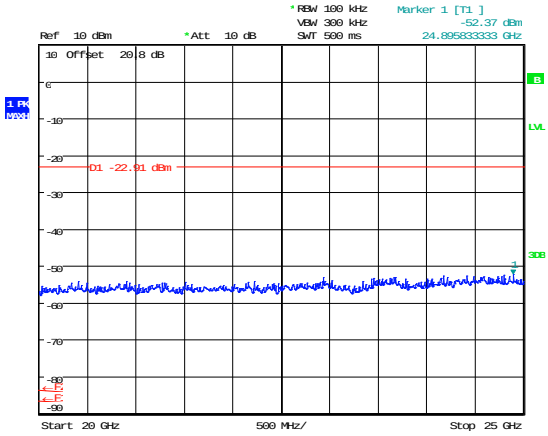
5 GHz to 10 GHz



10 GHz to 15 GHz

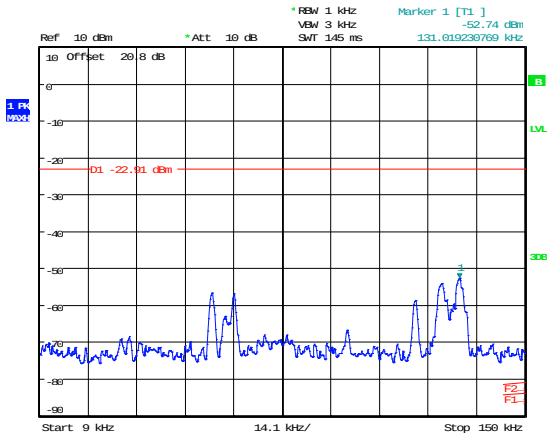


15 GHz to 20 GHz



20 GHz to 25 GHz

Conducted Spurious emissions 802.11b - 2462 MHz



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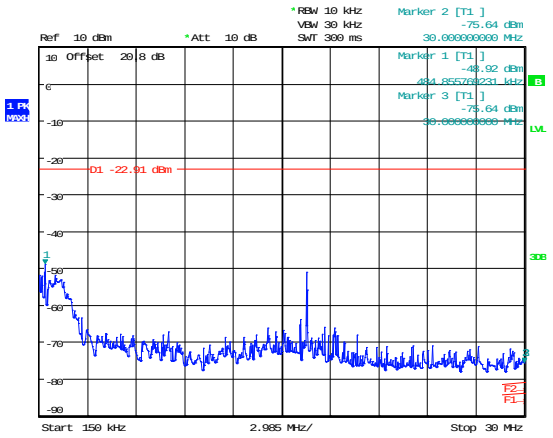
9kHz – 150 kHz



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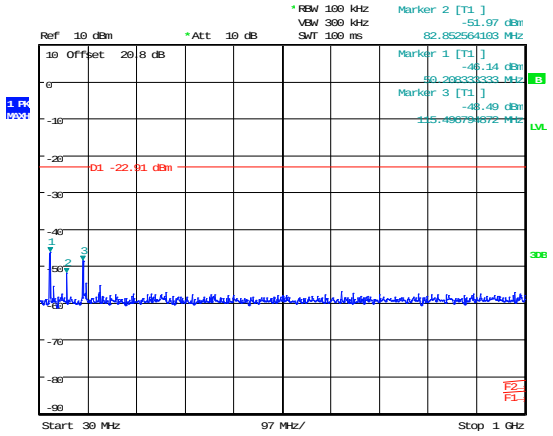
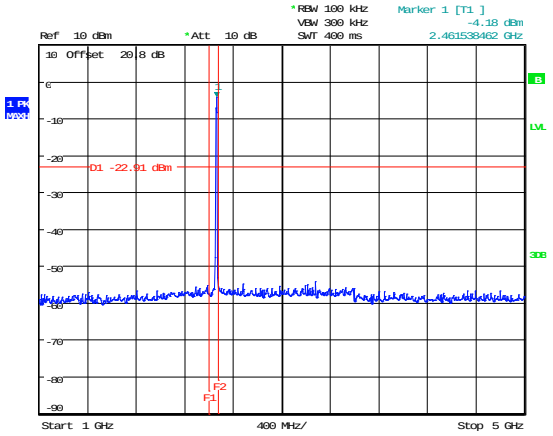
150kHz – 30 MHz



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

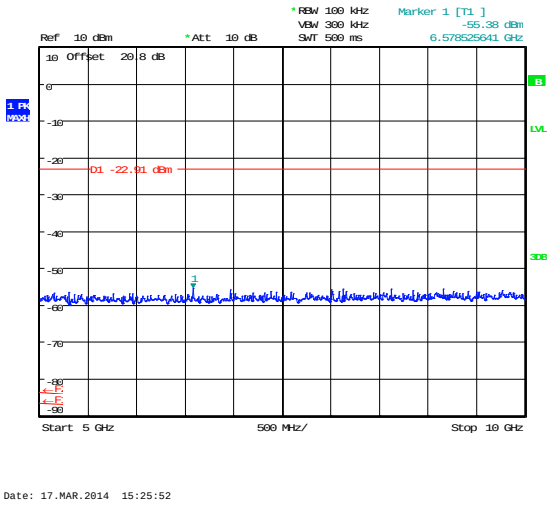
30 MHz to 1 GHz



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

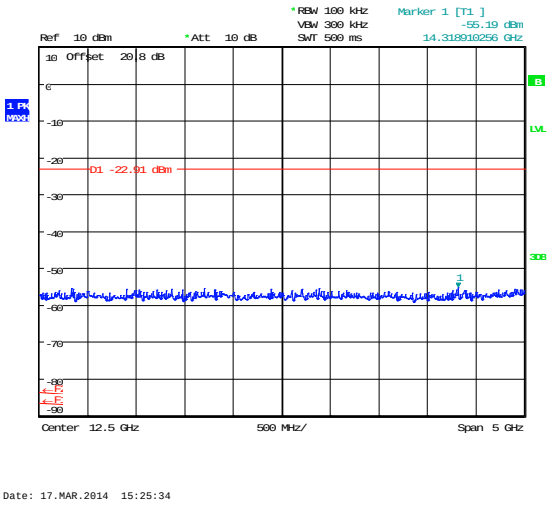
1 GHz to 5 GHz

Conducted Spurious emissions 802.11b - 2462 MHz



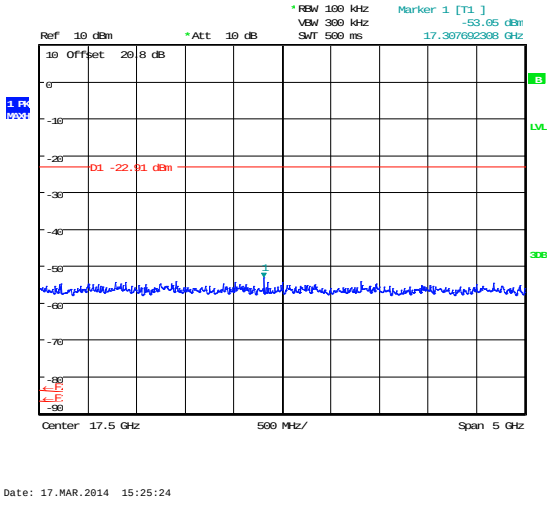
Date: 17.MAR.2014 15:25:52

5 GHz to 10 GHz



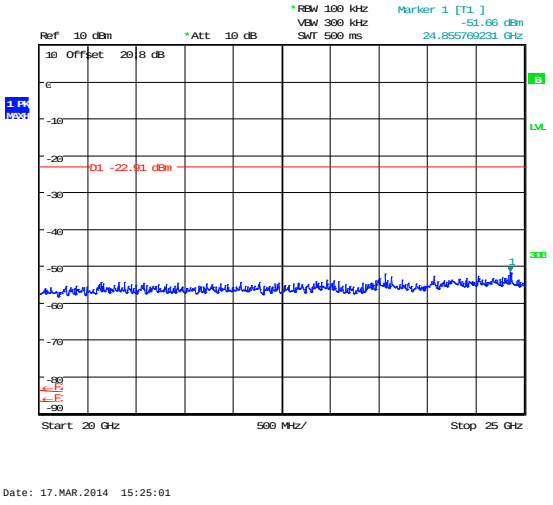
Date: 17.MAR.2014 15:25:34

10 GHz to 15 GHz



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

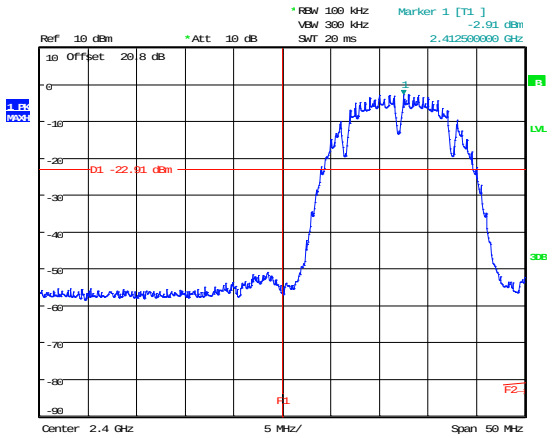
15 GHz to 20 GHz



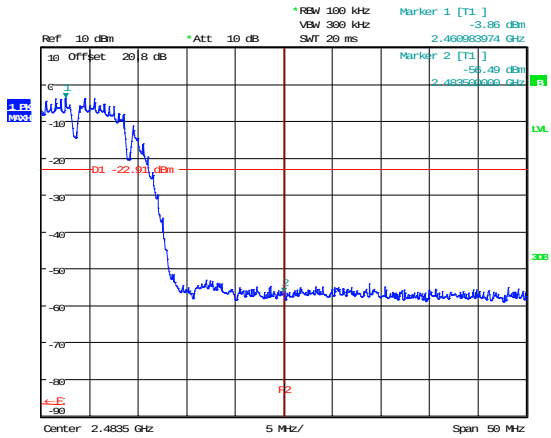
Date: 17.MAR.2014 15:25:01

20 GHz to 25 GHz

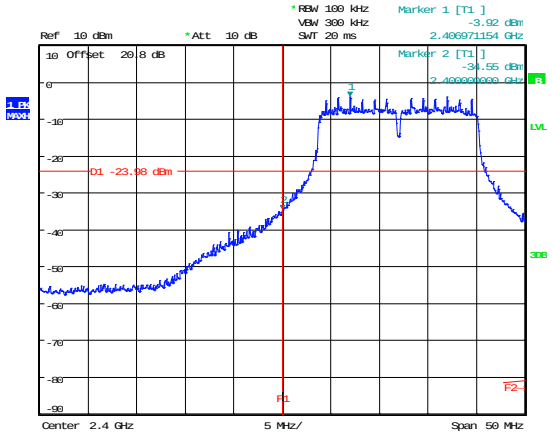
Conducted band-edge compliance



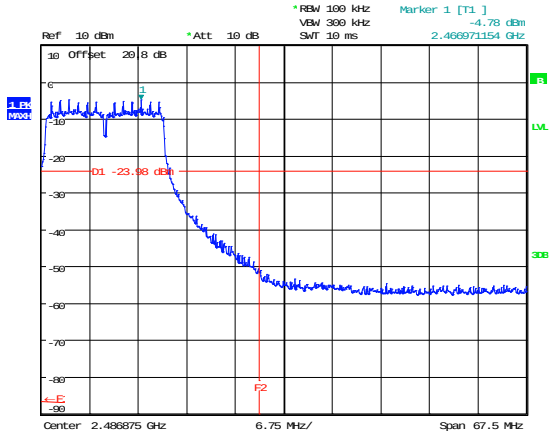
lower band edge – 802.11b



upper band-edge– 802.11b

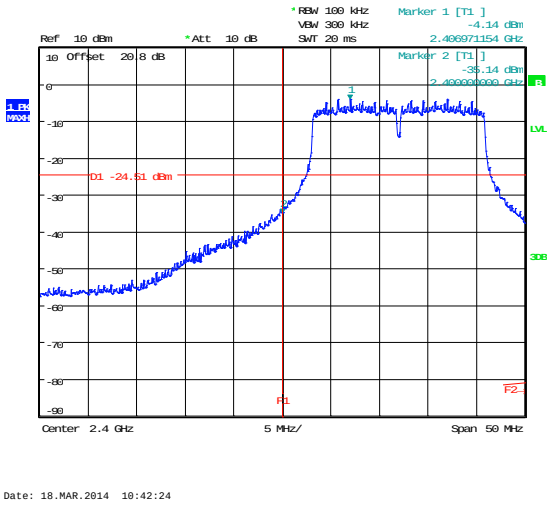


lower band edge – 802.11g

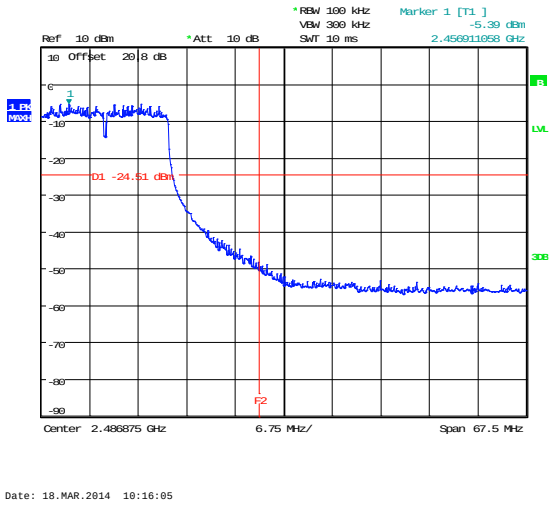


upper band-edge– 802.11g

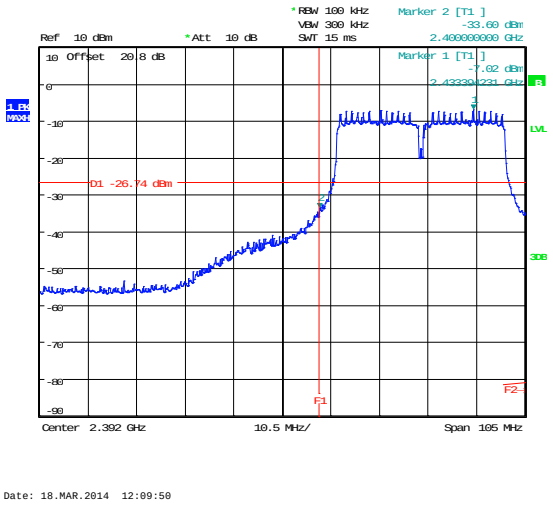
Conducted band-edge compliance



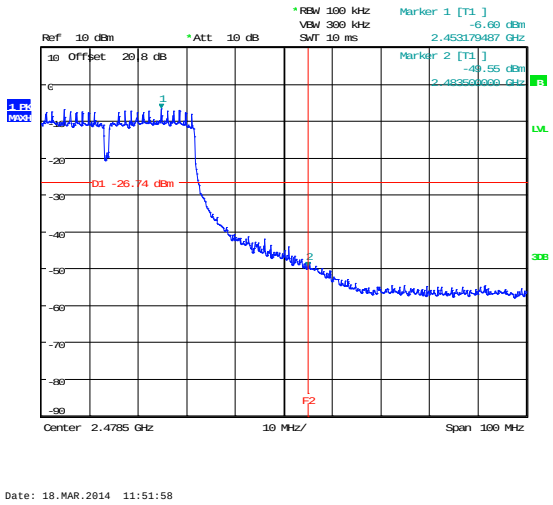
lower band edge – 802.11n HT20



upper band-edge– 802.11n HT20

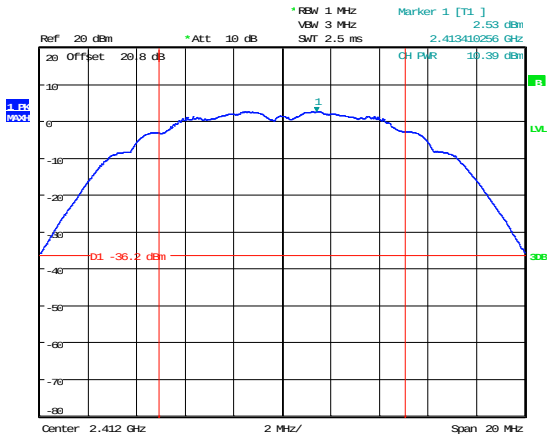


lower band edge – 802.11n HT40

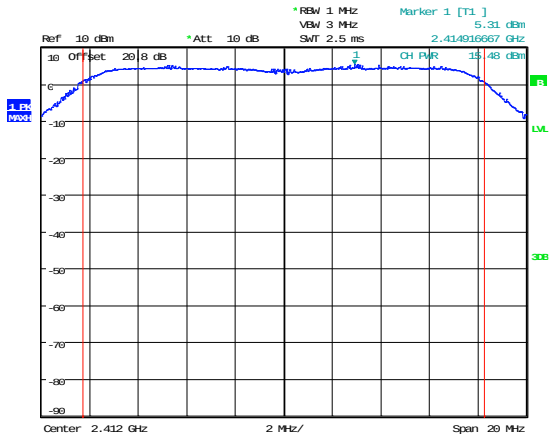


upper band-edge– 802.11n HT40

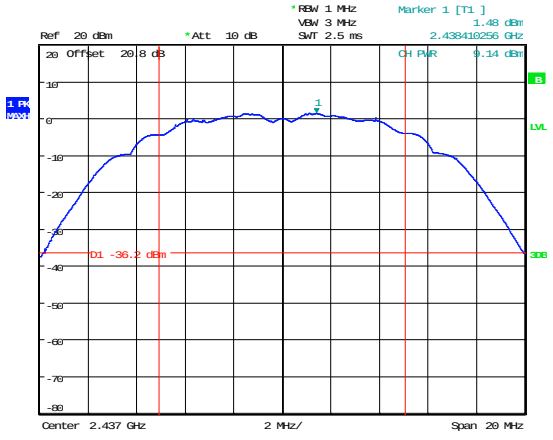
Conducted carrier power



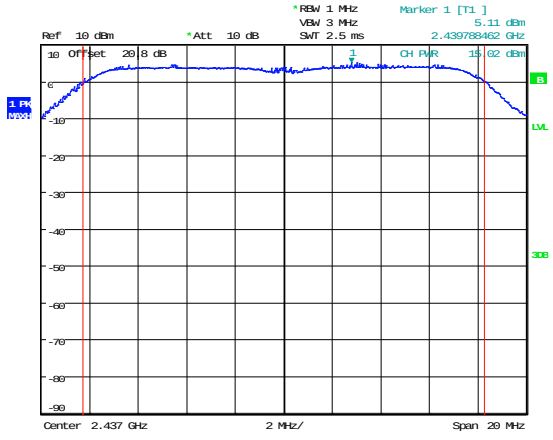
802.11b Channel 1



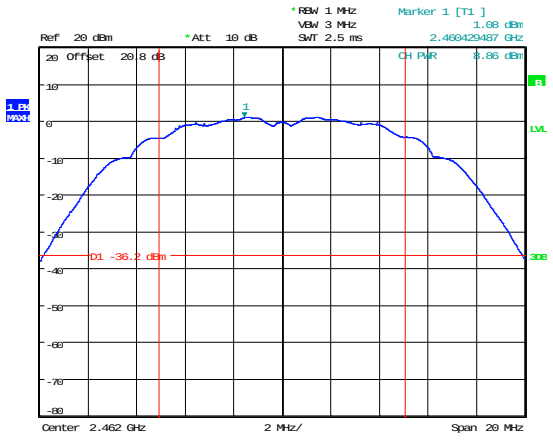
802.11g Channel 1



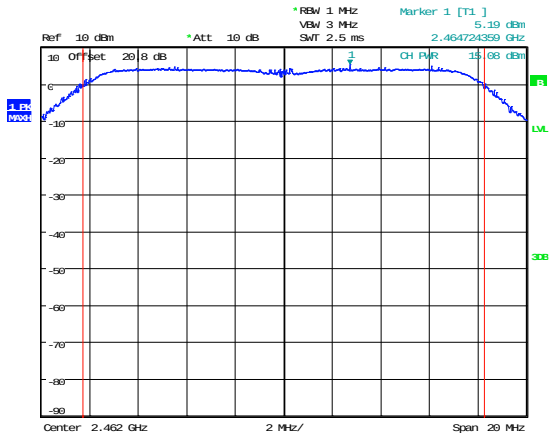
802.11b Channel 6



802.11g Channel 6

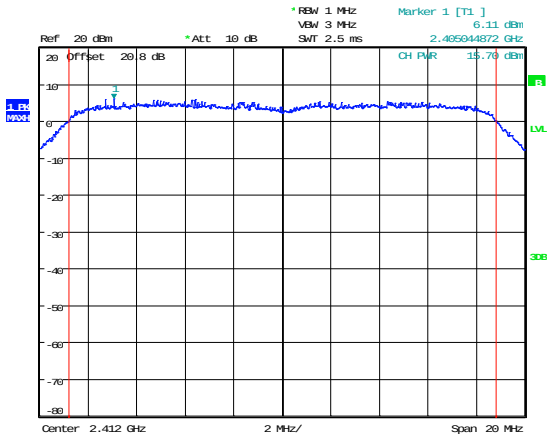


802.11b Channel 11

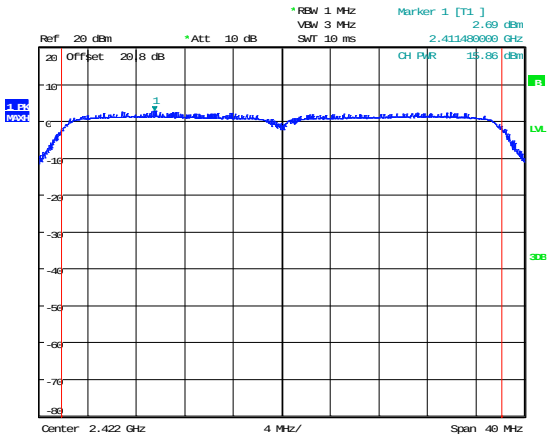


802.11g Channel 11

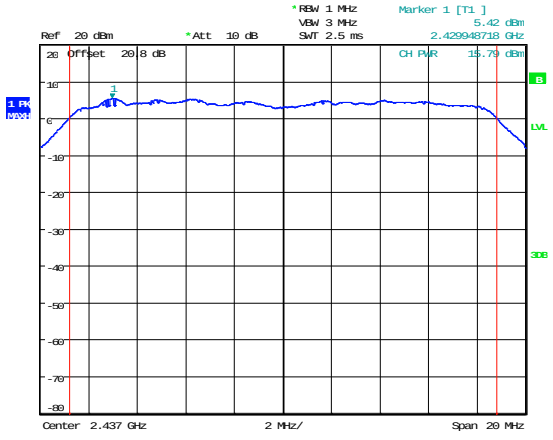
Conducted carrier power



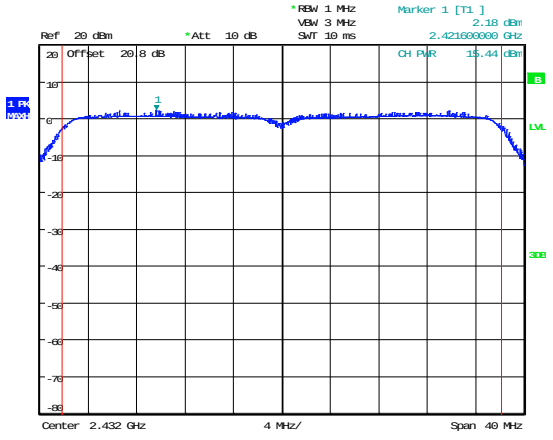
802.11n HT20 Channel 1



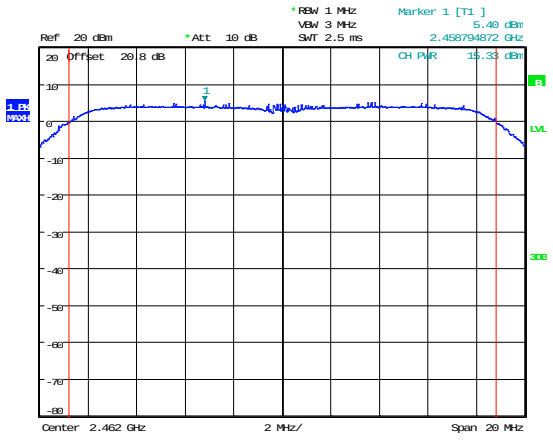
802.11n HT40 Channel 3



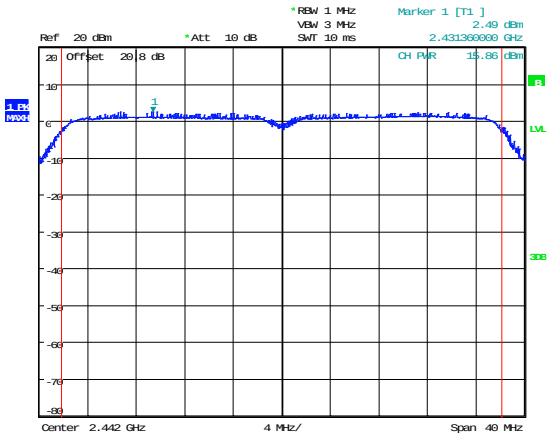
802.11n HT20 Channel 6



802.11n HT20 Channel 5

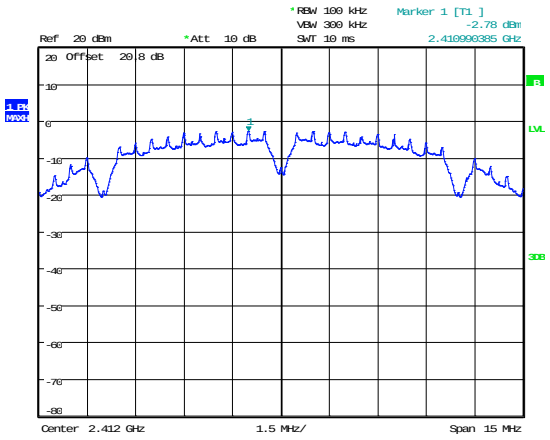


802.11n HT20 Channel 11

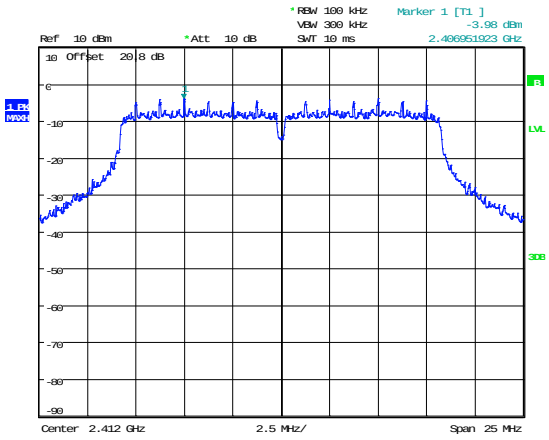


802.11n HT20 Channel 7

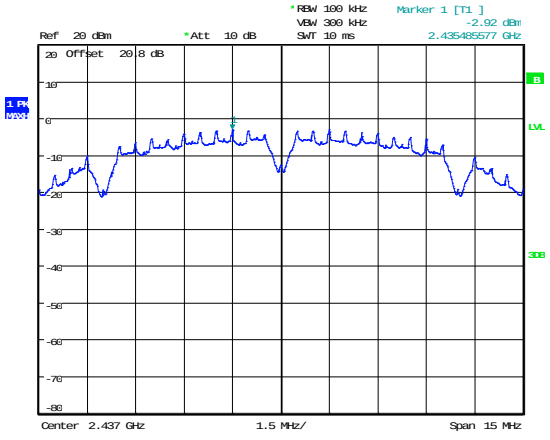
Conducted power spectral density



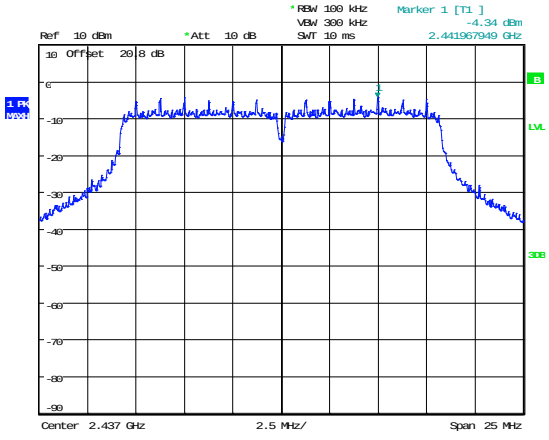
802.11b Channel 1



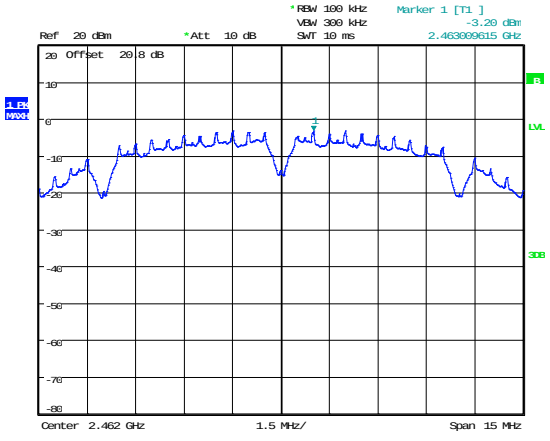
802.11g Channel 1



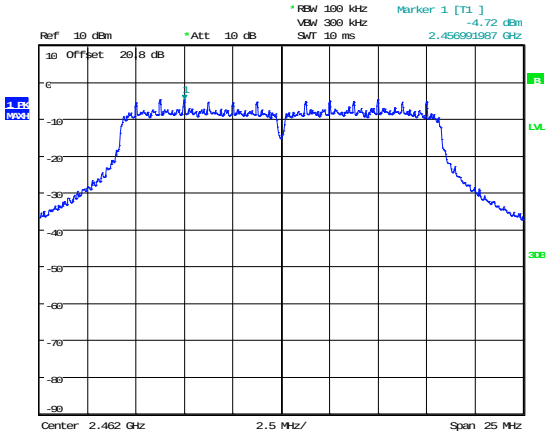
802.11b Channel 6



802.11g Channel 6

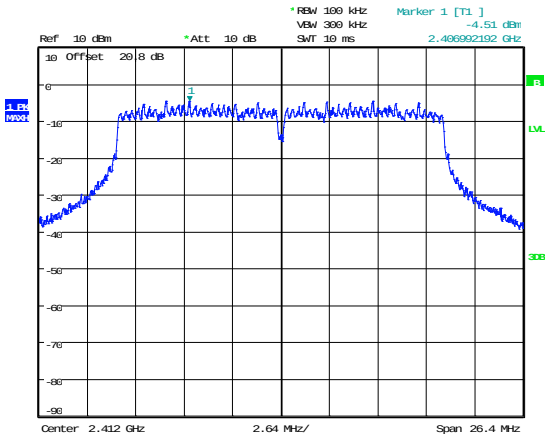


802.11b Channel 11

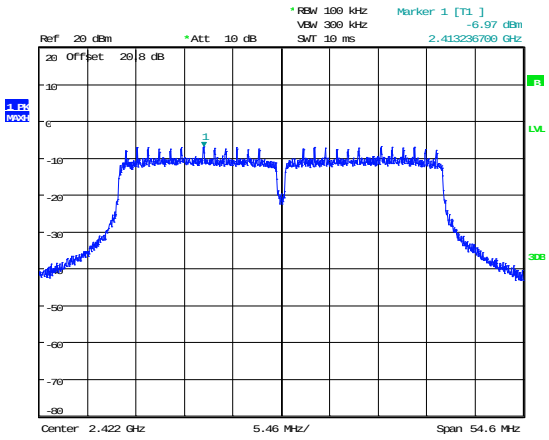


802.11g Channel 11

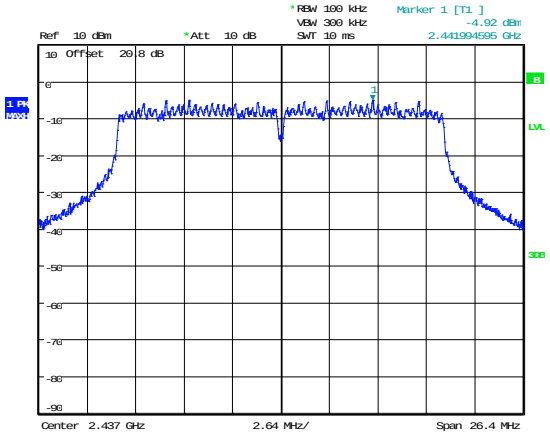
Conducted power spectral density



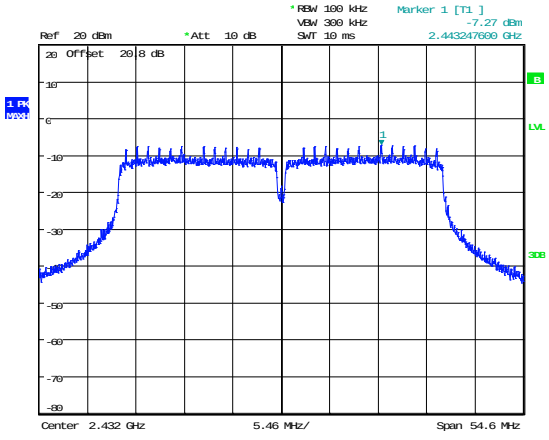
802.11n HT20 Channel 1



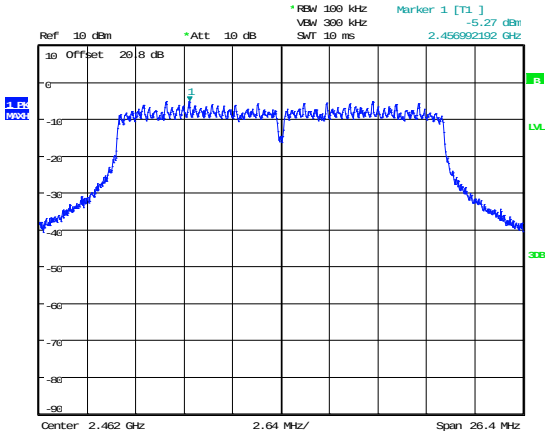
802.11n HT40 Channel 3



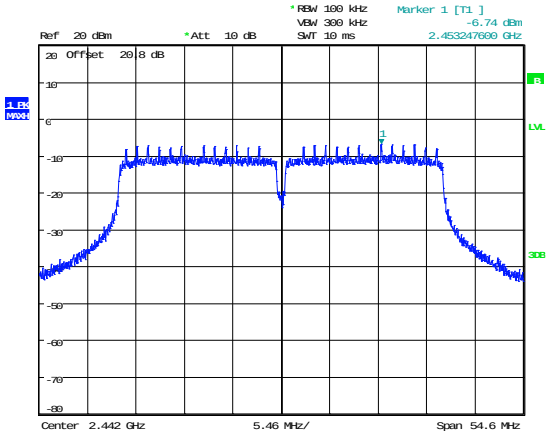
802.11n HT20 Channel 6



802.11n HT20 Channel 5

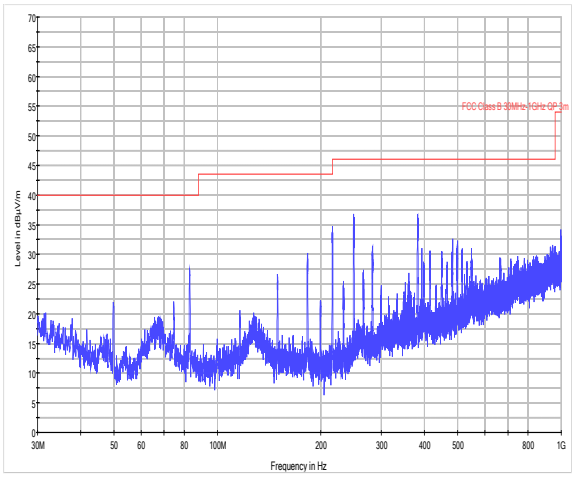


802.11n HT20 Channel 11

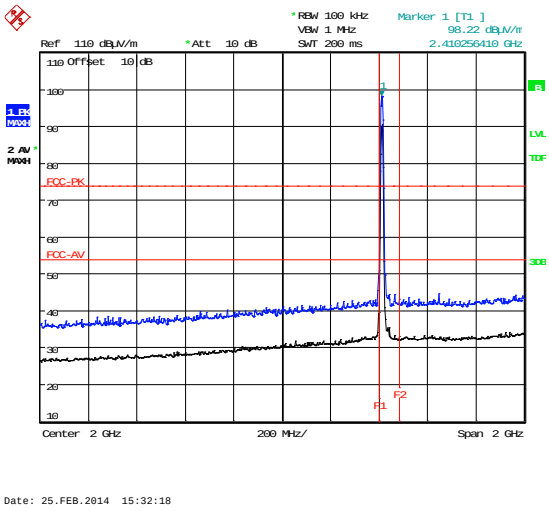


802.11n HT20 Channel 7

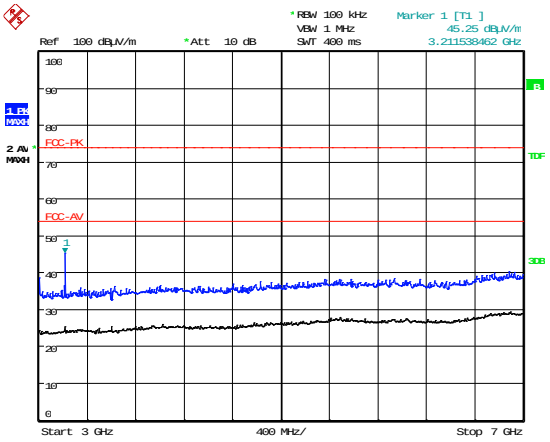
Radiated Spurious emissions 802.11b - 2412 MHz



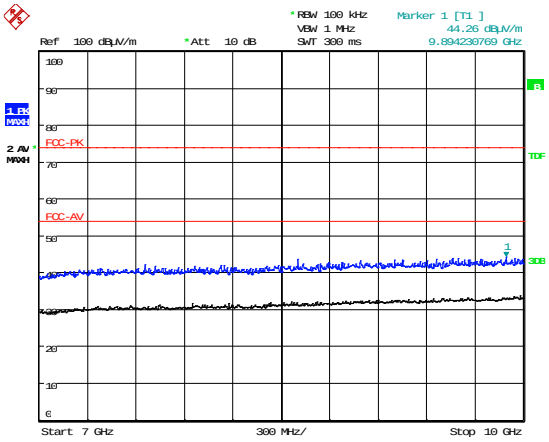
30 MHz to 1 GHz



1 GHz to 3 GHz

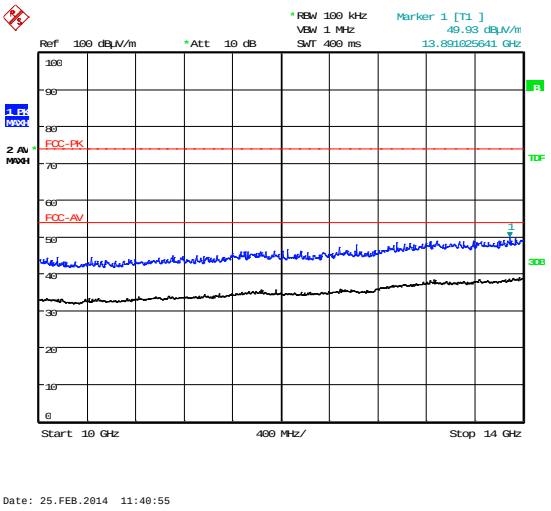


3 GHz to 7 GHz



7 GHz to 10 GHz

Radiated Spurious emissions 802.11b - 2412 MHz



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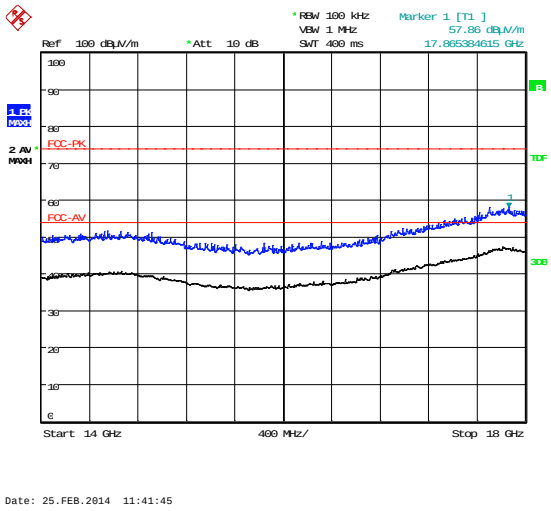
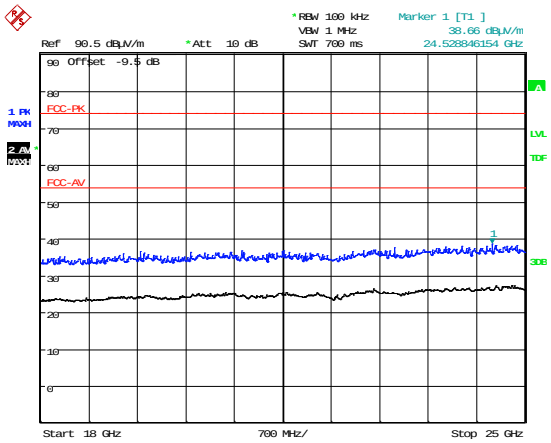
10 GHz to 14 GHz



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

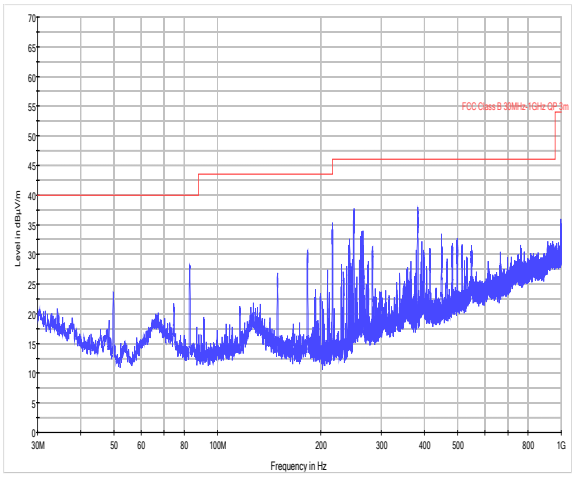
14 GHz to 18 GHz



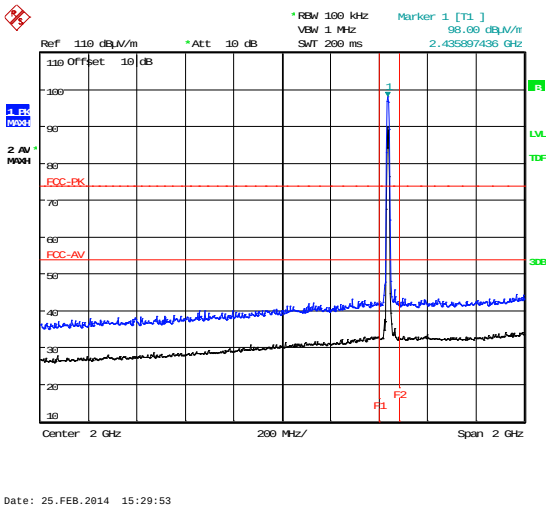
Date: 26.FEB.2014 16:55:56

18 GHz to 25 GHz

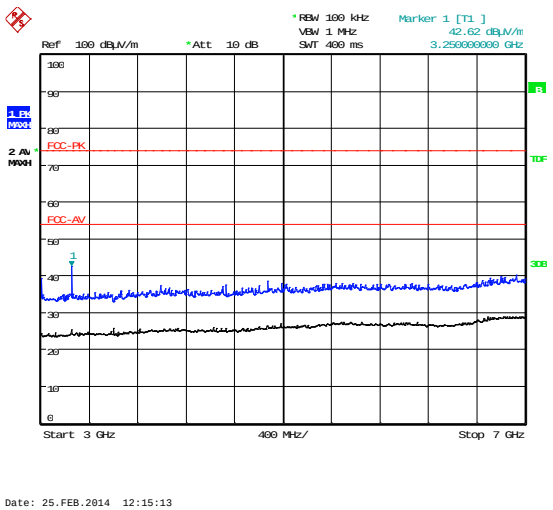
Radiated Spurious emissions 802.11b - 2437 MHz



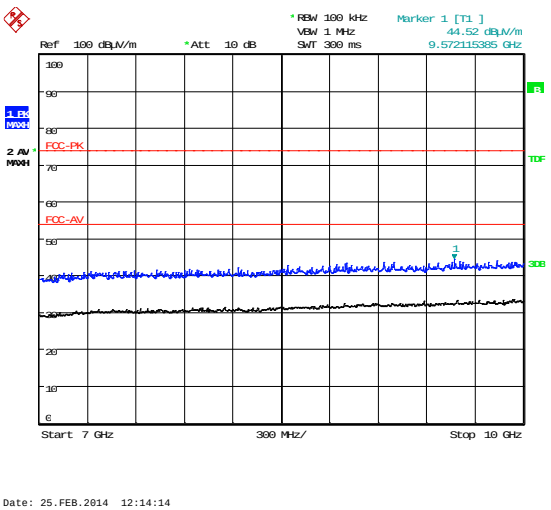
30 MHz to 1 GHz



1 GHz to 3 GHz



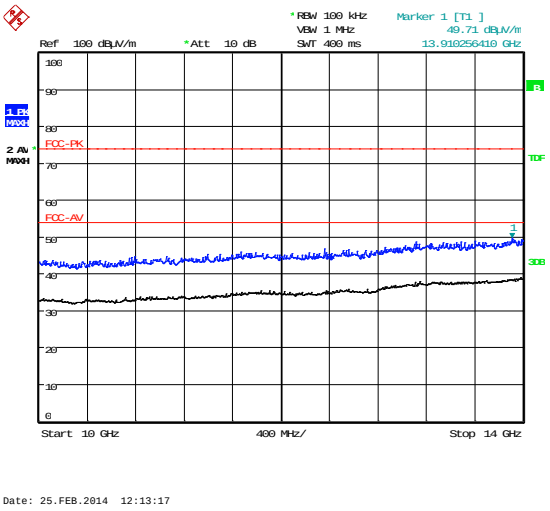
3 GHz to 7 GHz



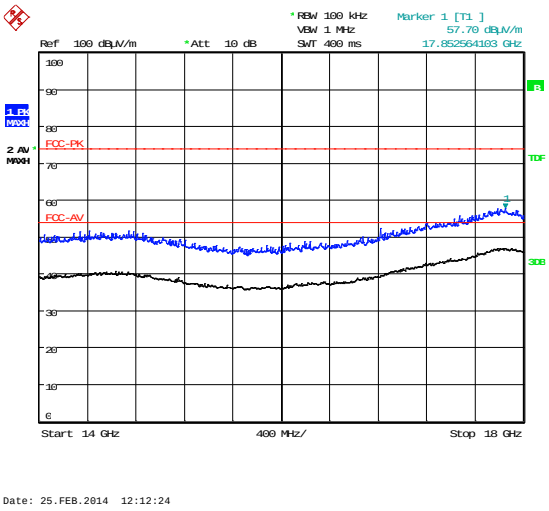
7 GHz to 10 GHz

Radiated Spurious emissions

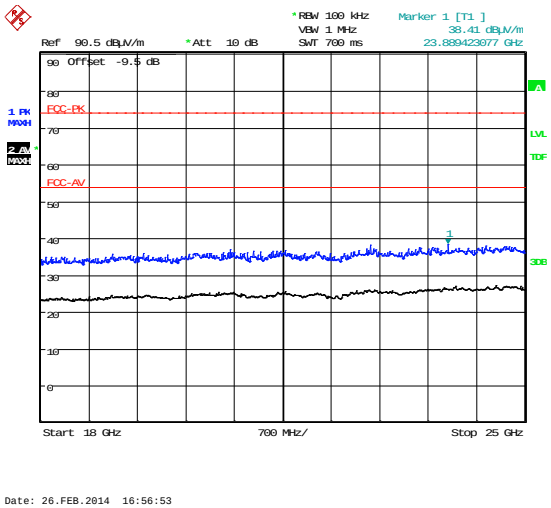
802.11b - 2437 MHz



10 GHz to 14 GHz

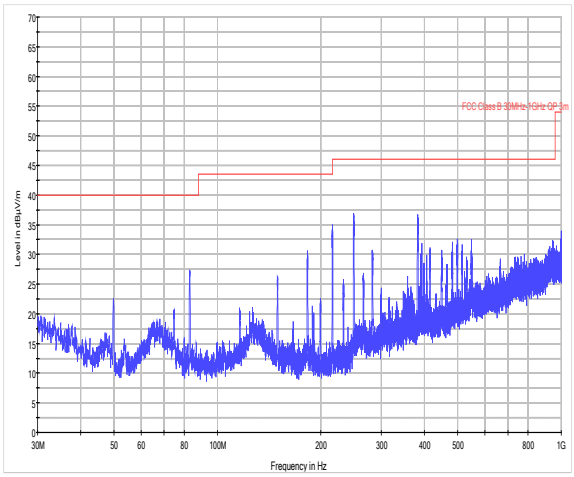


14 GHz to 18 GHz

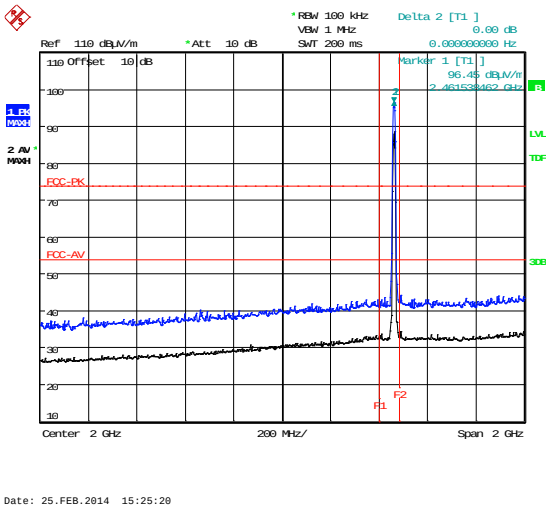


18 GHz to 25 GHz

Radiated Spurious emissions 802.11b - 2462 MHz



30 MHz to 1 GHz



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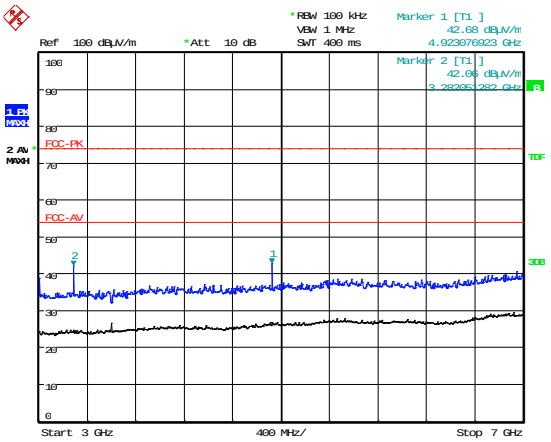
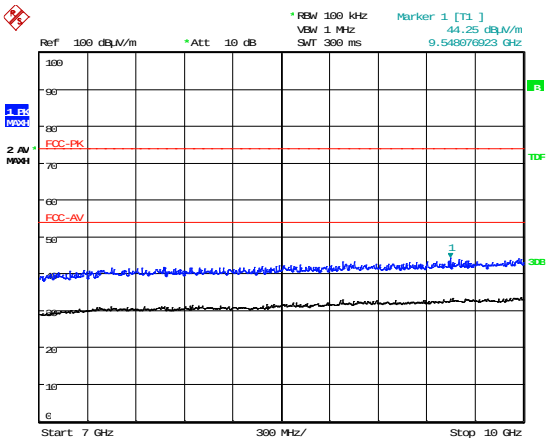
1 GHz to 3 GHz



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

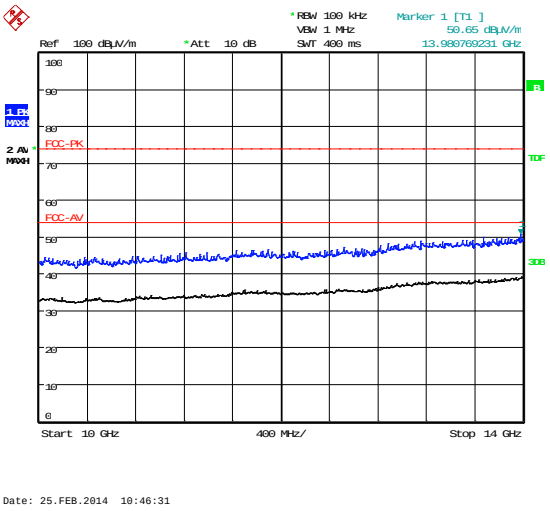
3 GHz to 7 GHz

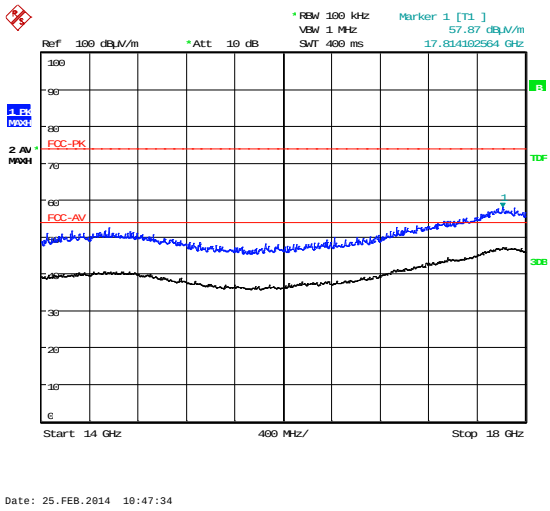


Date: 25.FEB.2014 10:44:15

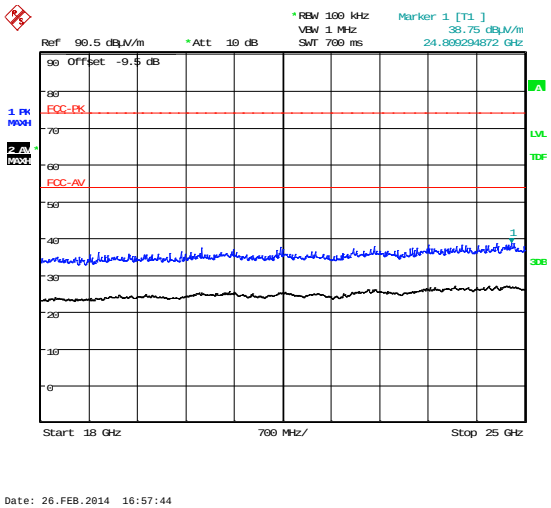
7 GHz to 10 GHz

Radiated Spurious emissions 802.11b - 2462 MHz



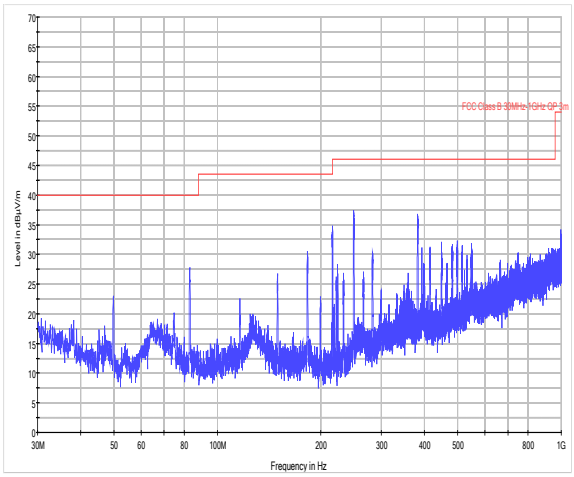


10 GHz to 14 GHz 14 GHz to 18 GHz

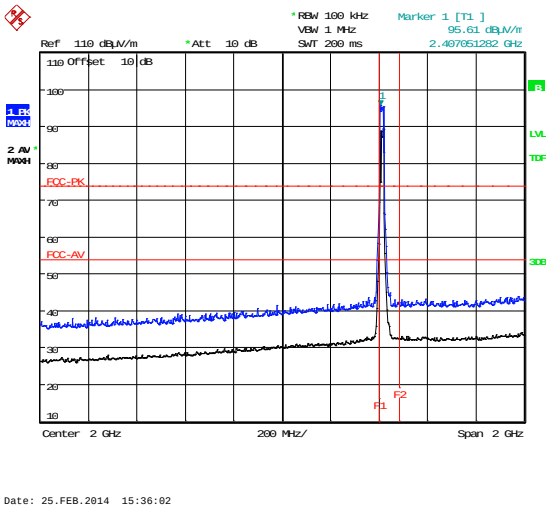


18 GHz to 25 GHz

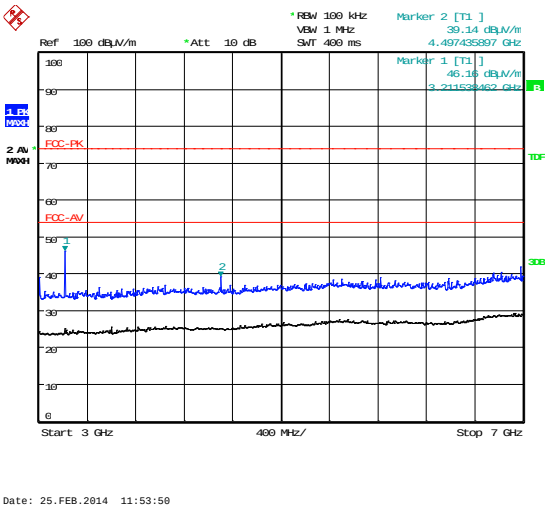
Radiated Spurious emissions 802.11g - 2412 MHz



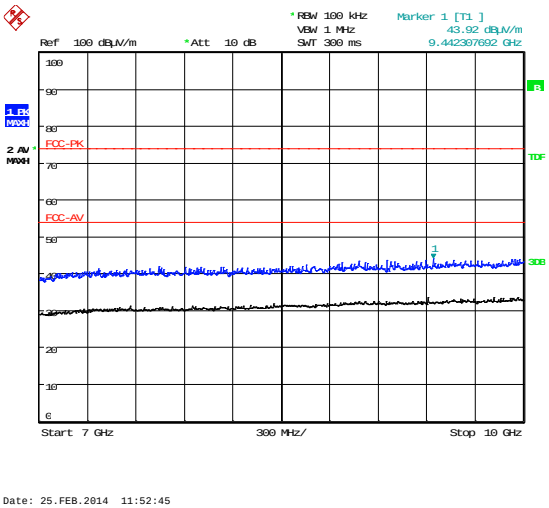
30 MHz to 1 GHz



1 GHz to 3 GHz



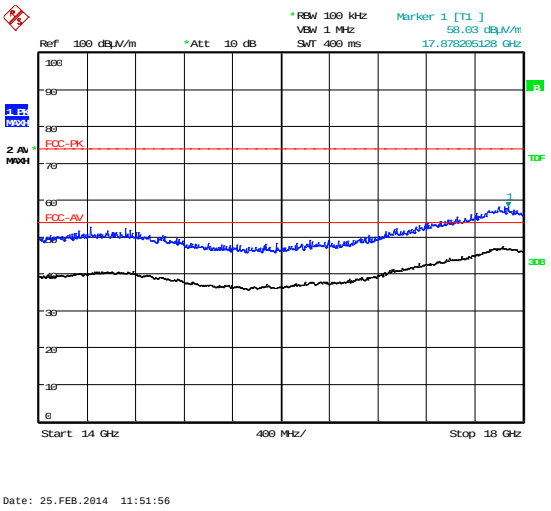
3 GHz to 7 GHz

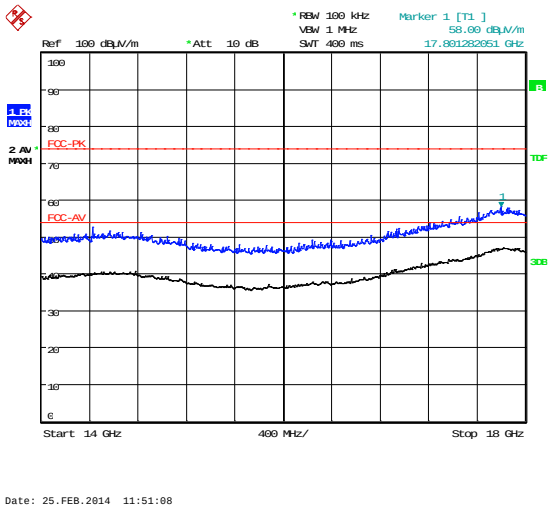


7 GHz to 10 GHz

Radiated Spurious emissions

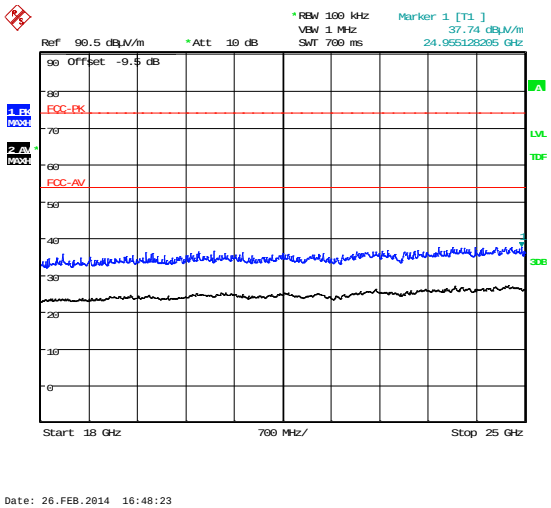
802.11g - 2412 MHz





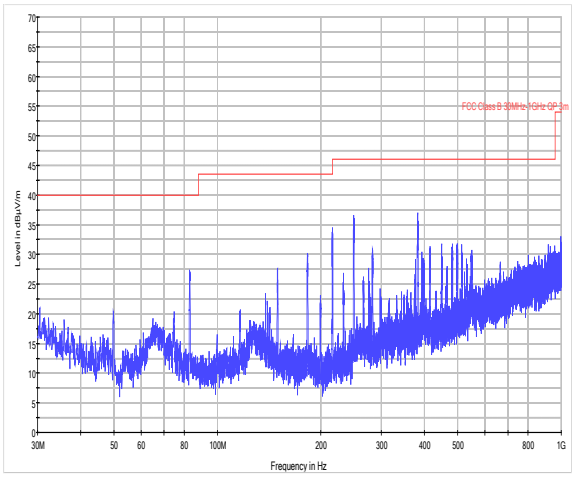
10 GHz to 14 GHz

14 GHz to 18 GHz

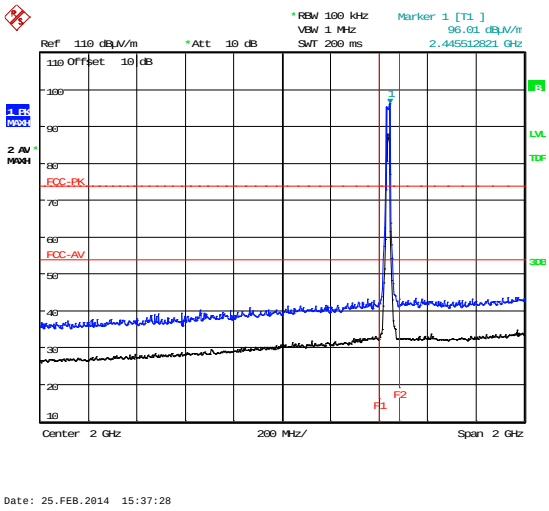


18 GHz to 25 GHz

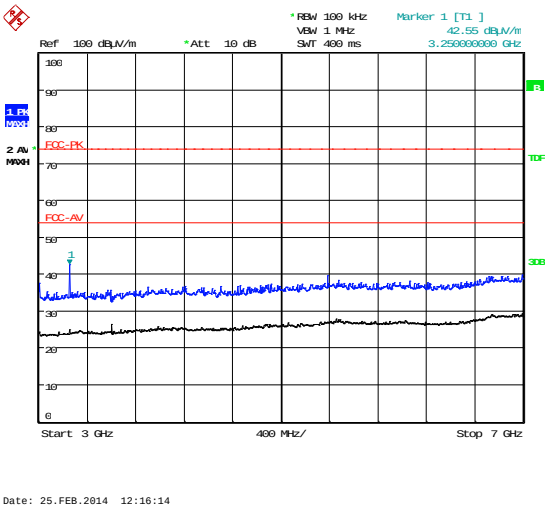
Radiated Spurious emissions 802.11g - 2437 MHz



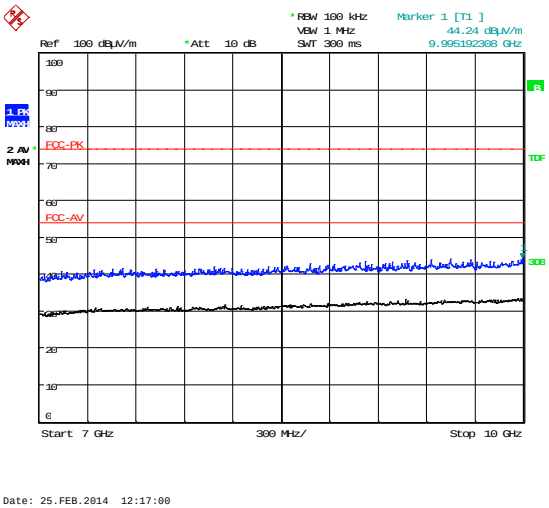
30 MHz to 1 GHz



1 GHz to 3 GHz

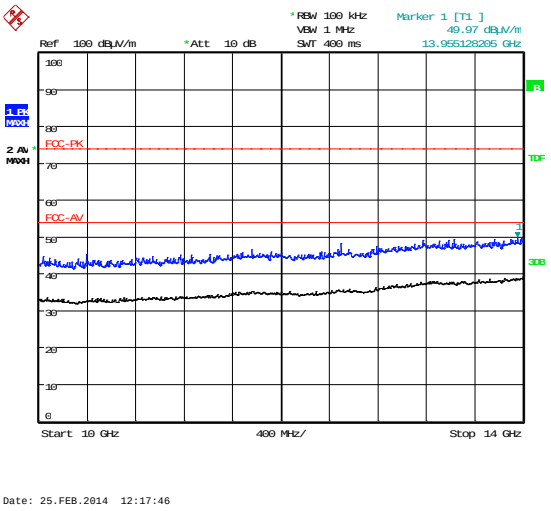


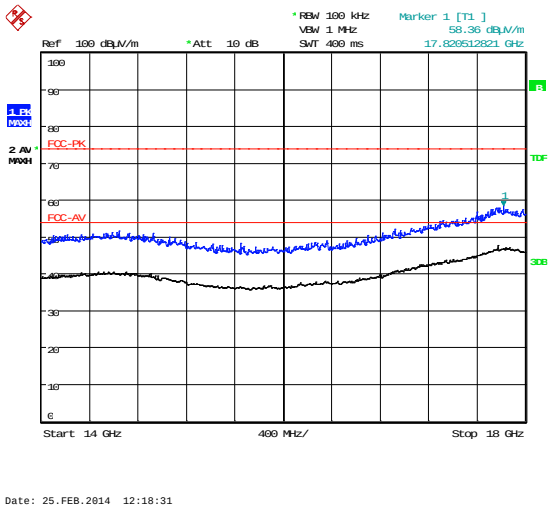
3 GHz to 7 GHz



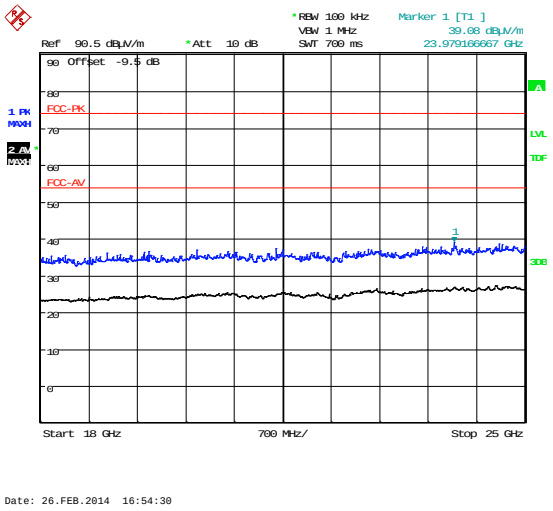
7 GHz to 10 GHz

Radiated Spurious emissions 802.11g - 2437 MHz



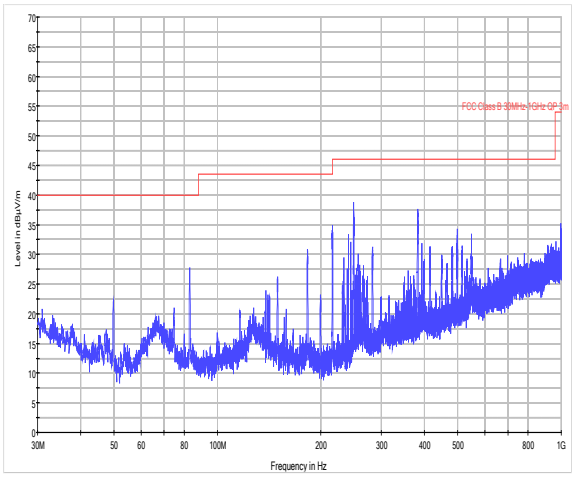


10 GHz to 14 GHz 14 GHz to 18 GHz

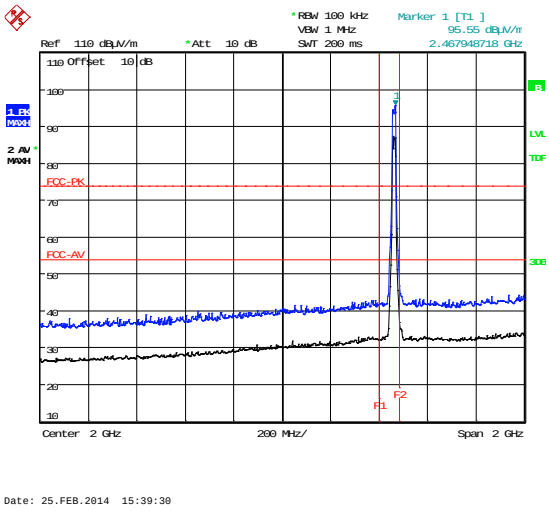


18 GHz to 25 GHz

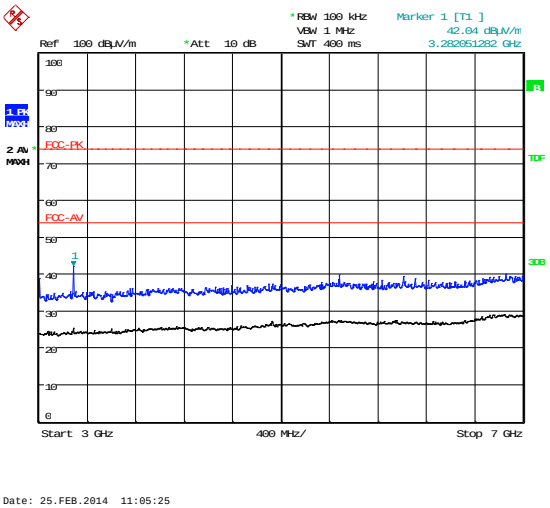
Radiated Spurious emissions 802.11g - 2462 MHz



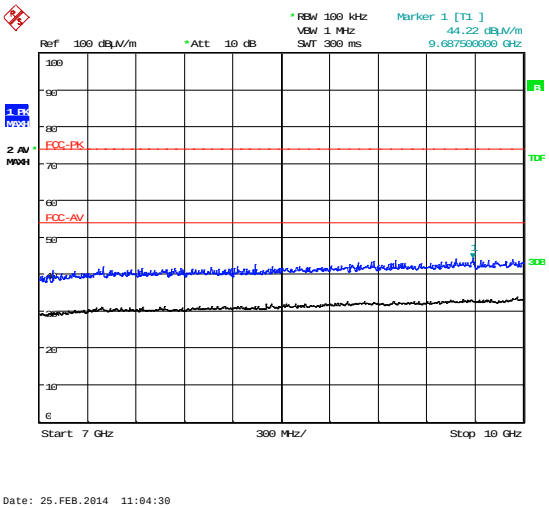
30 MHz to 1 GHz



1 GHz to 3 GHz



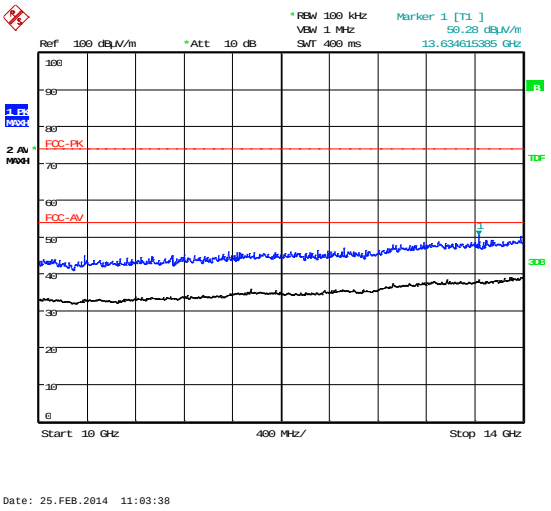
3 GHz to 7 GHz

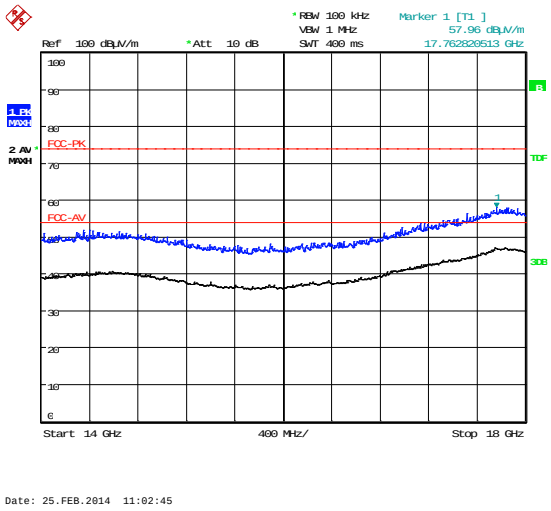


7 GHz to 10 GHz

Radiated Spurious emissions

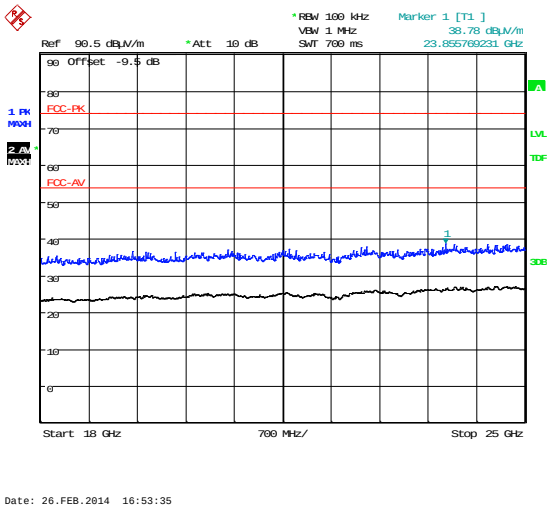
802.11g - 2462 MHz





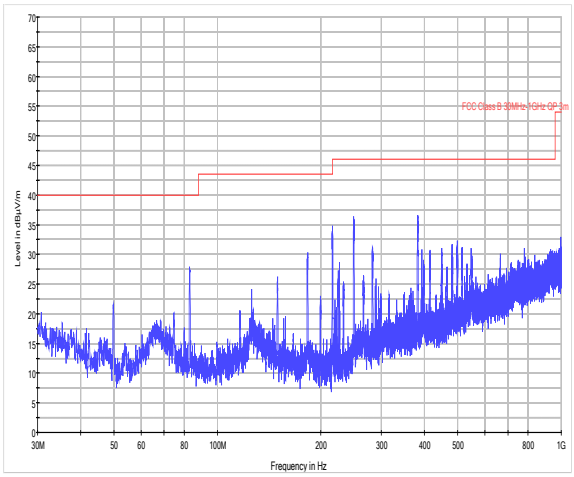
10 GHz to 14 GHz

14 GHz to 18 GHz

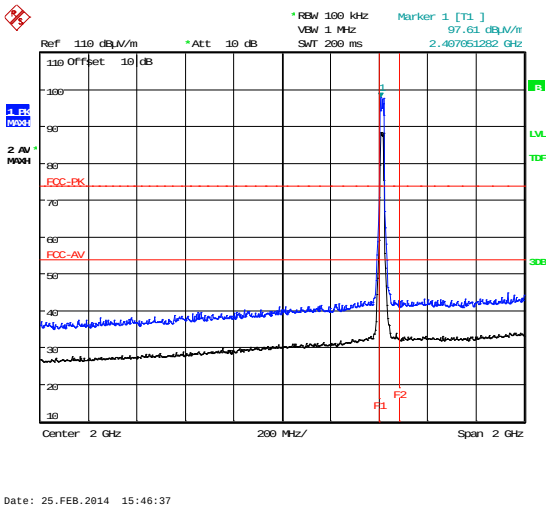


18 GHz to 25 GHz

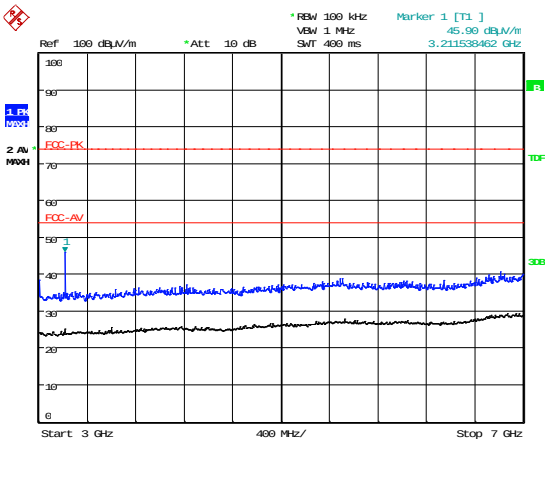
Radiated Spurious emissions 802.11n HT20 - 2412 MHz



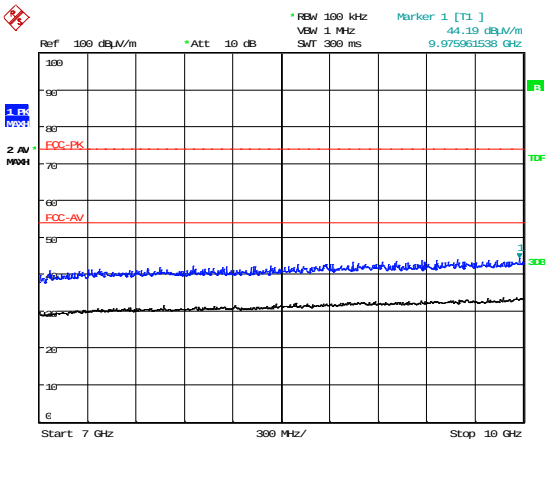
30 MHz to 1 GHz



1 GHz to 3 GHz



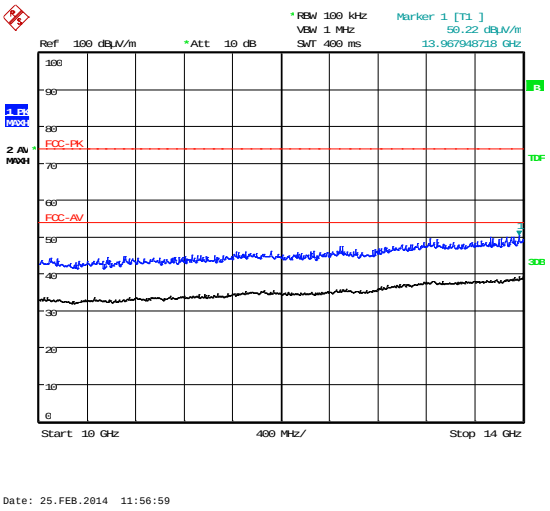
3 GHz to 7 GHz



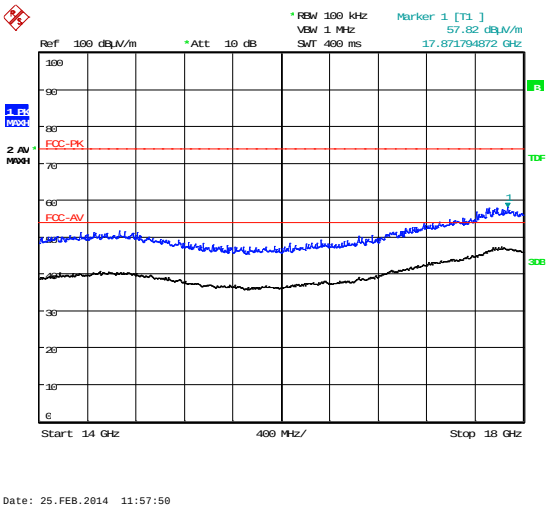
7 GHz to 10 GHz

Radiated Spurious emissions

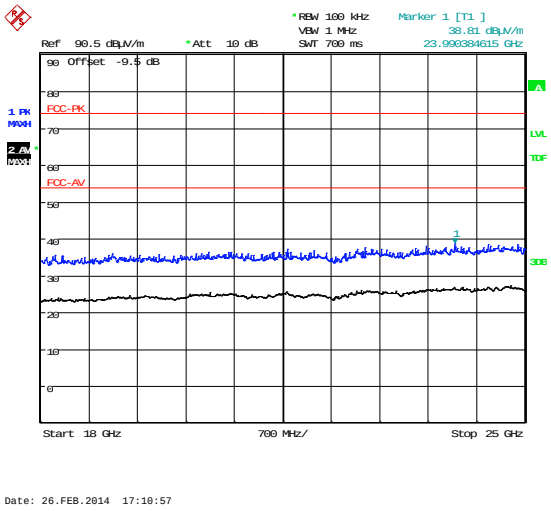
802.11n HT20 - 2412 MHz



10 GHz to 14 GHz



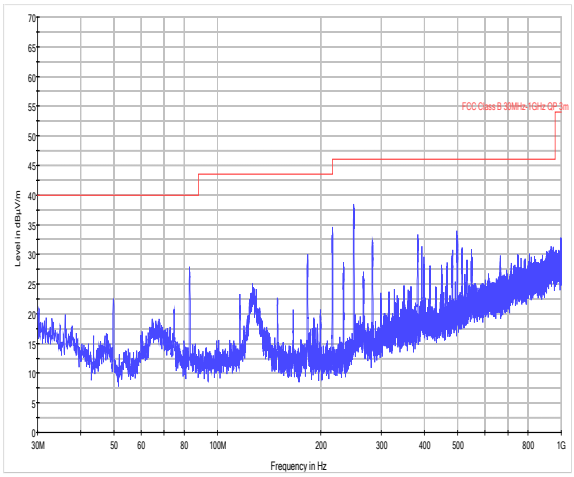
14 GHz to 18 GHz



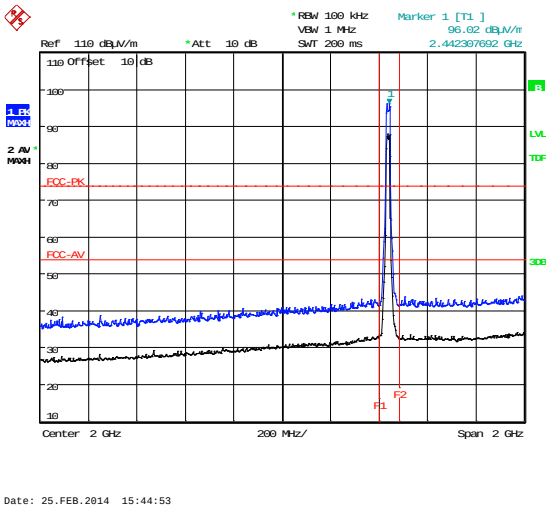
18 GHz to 25 GHz

Radiated Spurious emissions

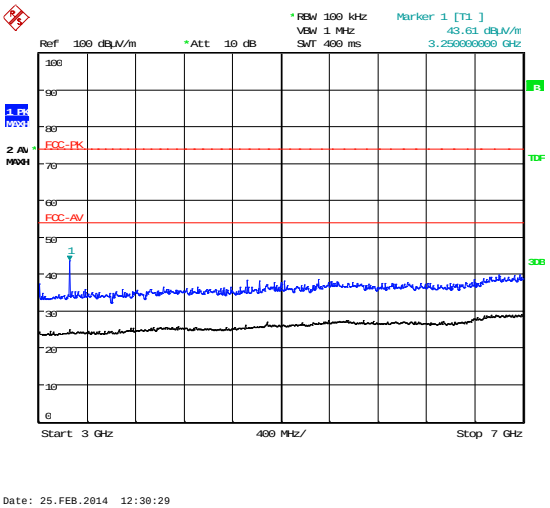
802.11n HT20 - 2437 MHz



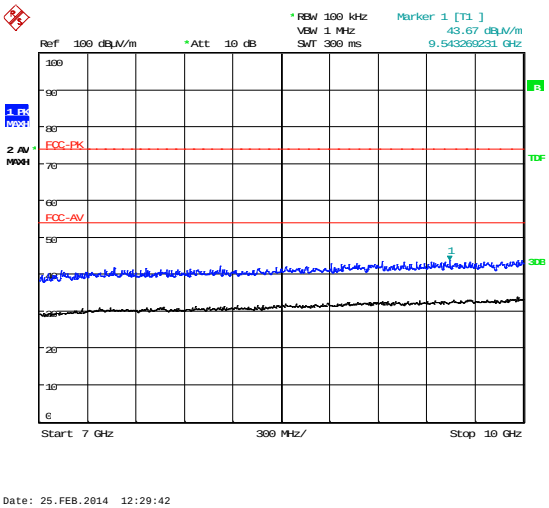
30 MHz to 1 GHz



1 GHz to 3 GHz



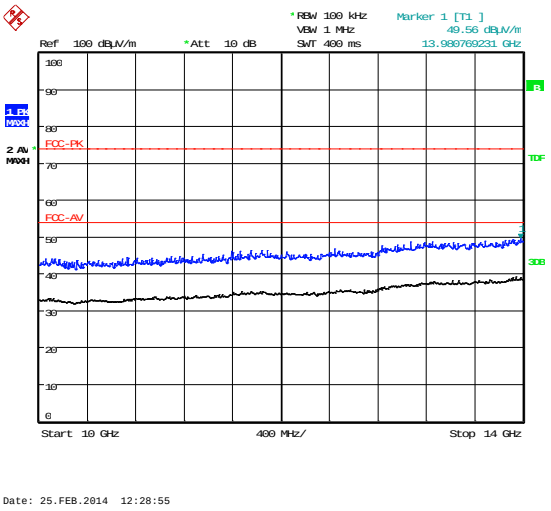
3 GHz to 7 GHz

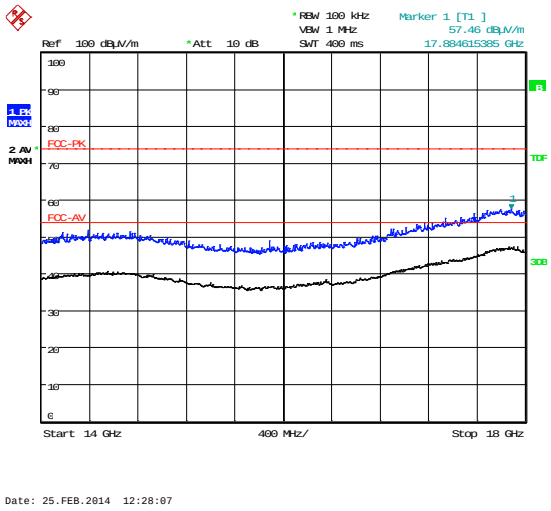


7 GHz to 10 GHz

Radiated Spurious emissions

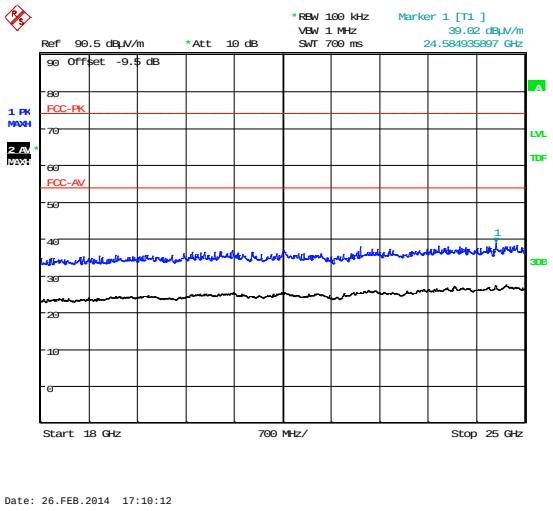
802.11n HT20 - 2437 MHz





10 GHz to 14 GHz

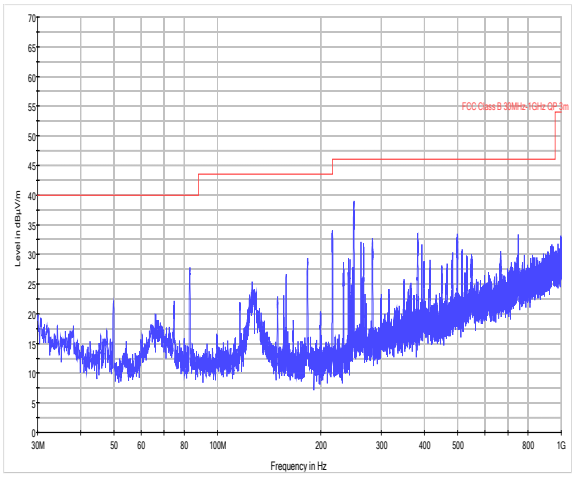
14 GHz to 18 GHz



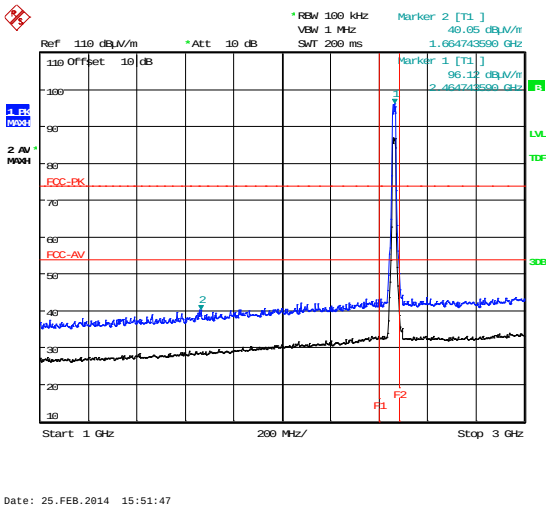
18 GHz to 25 GHz

Radiated Spurious emissions

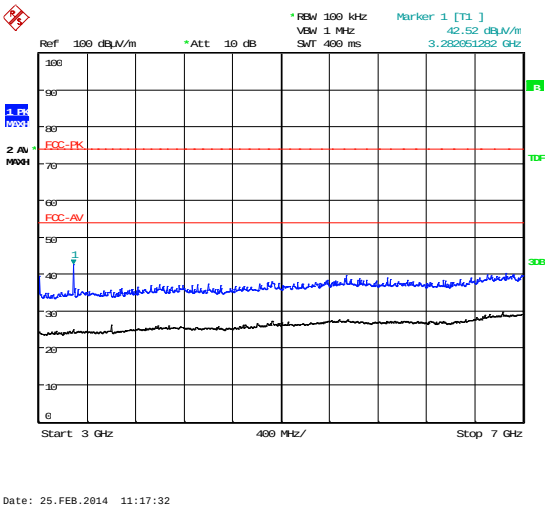
802.11n HT40 - 2462 MHz



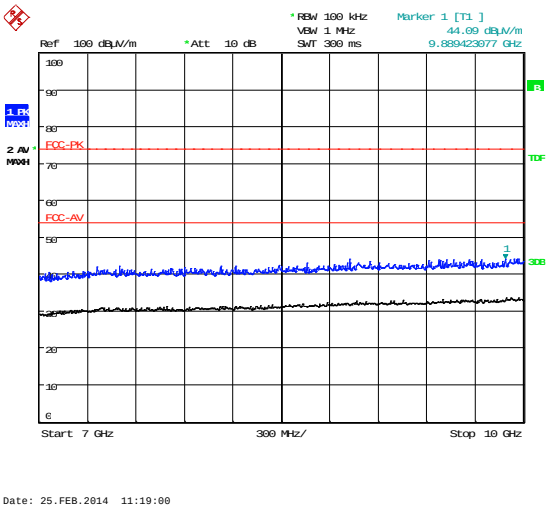
30 MHz to 1 GHz



1 GHz to 3 GHz



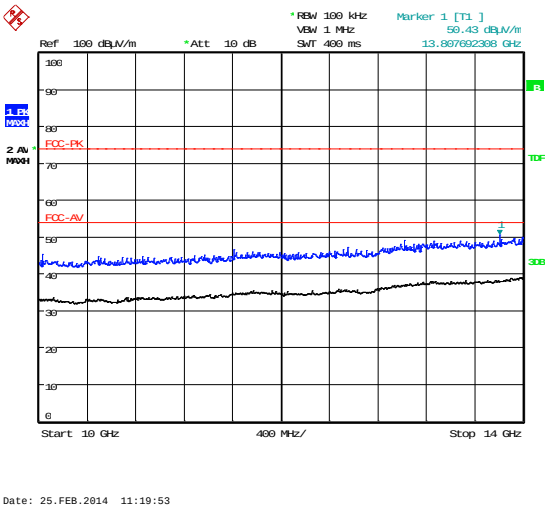
3 GHz to 7 GHz

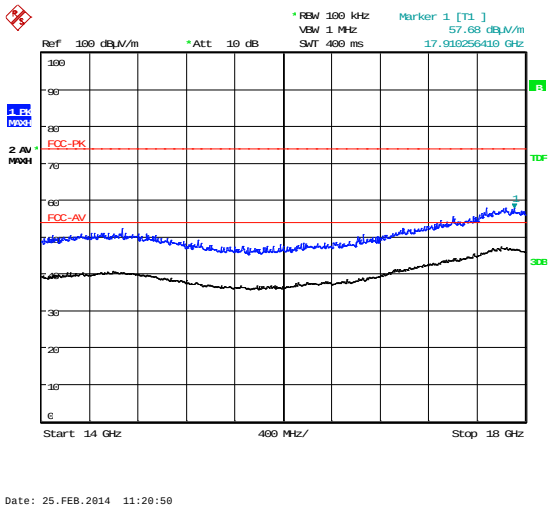


7 GHz to 10 GHz

Radiated Spurious emissions

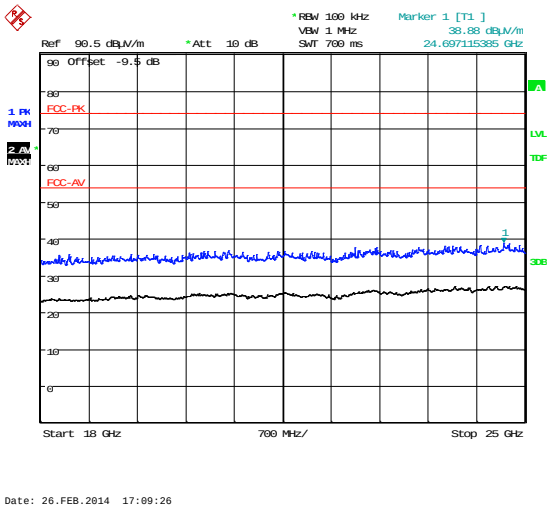
802.11n HT40 - 2462 MHz





10 GHz to 14 GHz

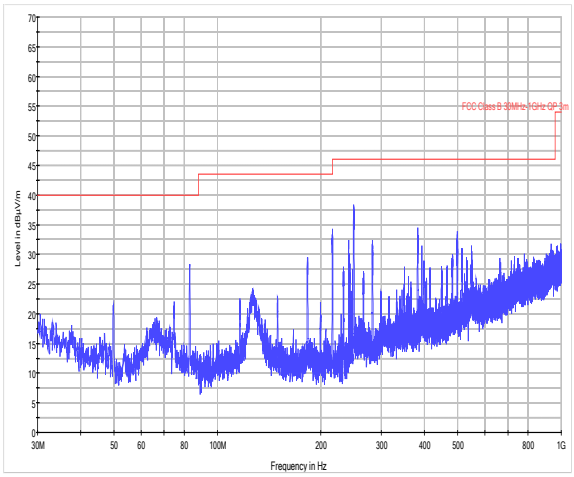
14 GHz to 18 GHz



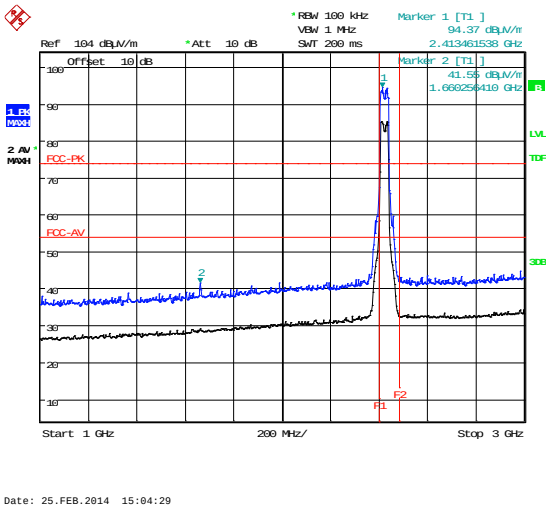
18 GHz to 25 GHz

Radiated Spurious emissions

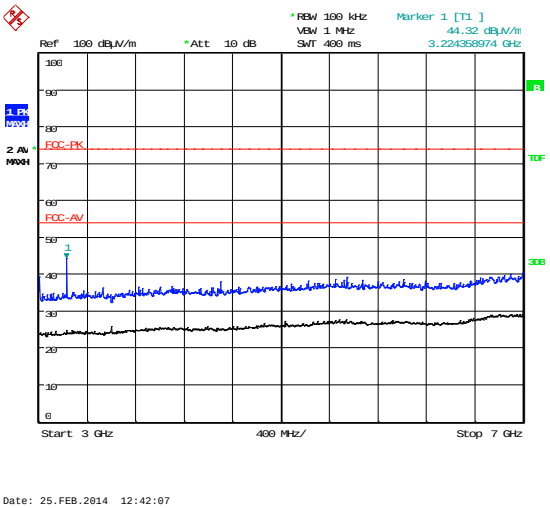
802.11n HT40 - 2422 MHz



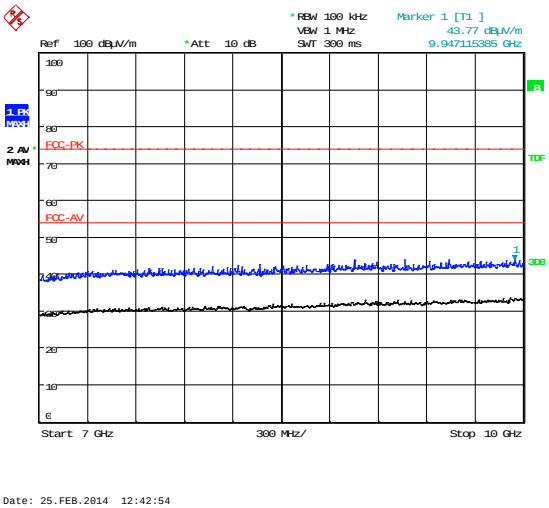
30 MHz to 1 GHz



1 GHz to 3 GHz



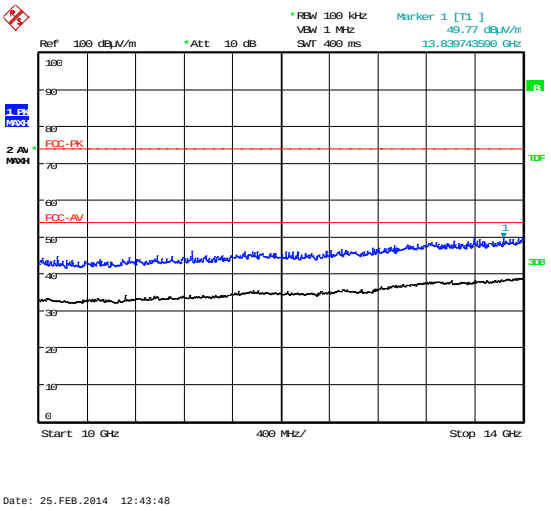
3 GHz to 7 GHz

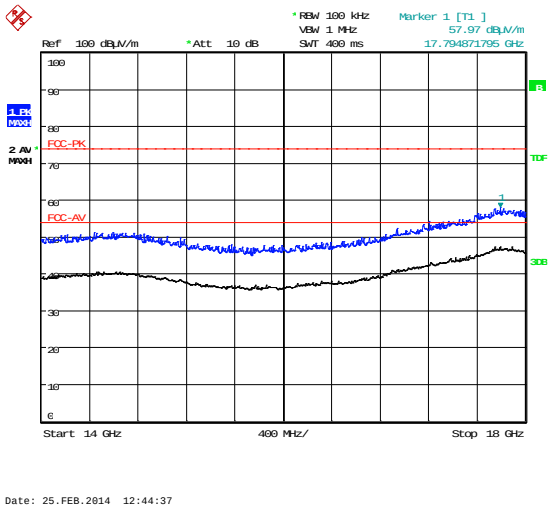


7 GHz to 10 GHz

Radiated Spurious emissions

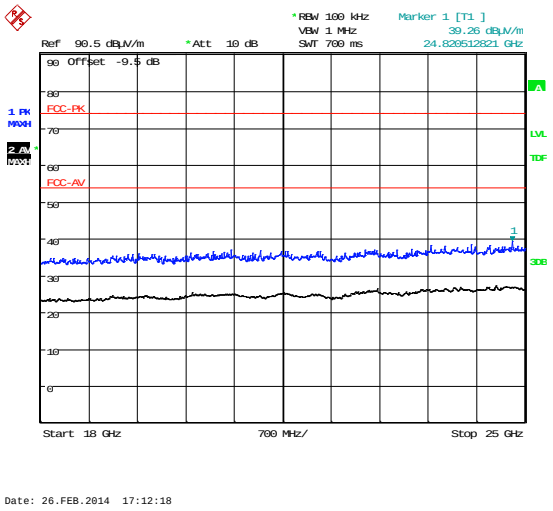
802.11n HT40 - 2422 MHz





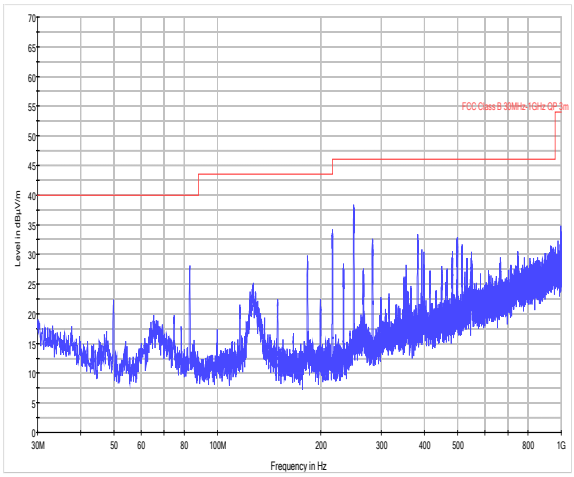
10 GHz to 14 GHz

14 GHz to 18 GHz

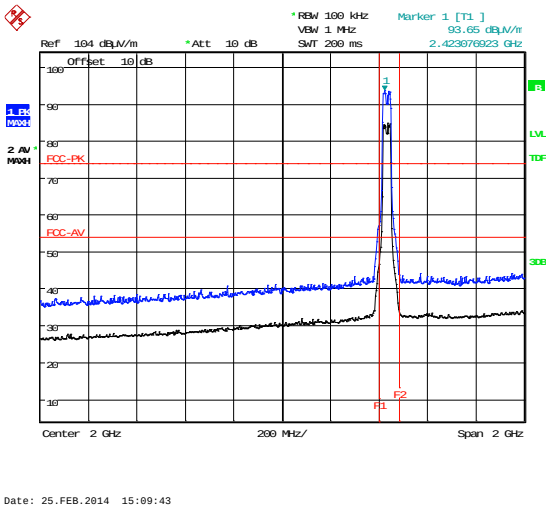


18 GHz to 25 GHz

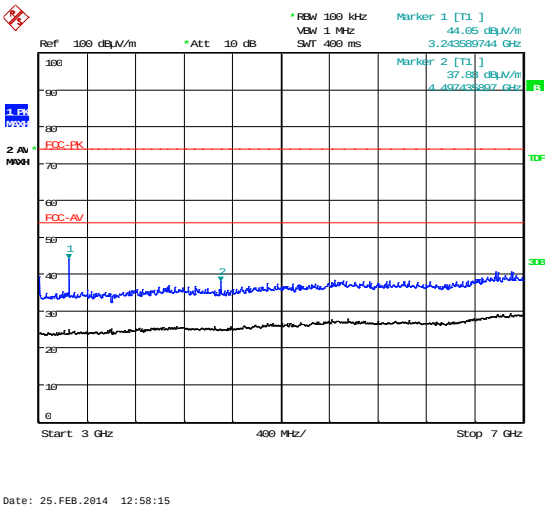
Radiated Spurious emissions 802.11n HT40 - 2432 MHz



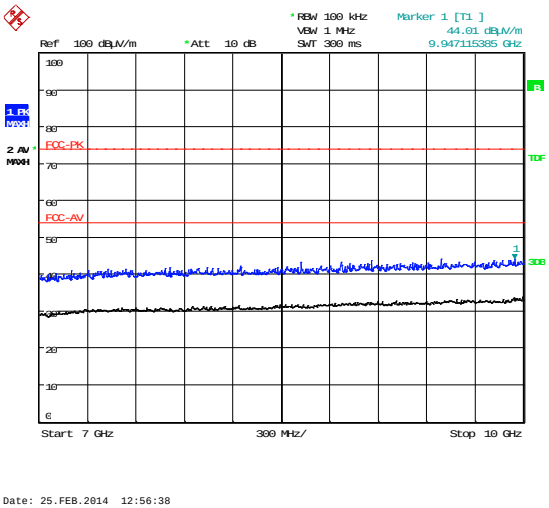
30 MHz to 1 GHz



1 GHz to 3 GHz



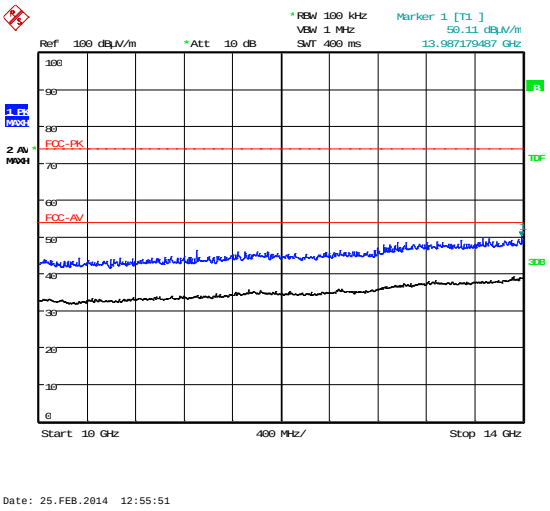
3 GHz to 7 GHz

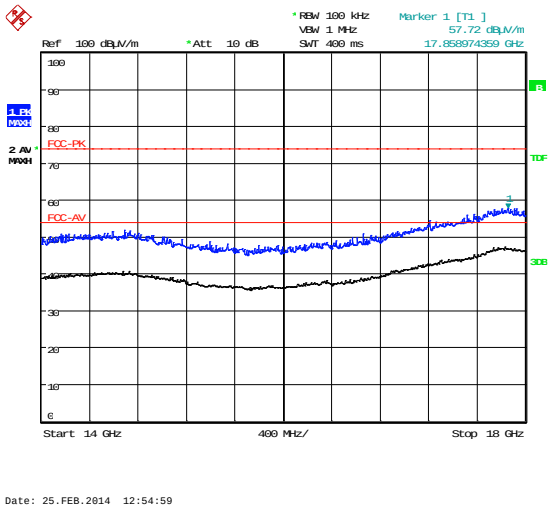


7 GHz to 10 GHz

Radiated Spurious emissions

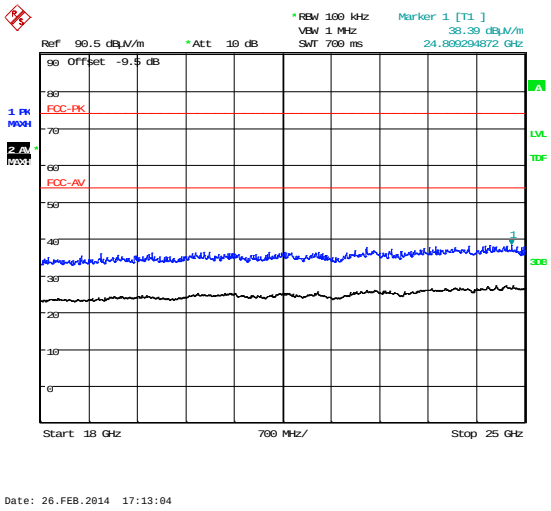
802.11n HT40 - 2432 MHz





10 GHz to 14 GHz

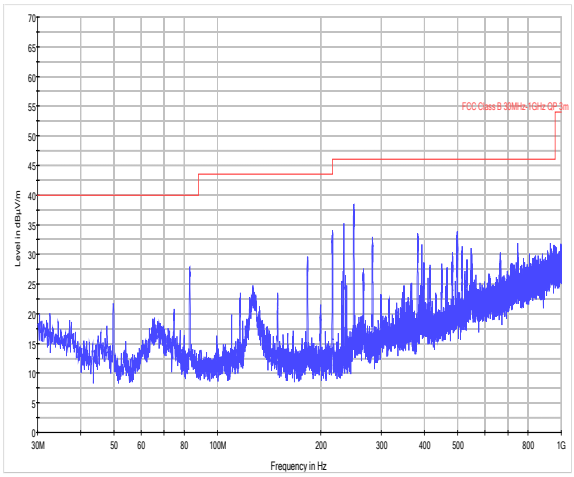
14 GHz to 18 GHz



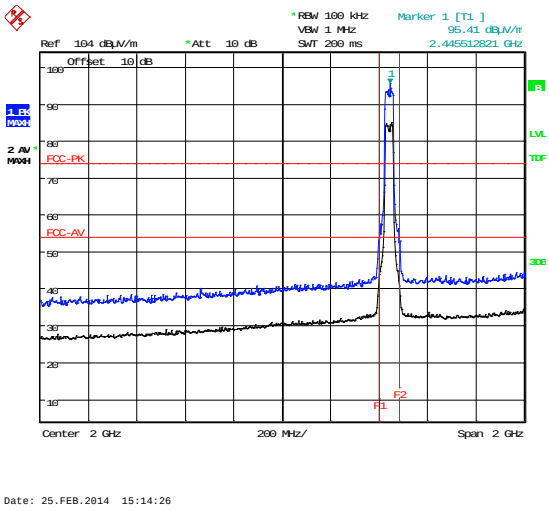
18 GHz to 25 GHz

Radiated Spurious emissions

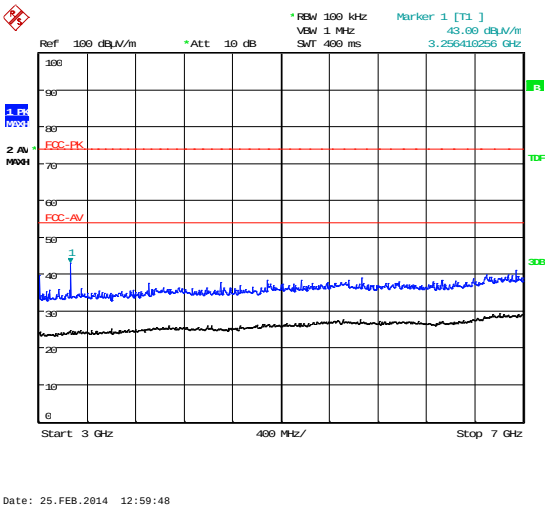
802.11n HT40 - 2442 MHz



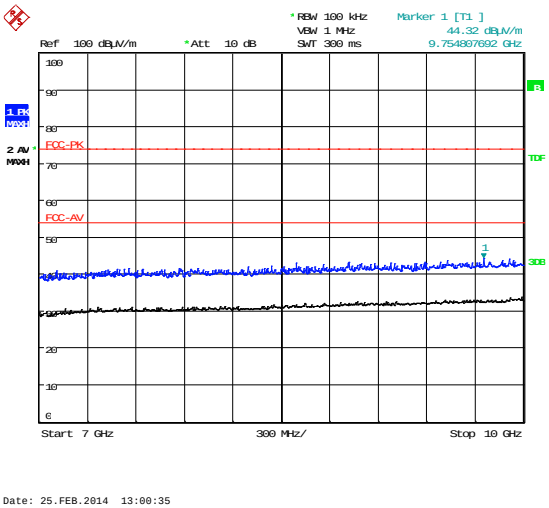
30 MHz to 1 GHz



1 GHz to 3 GHz



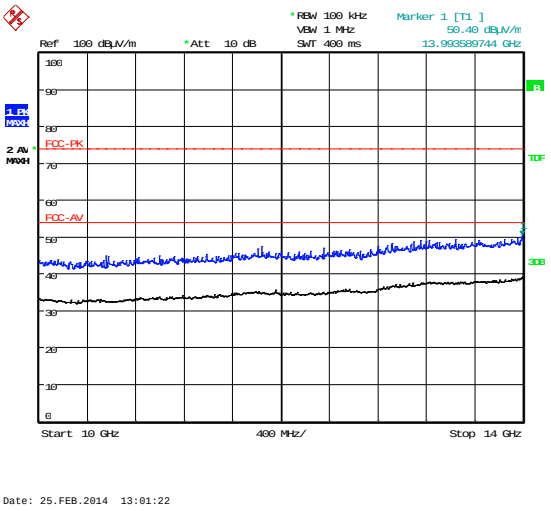
3 GHz to 7 GHz

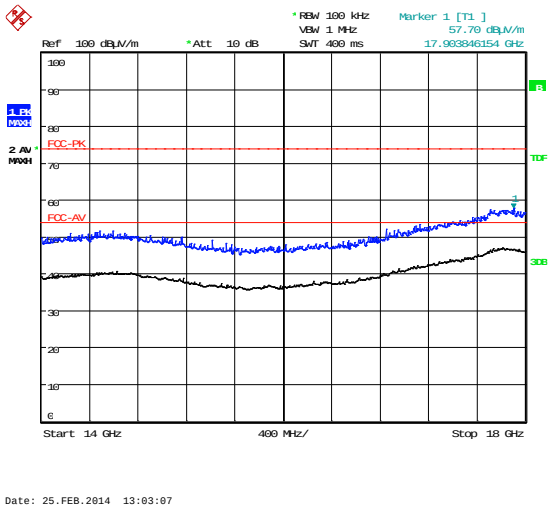


7 GHz to 10 GHz

Radiated Spurious emissions

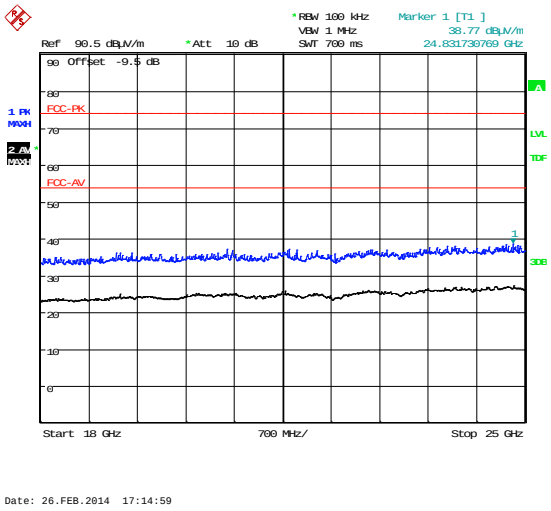
802.11n HT40 - 2442 MHz





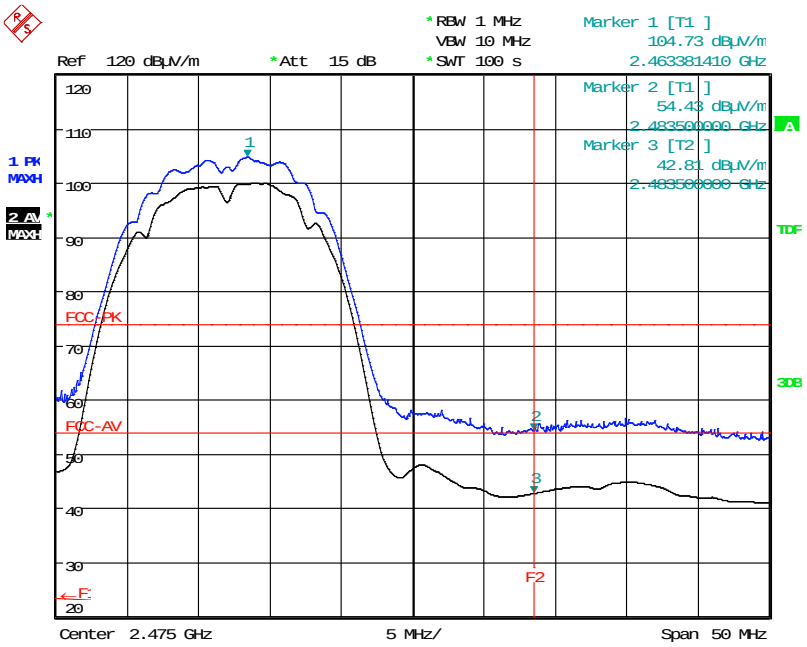
10 GHz to 14 GHz

14 GHz to 18 GHz



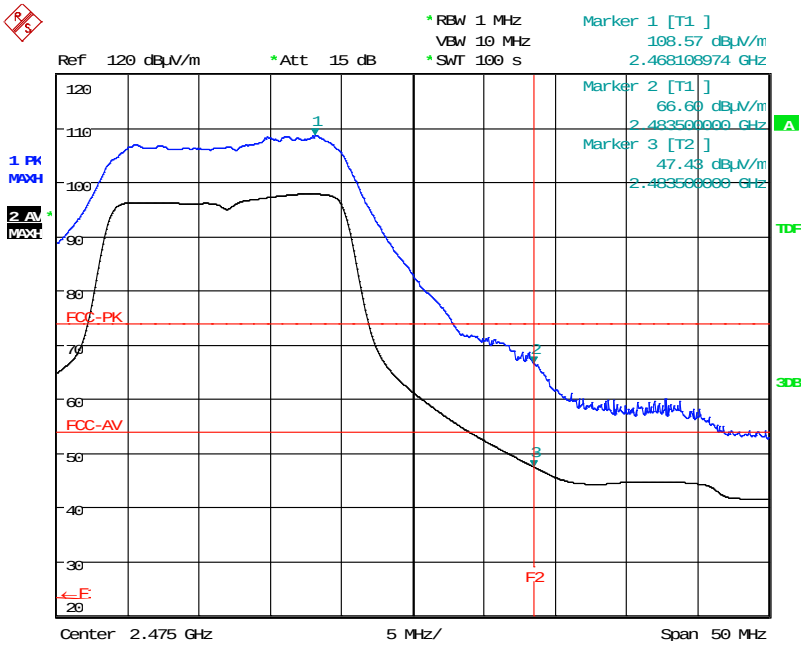
18 GHz to 25 GHz

Radiated band-edge compliance



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

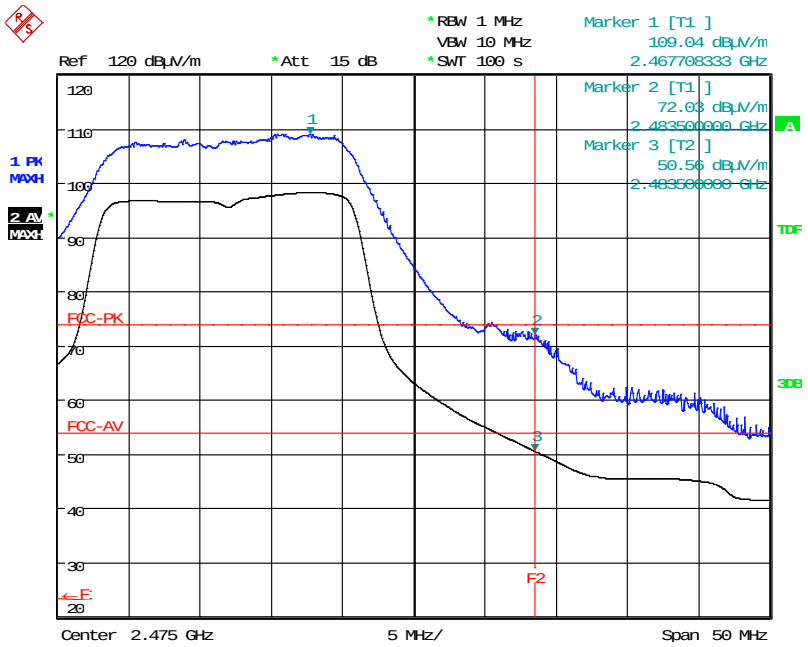
upper band-edge– 802.11b



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

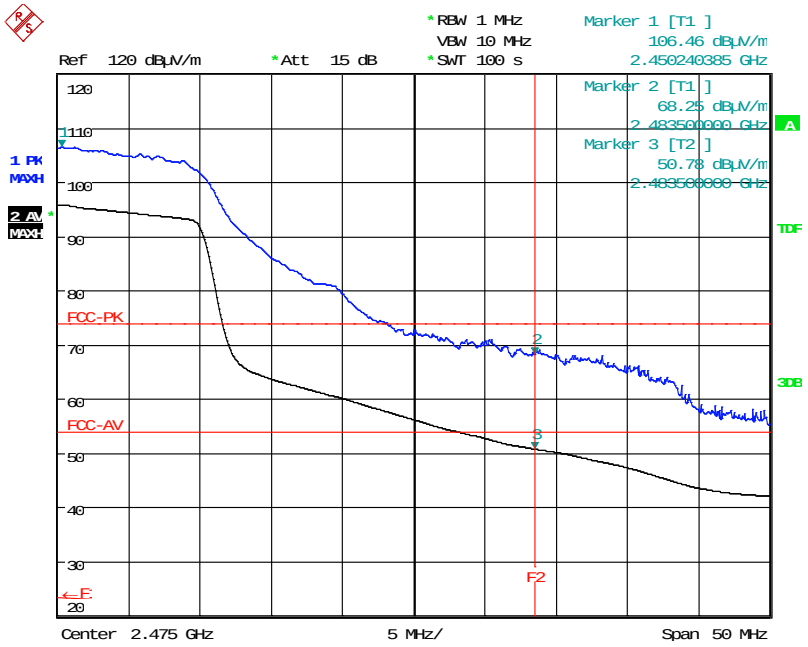
upper band-edge– 802.11g

Radiated band-edge compliance



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

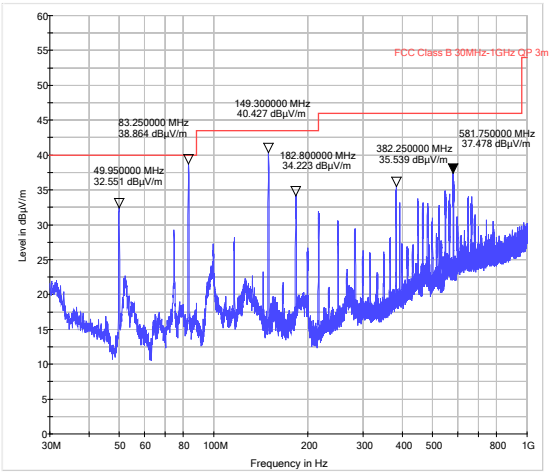
upper band-edge– 802.11n HT20



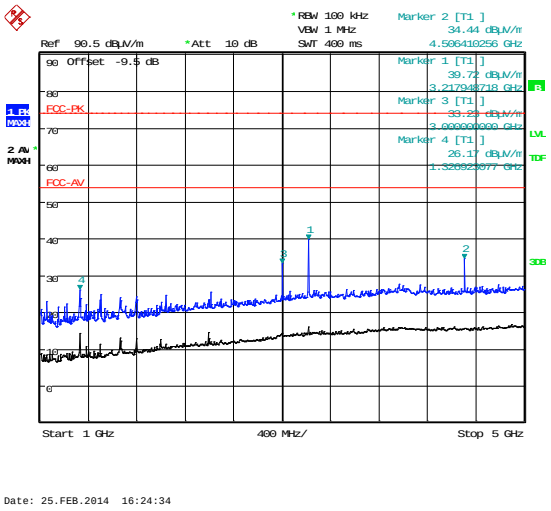
Date: 24.FEB.2014 14:00:02

upper band-edge– 802.11n HT40

Unintentional Radiated Spurious emissions 2412 MHz

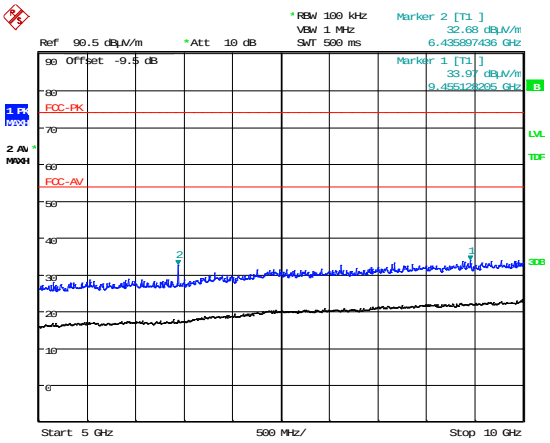


30 MHz to 1 GHz



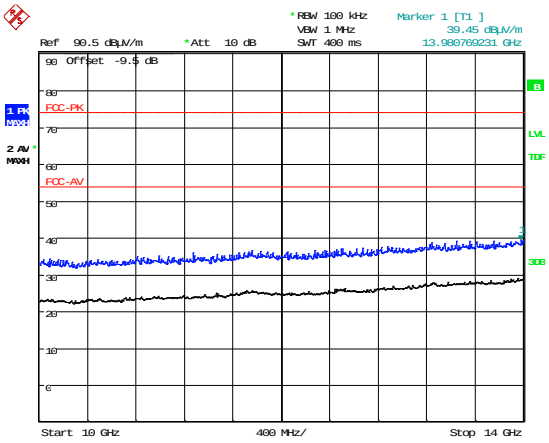
Date: 25.FEB.2014 16:24:34

1 GHz to 5 GHz



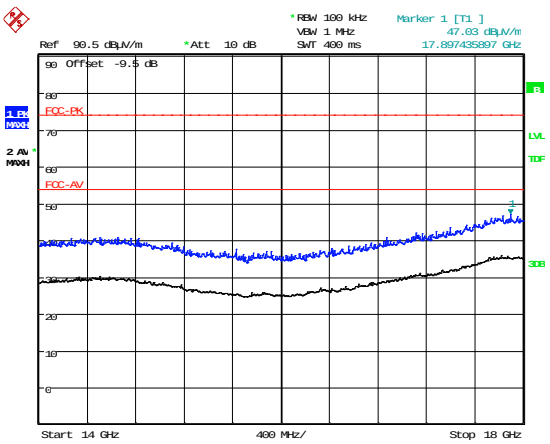
Date: 25.FEB.2014 16:39:57

5 GHz to 10 GHz



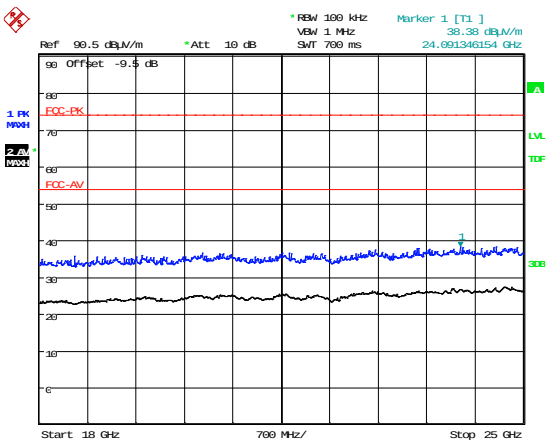
Date: 25.FEB.2014 16:39:02

10 GHz to 14 GHz



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

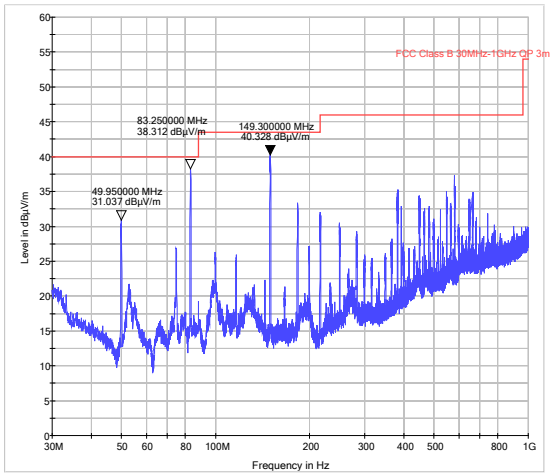
14 GHz to 18 GHz



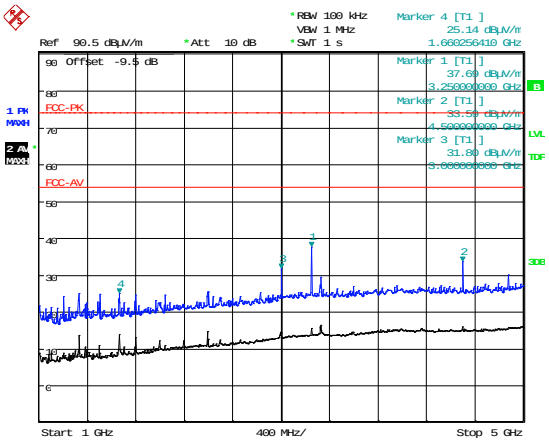
Date: 26.FEB.2014 17:28:52

18 GHz to 25 GHz

Unintentional Radiated Spurious emissions 2437 MHz

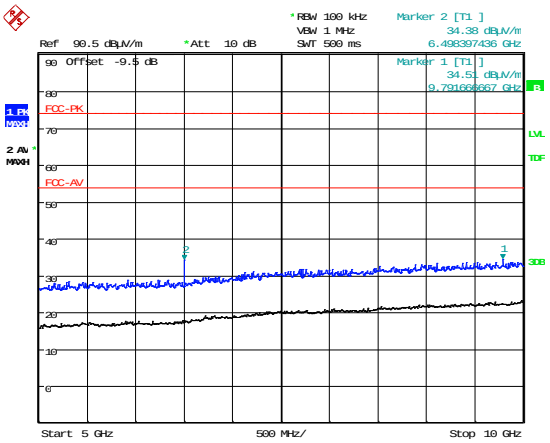


30 MHz to 1 GHz



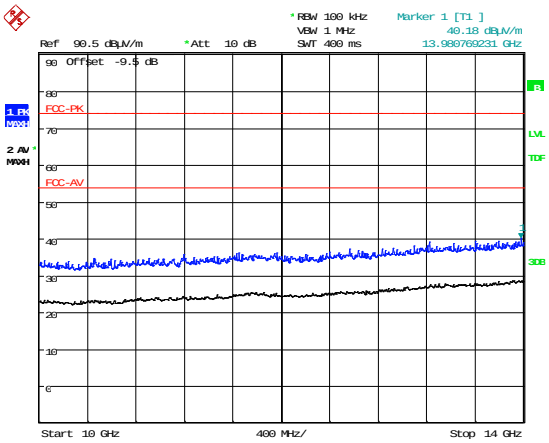
Date: 26.FEB.2014 14:27:58

1 GHz to 5 GHz



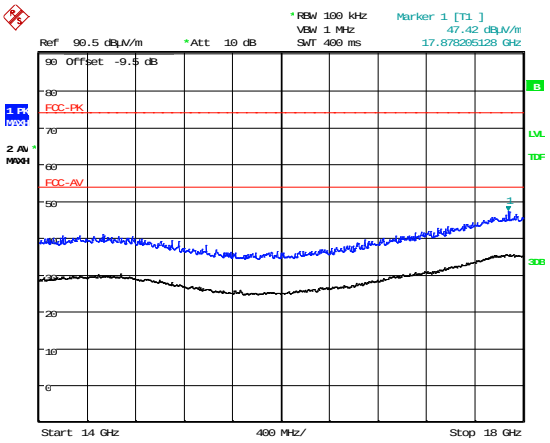
Date: 25.FEB.2014 16:44:14

5 GHz to 10 GHz



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

10 GHz to 14 GHz



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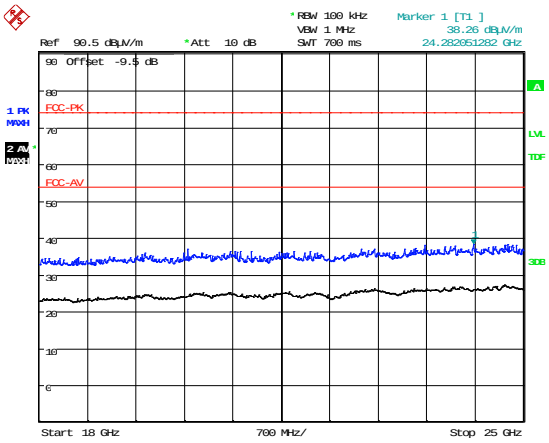
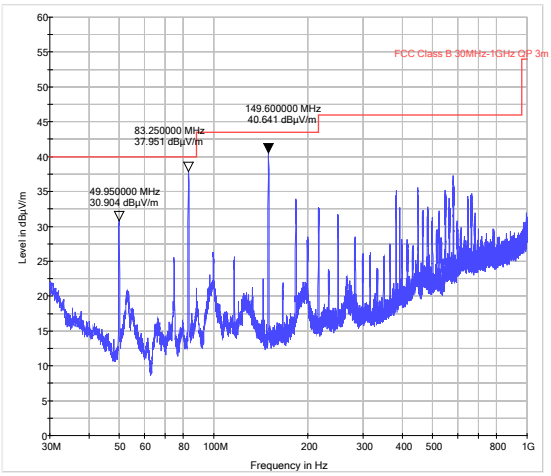
14 GHz to 18 GHz



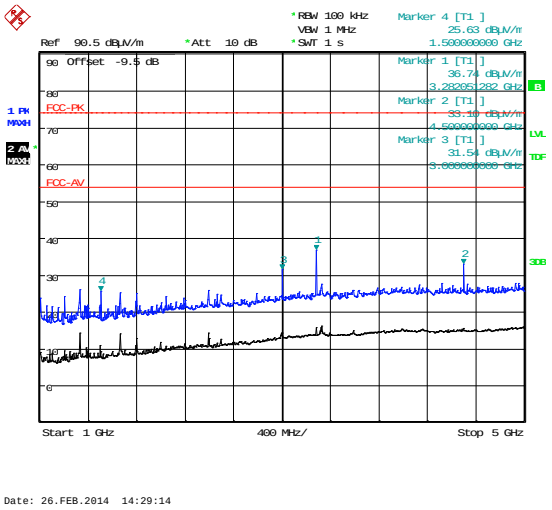
Date: 26.FEB.2014 17:27:50

18 GHz to 25 GHz

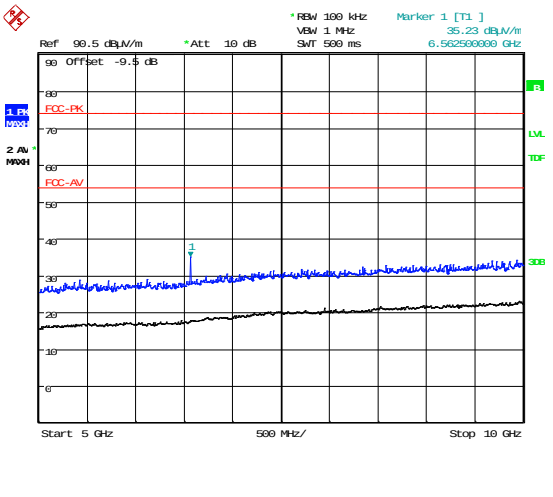
Unintentional Radiated Spurious emissions 2462 MHz



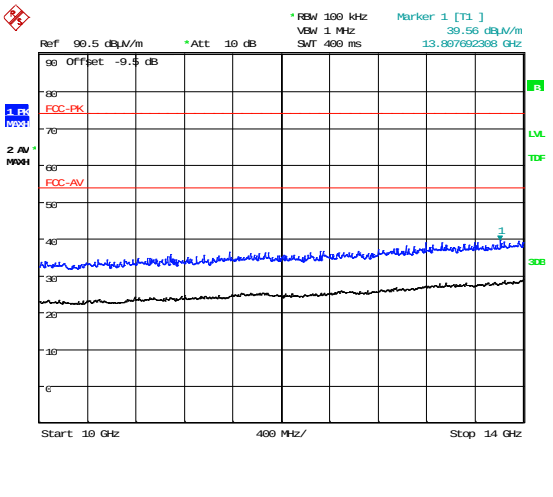
30 MHz to 1 GHz



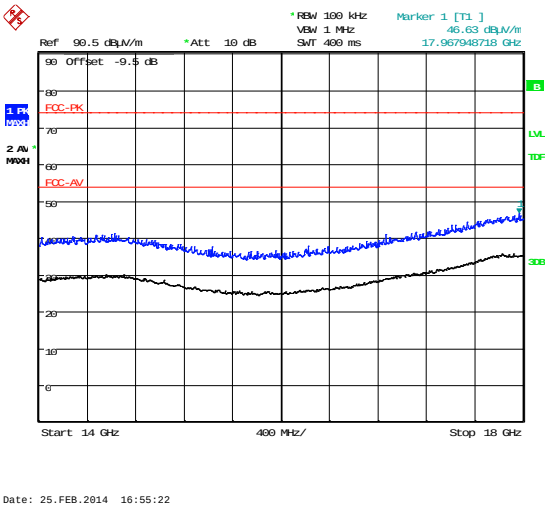
1 GHz to 5 GHz



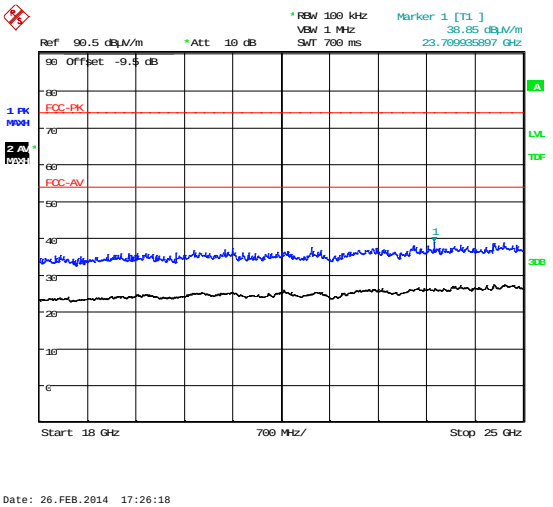
5 GHz to 10 GHz



10 GHz to 14 GHz



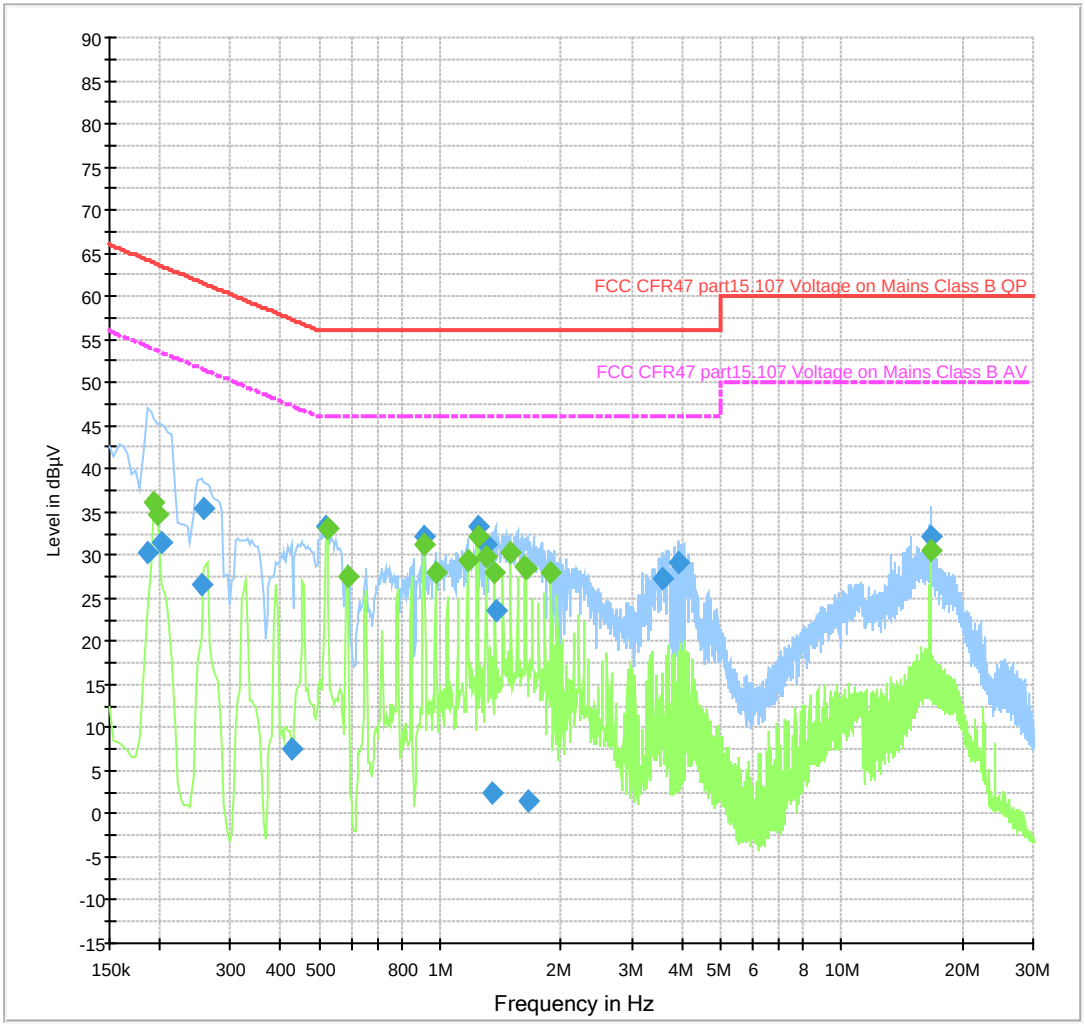
14 GHz to 18 GHz



18 GHz to 25 GHz

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-ampifier	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 x (Log_{10} 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 = $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{\text{100ms}}$

e.g

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

0.07459 or 7.459%

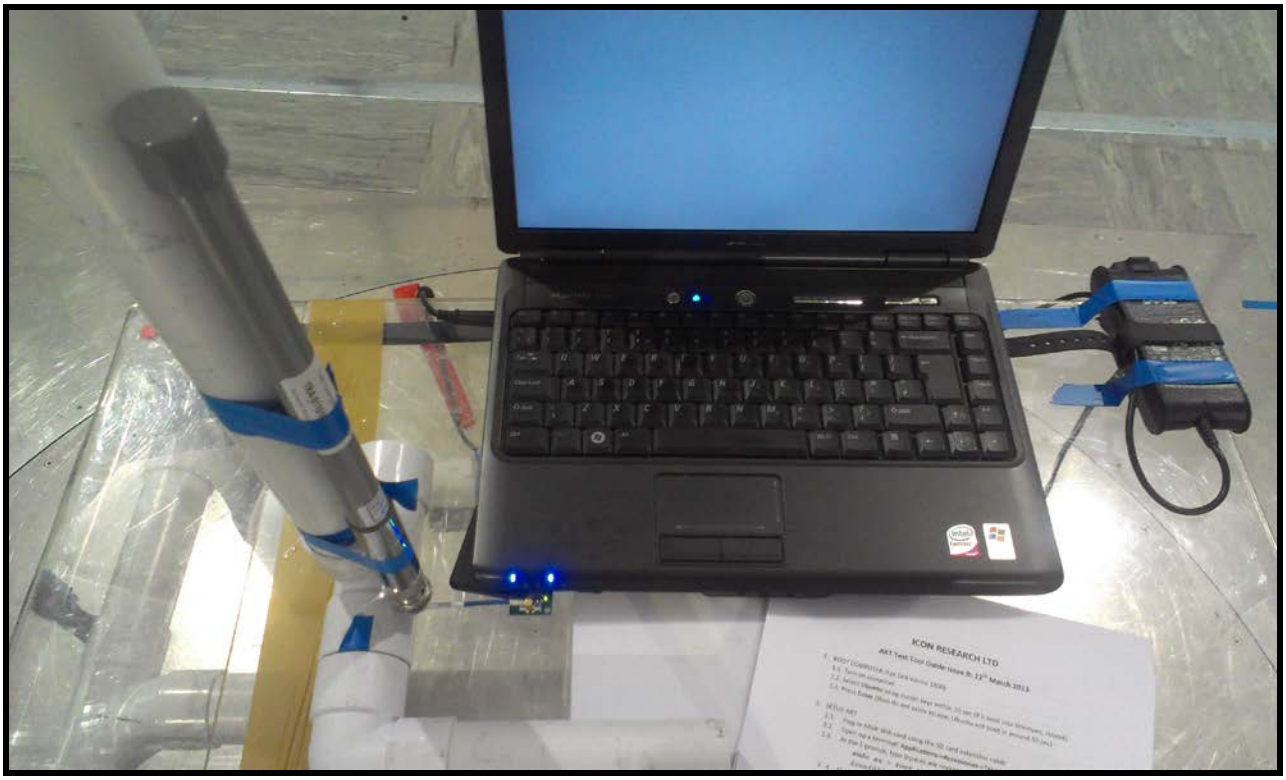
Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

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 2

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/cm^2 power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

Equation from KDB 447498

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

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

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