

CONFORMANCE TEST REPORT**FOR****Subpart C Part 15.247****Report No. : JNDL-NU-16R-0003**

Client: S-1 Corporation
Product: Access Controller
Model: CNT10003
Manufacture/supplier: S-1 Corporation



Date test item received: 2016/06/07
Date test campaign completed: 2016/07/22
Date of issue: 2016/08/01

ATTESTATION STATEMENT

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards.

All **JNDL Laboratory. CO., LTD** instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

Total number of pages of this test report : 61 pages

Test engineer	Report reviewed by
	
Seok-Hee Han	Byoung-Su, Shim

REPORT SUMMARY

Purpose of Test :	To demonstrate the EUT in compliance with FCC Part 15 Subpart C for DTS (Part 15 Digital Transmission System)
Disclaimer :	The test results relate only to the items tested.
Applicable Standards :	Pt 15.247, ANSI C63.4-2009

TEST ENVIRONMENT AND TEST SETUP

Test Facilities :	Test Firm Registration # : 748649 3m & 10m Open Site : 386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 3m semi-Anechoic chamber : B 114~115, 810 Kwanyang-Dong, dongan-Gu, Anyang-Si, Kyunggi-Do, 431-060, Korea
Laboratory Test Conditions :	Open Site : Temperature 28 °C, Humidity : 70 % 3m anechoic chamber : Temperature 24 °C, Humidity : 46 %
Test Exercise :	The EUT was set in continuous transmit mode of operation unless stated otherwise.
Modification to the EUT :	No modification was made.
Supporting Accessories :	None

REVISION HISTORY

Revision	Date	Descriptions
0	2016. 08. 01	Original release

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1. General Remarks

The test results in this report apply to the particular Equipment Under Test (EUT) as declared in this report.

The test results presented in this report relate only to the item tested.

2. Test Site

2.1 Location

JNDL Laboratory. CO., LTD. (Test Firm Registration # : 748649)

3m anechoic chamber : B 114~115, 810 Kwanyang-Dong, dongan-Gu, Anyang-Si, Kyunggi-Do, Korea

3m & 10m Open site : 386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea

2.2 List of Test equipment used for tests

No.	Instrument	Model No.	Due to Calibration	Manufactor	Serial No.
<input checked="" type="checkbox"/>	PSA SPECTRUM ANALYZER (3 Hz ~ 26.5 GHz)	E4440A	2017-01-12	Agilent Technologies	MY46185375
<input checked="" type="checkbox"/>	SPECTRUM ANALYZER (9 KHz ~ 40 GHz)	FSP40	2016-09-01	Rohde & Schwarz	100308
<input checked="" type="checkbox"/>	SIGNAL GENERATOR (10 MHz ~ 40 GHz)	MG3694B	2016-09-08	Anritsu Corp	062513
<input checked="" type="checkbox"/>	POWER METER (DC ~ 67 GHz)	NRP2	2016-09-02	Rohde & Schwarz	100973
<input checked="" type="checkbox"/>	POWER SENSOR (50 MHz ~ 40 GHz)	NRP-Z85	2016-09-02	Rohde & Schwarz	101121
<input checked="" type="checkbox"/>	POWER SENSOR (9 KHz ~ 6 GHz)	NRP-Z92	2016-09-02	Rohde & Schwarz	100093
<input type="checkbox"/>	EMI TEST RECEIVER (9 KHz ~ 7 GHz)	ESC17	2016-09-01	Rohde & Schwarz	100933
<input checked="" type="checkbox"/>	EMI TEST RECEIVER (20 MHz ~ 1000 MHz)	ESVS30	2016-09-01	Rohde & Schwarz	828525/005
<input checked="" type="checkbox"/>	AUTORAING POWER SUPPLY	E3630A	2016-09-01	Agilent Technologies	MY40005094
<input checked="" type="checkbox"/>	BILOG ANTENNA (30 MHz ~ 1000 MHz)	VULB 9168	2017-03-15	Schwarzbeck	9168-505
<input checked="" type="checkbox"/>	HORN ANTENNA (1 GHz ~ 18 GHz)	BBHA 9120D	2018-03-10	Schwarzbeck	568
<input checked="" type="checkbox"/>	HORN ANTENNA (18 GHz ~ 40 GHz)	BBHA 9170	2017-04-29	Schwarzbeck	BBHA9170440
<input checked="" type="checkbox"/>	HORN ANTENNA (18 GHz ~ 40 GHz)	BBHA 9170	2017-04-29	Schwarzbeck	BBHA9170444
<input checked="" type="checkbox"/>	Low Noise Amplifier (100 MHz ~ 26.5 GHz)	TTA2650-HG	2017-05-09	MITEQ	1881352
<input checked="" type="checkbox"/>	Low Noise Amplifier (18 GHz ~ 40 GHz)	AMF-6F-18004000-37-8P	2016-09-04	MITEQ	1814914

➔ All equipment is calibrated with traceable calibrations.

Each calibration is traceable to the national or international standards.

2.3 Test Date

Date of Application: 2016-07 -01

Date of Test: 2016-07-04 ~ 2016-07-22

3. Product Information

3.1 Manufacturers declarations

Manufacturer :	S-1 Corporation
Product Description :	CNT10003 is a controller which receives information from various card reader interfaces (LCD/LED/Fingerprint)and sends information back to the Access Control Server.
FCC ID :	Q54CNT10003
Model Name :	CNT10003
Multiple Model Name :	
Operationg Frequency :	802.11b/g/n(HT20): 2 412 MHz to 2 472 MHz and Channel Spacing 5 MHz (13 Ch)
Type of Modulation :	DSSS (CCK), OFDM (QAM)
Air Date Rate :	11 Mbps (802.11b), 54 Mbps (802.11g), 150 Mbps (802.11n)
Antenna Type :	Internal Antenna (Integral)
Antenna Gain(Max) :	2.54 dBi
RF Power :	8.810 mW
EUT Power Source :	Primary power –110 Vac, 2.5 A (Not use AC adapter)
	Secondary Power – N/A

- ➔ All the testing were performed according to the procedures in FCC Parts 15.247
The EUT was operation in special test mode.

3.2 General Specification

CPU		Cortex-A9 Series	Configuration Port		2.4GHz Wi-Fi USB2.0
Memory		4GB eMMC Flash 1GB SDRAM 4GB SD Card	Operating Voltage		AC 100 ~ 240V (50Hz ~ 60Hz)
Template Capacity		200,000 cards	Operating Temperature		-10℃ ~ +45℃
Log Capacity		200,000 events	Power Consumption		Max 0.8A (AC 220V) Max 2.5A (AC 110V)
Input/ Output		* TCP/IP - 2 Port (WAN, LAN)	Size (WxHxD)		250×305×62.5[mm]
		S-1's C-LAN - 2Port	Weight		2.26Kg (Including Battery) * Bracket : 0.74Kg
Max. Card Reader		256EA Max (SLC-10001 Up to 32 downstream devices)			
Power Module	Output Voltage	DC 14.0V ± 0.5V (Inner voltage)			
	Output Current	Max. 2.7A (Inner max work current)			
	Ripple & Noise	Max. 150mV			
Battery	Type	Lead-Acid Battery (12V, 2A) : 1EA			
	Charge Specification	Charging Voltage : DC 13.5V ~ 13.8V Charging Current : 300±50mA Charging Type : Static Charge Charging Time : Min. 24hr			
	Cutoff Voltage (to protect over-discharge)	9.8V ±0.2V			
Network Interface (with Controller or Server)		TCP/IP (10/100Mbps), SEED or AES encryption			
Network Interface (with other Devices)		TCP/IP (10/100Mbps), SEED or AES encryption C-LAN (Max. 50kbps)			

4. Description of Test

The tests documented in this report were performed in accordance with ANSI C63.4-2009 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

4.1 Radiated Emission Measurement

Radiated emission measurements were made in accordance with § 13 in ANSI C63.4-2009 "Measurement of Intentional radiators" The measurements were performed over the frequency range of 30 MHz to 40 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak, Quasi-peak, Average" within a bandwidth of 120 kHz and above 1 GHz is 1 MHz.

Preliminary measurements were made at 3 m using broadband antennas, and spectrum analyzer to determine the frequency producing the maximum emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1 000 MHz using Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site or SVSWR chamber at 3 m. The test equipment was placed on a styrofoam table. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8 m high nonmetallic 1.0 m x 1.5 m table. The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 m to 4 m and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade) as per section 15.31(f).

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

4.2 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section § 13 in ANSI C63.4-2009 "measurement of intentional radiators" The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to a Spectrum Analyzer or a Test Receiver. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 9 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1 m x 1.5 m x 0.8 m wooden table which is placed 0.4 m away from the vertical wall and 1.5 m away from the side wall of the chamber room. Two LISN are bonded to the shielded room. The EUT is powered from the LISN and the support equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2 cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. Non-inductive bundling to a 1 m length shortened all interconnecting cables more than 1 m. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the EMI Test Receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 MHz to 30 MHz. The bandwidth of the spectrum analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission.

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

4.3 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 - 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 - 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 - 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 - 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 - 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 - 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 - 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 - 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 - 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 - 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 - 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 - 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 - 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 - 4 400	(²)
13.36 - 13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490 MHz - 0.510 MHz.

² Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements

5. TEST CONDITION

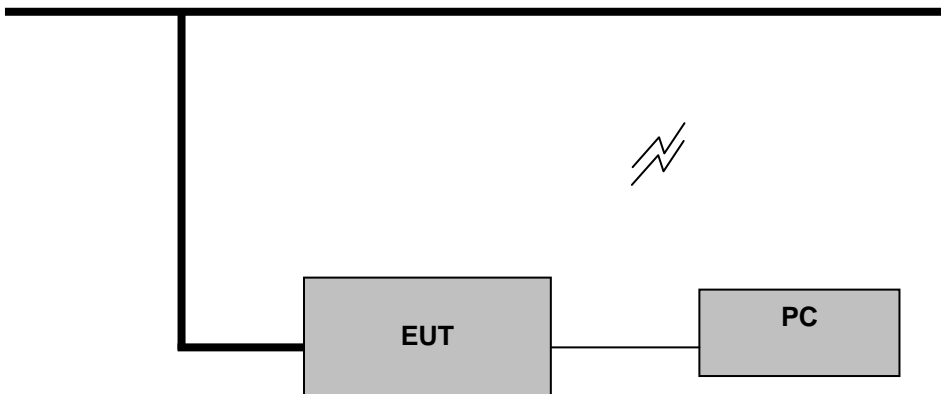
5.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

5.2 Description of Test modes

S1 that has the control software.

5.3 The setup drawing(s)



— : Signal line

— : Power line

6. TEST RESULTS

6.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

47 CFR Part 15, Subpart C	Measurement Required	Result
15.247(a)(2)	6 dB Bandwidth	Pass
15.247(b)(3)	Maximum Peak Output Power	Pass
15.247(d)	Bandwidth of Frequency Band Edges	Pass
15.247(e)	Power Spectral Density	Pass
15.209(a)	Spurious Emissions	Pass
15.207	Conducted Emissions	Pass
1.1307(b)(1)	RF Exposure	Pass

The data collected shows that the S-1 Corporation/Access Controller/CNT10003 complied with technical requirements of above rules part 15.207, 209 and 15.247 Limits.

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

6.2 6 dB Bandwidth

Limit

The maximum 6 dB bandwidth shall be at least 500 kHz.

Test Data

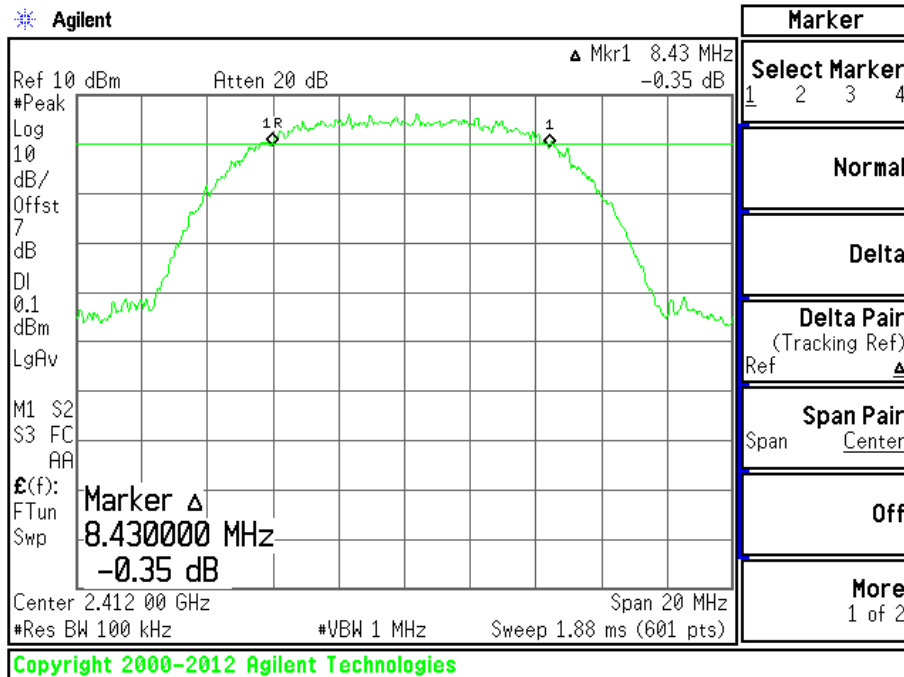
Mode	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit
802.11b	2 412	8.43	> 500 kHz
	2 442	7.73	
	2 472	8.37	
802.11g	2 412	16.57	
	2 442	16.57	
	2 472	16.57	
802.11n(HT20)	2 412	17.70	
	2 442	17.77	
	2 472	17.77	

NOTES:

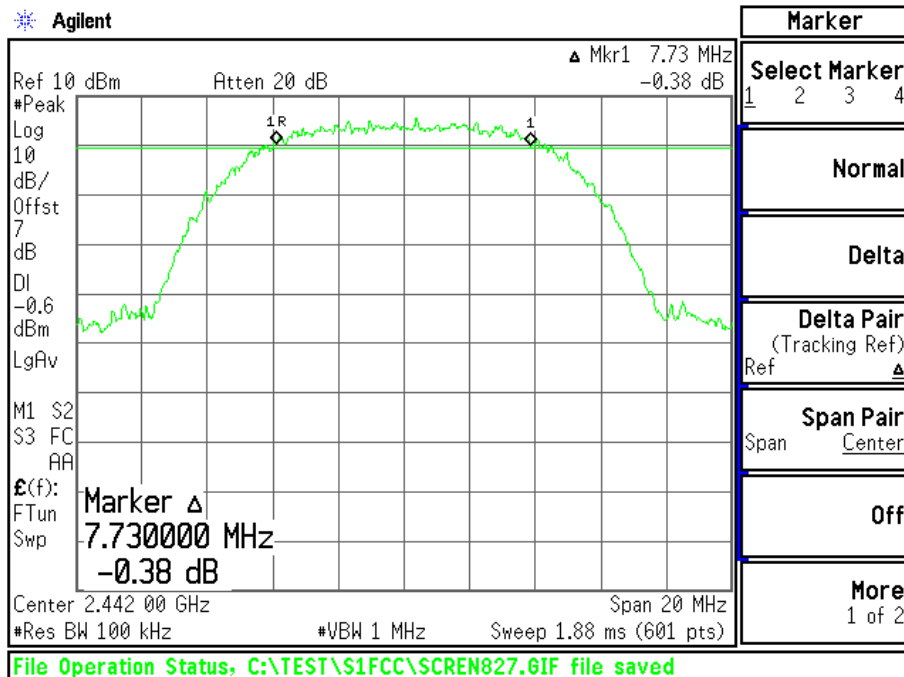
1. Measure frequency separation of relevant channel using spectrum analyzer.
2. RBW 300 kHz, VBW 1 MHz, Sweep time Auto.
3. Please see the measured plot in next page.

Plots of 6 dB Bandwidth (802.11b)

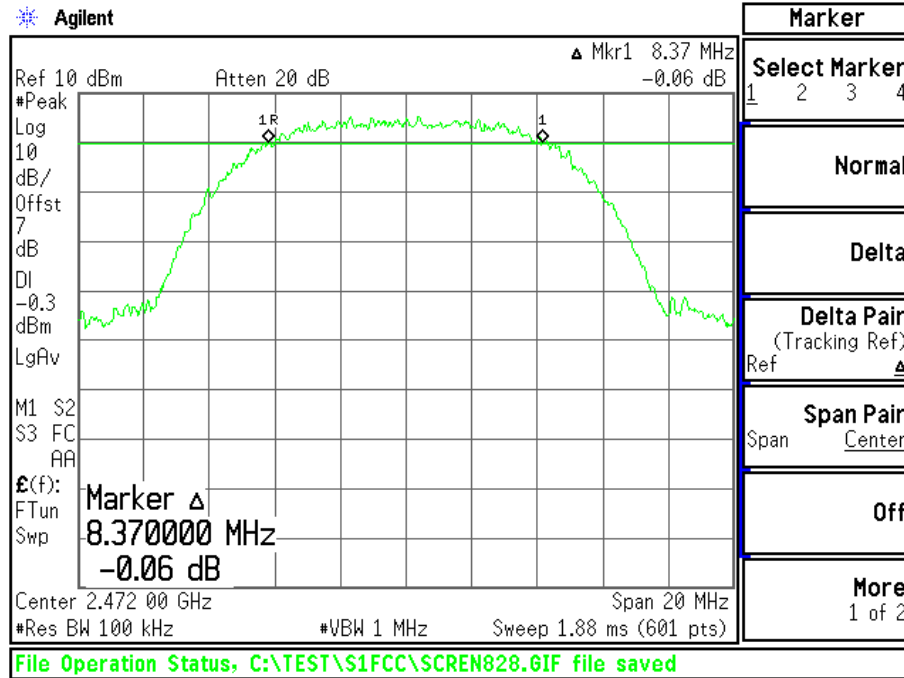
[2 412 MHz]



[2 442 MHz]

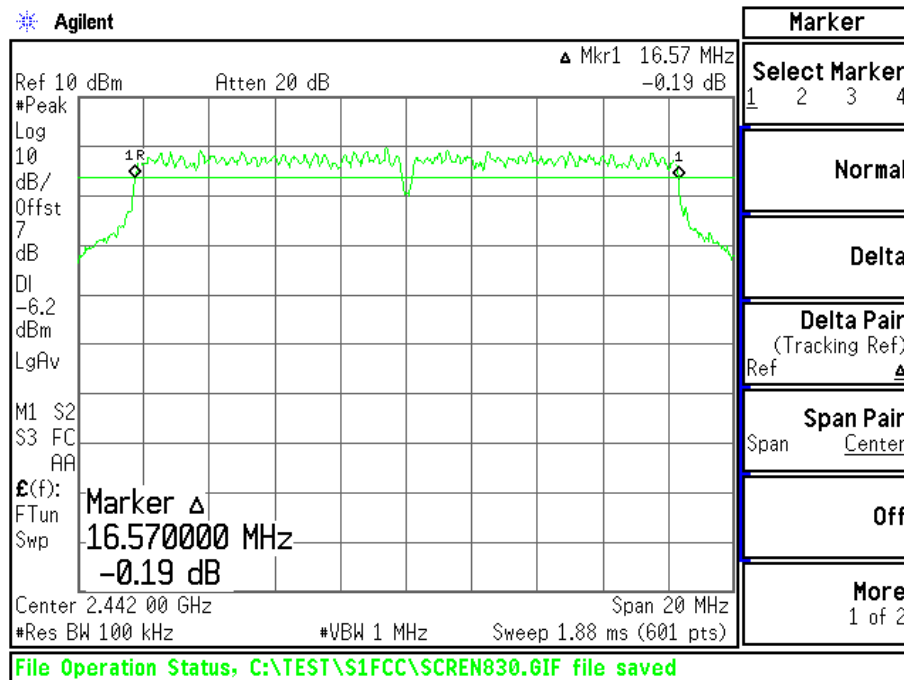


[2 472 MHz]

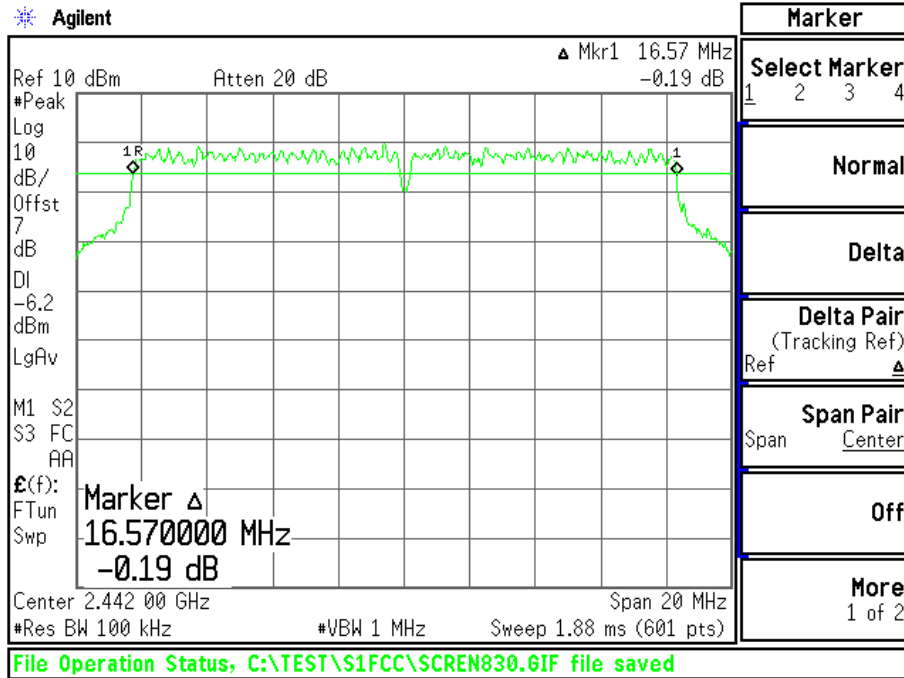


Plots of 6 dB Bandwidth (802.11g)

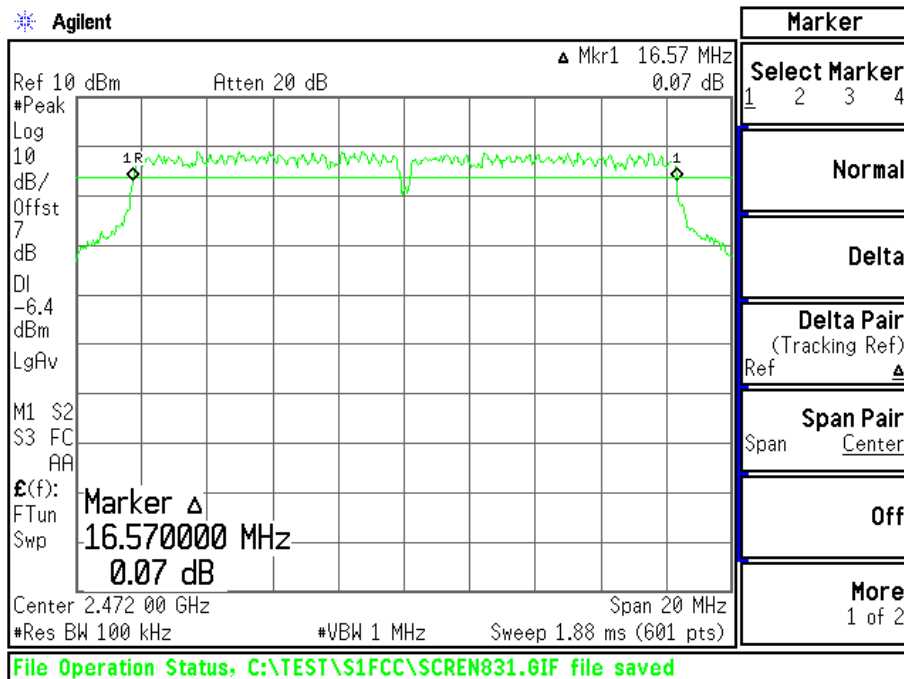
[2 412 MHz]



[2 442 MHz]

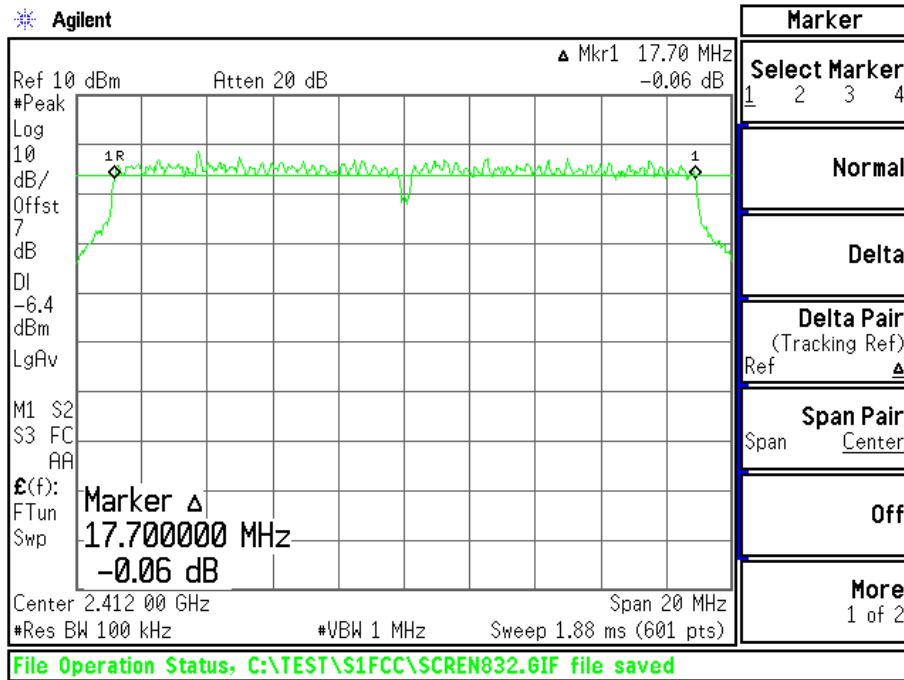


[2 472 MHz]

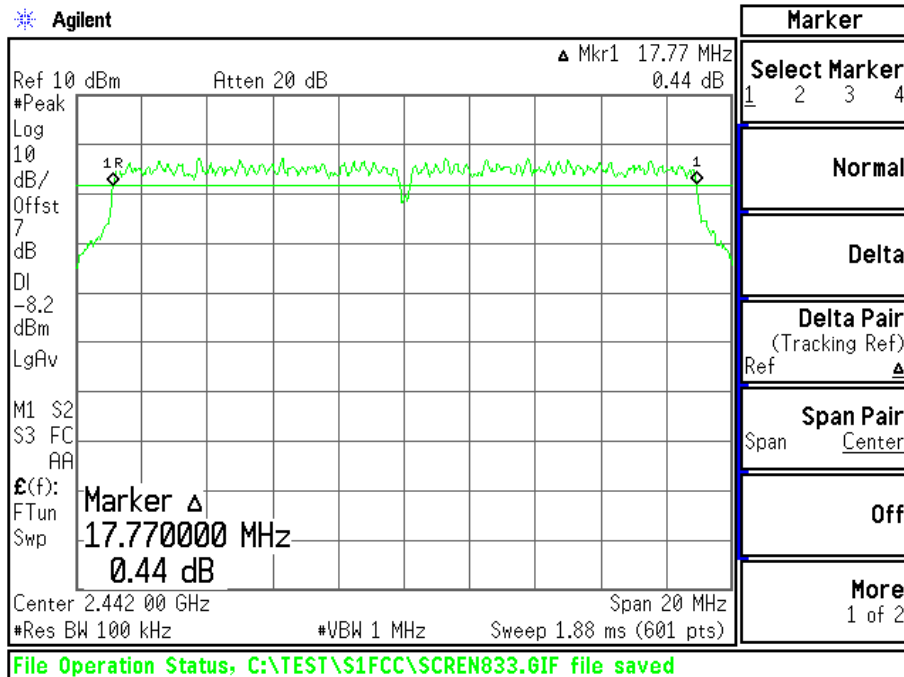


Plots of 6 dB Bandwidth (802.11n(HT20))

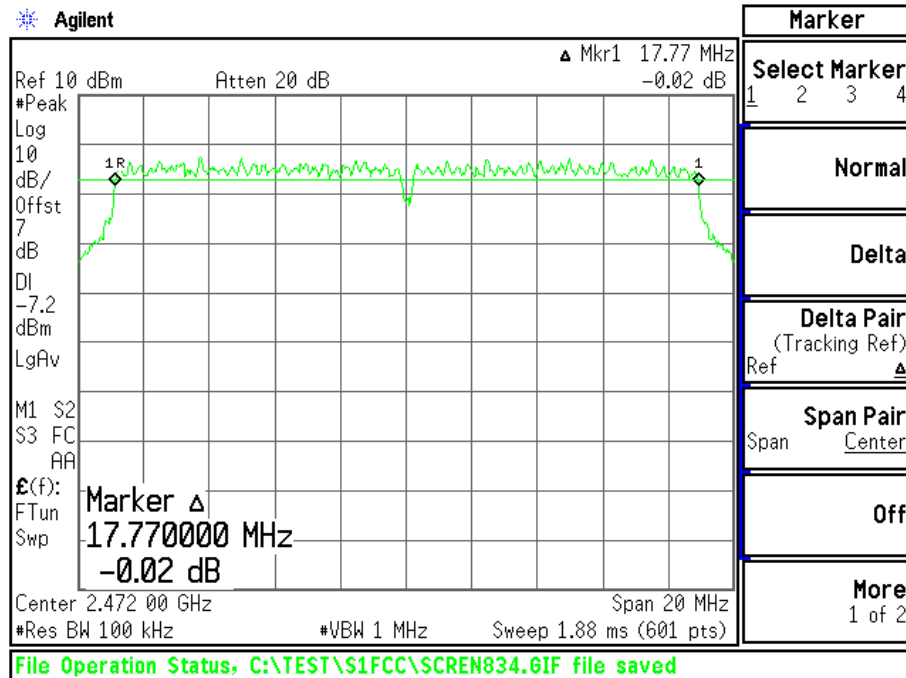
[2 412 MHz]



[2 442 MHz]



[2 472 MHz]



6.3 Maximum Peak Conducted Output Power

Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 2 400.0 MHz - 2 483.5 MHz band: 1 Watt

Test Data

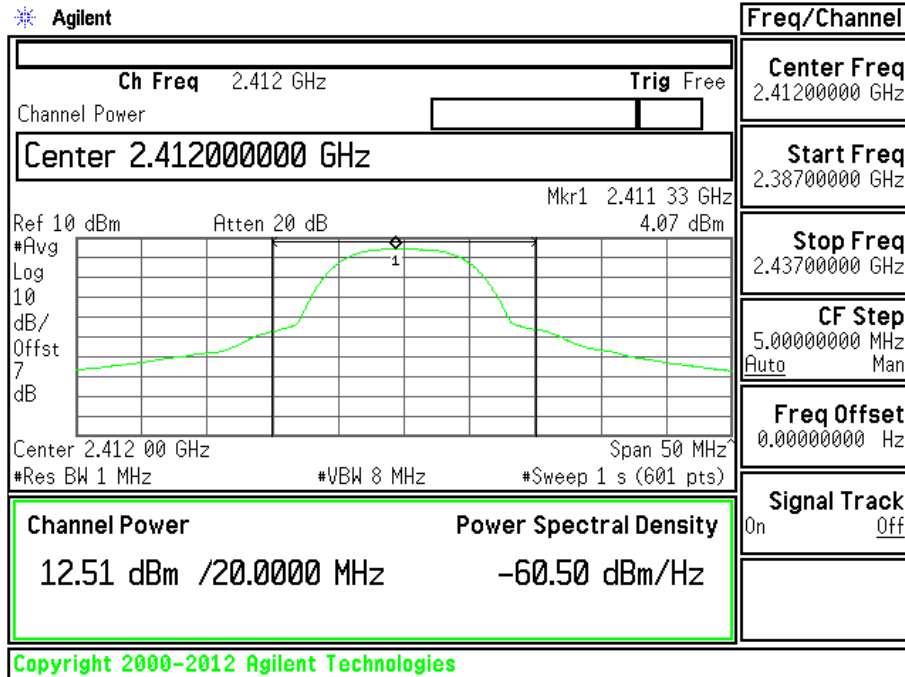
Mode	Frequency [MHz]	Output Power [dBm]	Limit
802.11b	2 412	12.51	< 30.00 dBm (1 W)
	2 442	12.29	
	2 472	12.48	
802.11g	2 412	10.18	
	2 442	9.98	
	2 472	10.04	
802.11n(HT20)	2 412	8.66	
	2 442	8.46	
	2 472	8.55	

NOTES:

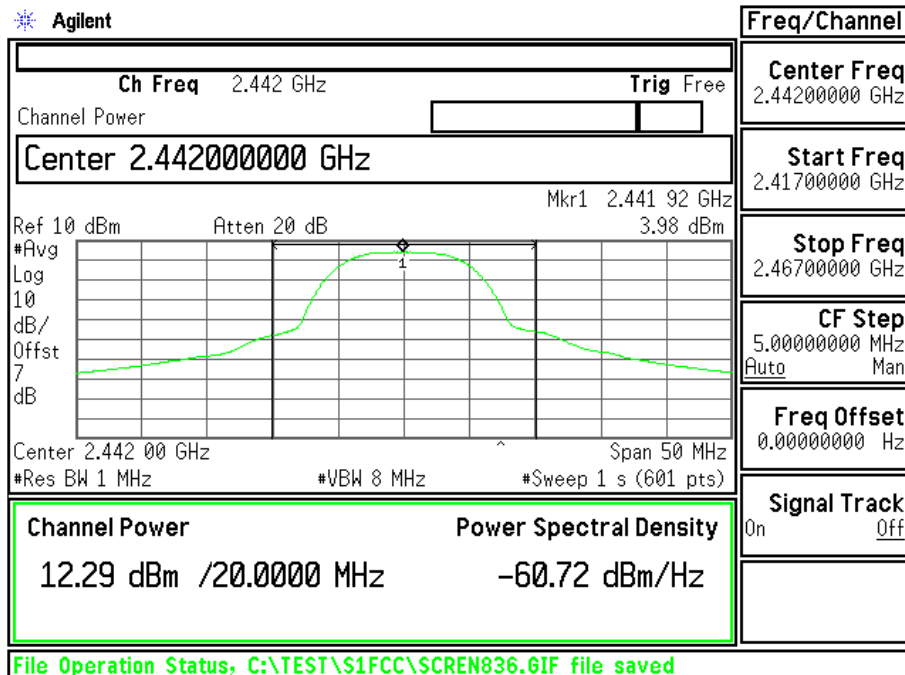
1. Measure conducted Channel power of relevant channel using spectrum analyzer.
2. RBW 1 MHz, VBW 8 MHz
3. Please see the measured plot in next page.

Plots of Maximum Peak Output Power Bandwidth (802.11b)

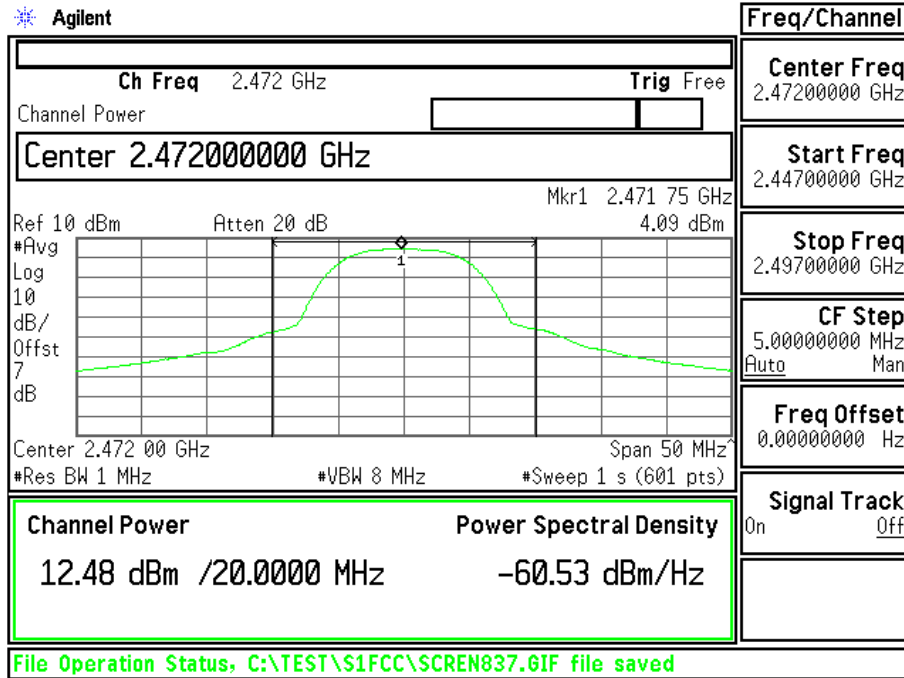
[2 412 MHz]



[2 442 MHz]

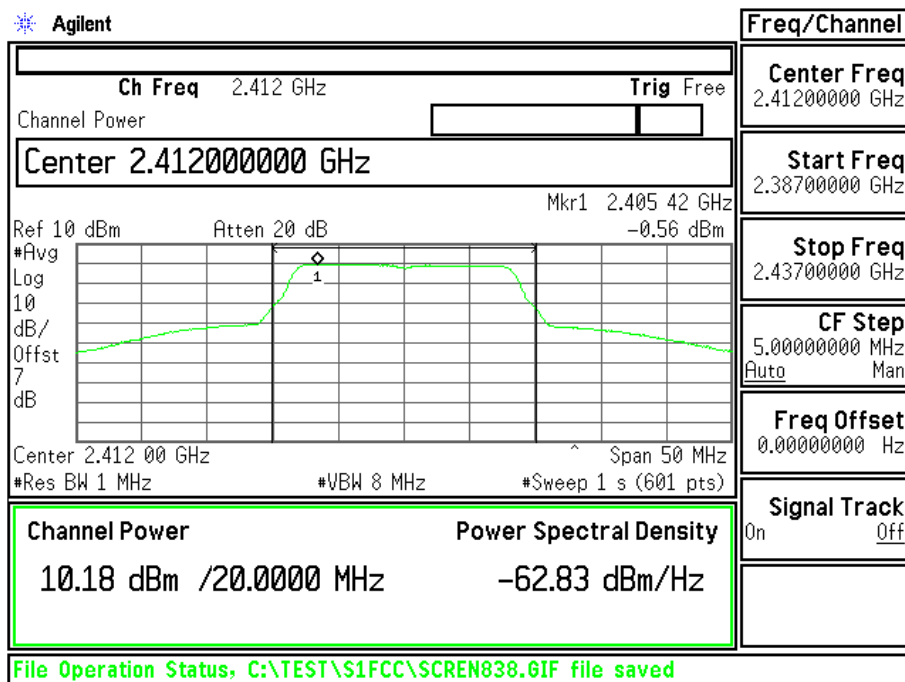


[2 472 MHz]

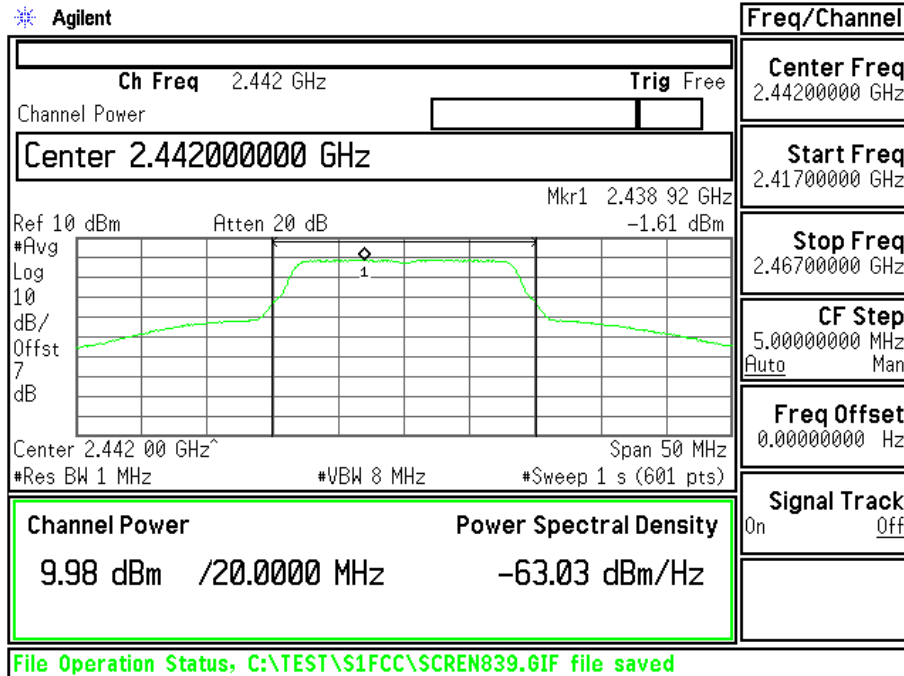


Plots of Maximum Peak Output Power Bandwidth (802.11g)

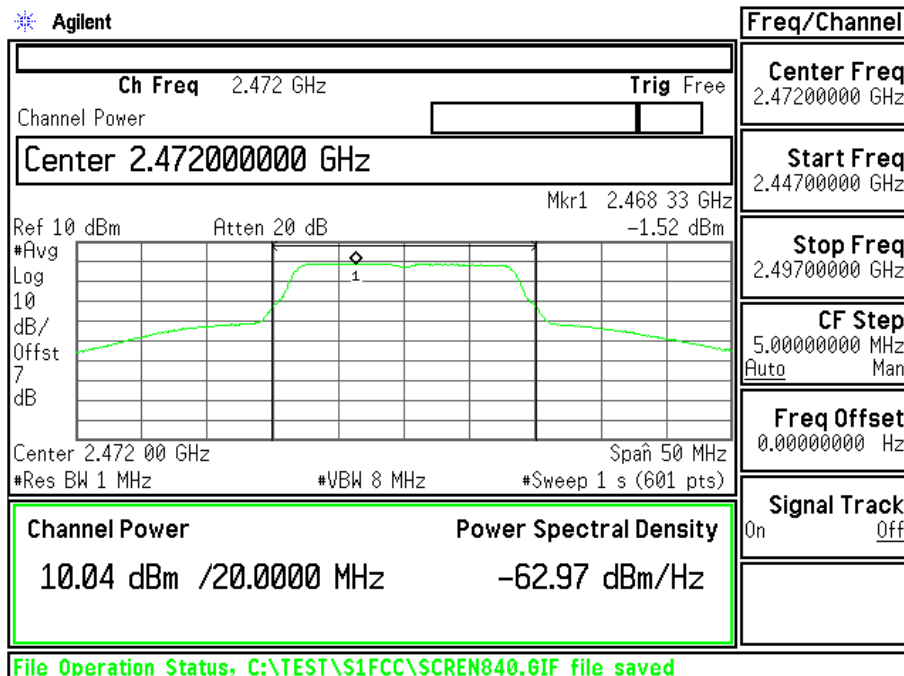
[2 412 MHz]



[2 442 MHz]

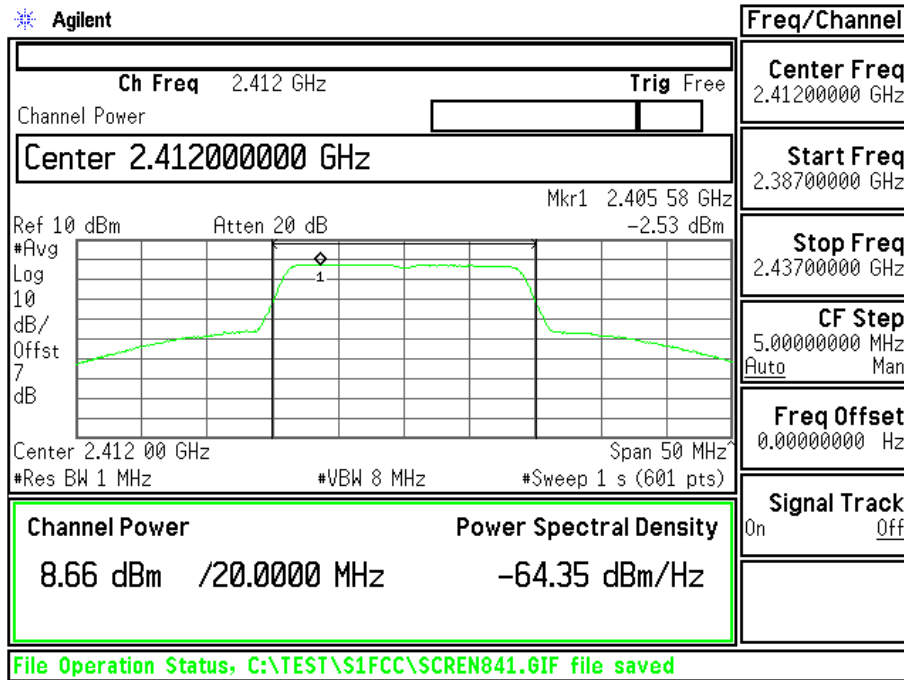


[2 472 MHz]

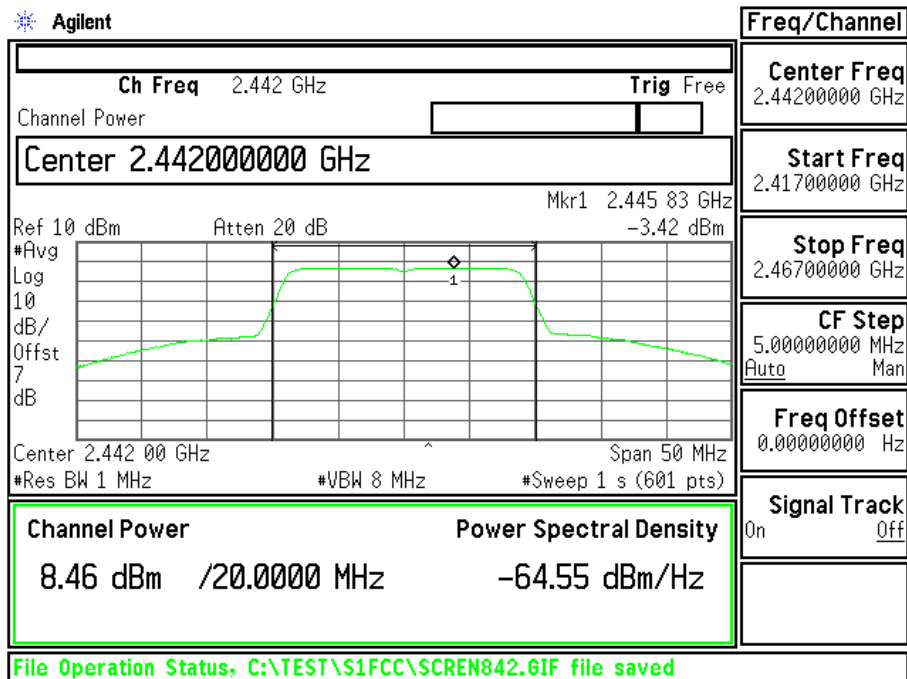


Plots of Maximum Peak Output Power Bandwidth (802.11n(HT20))

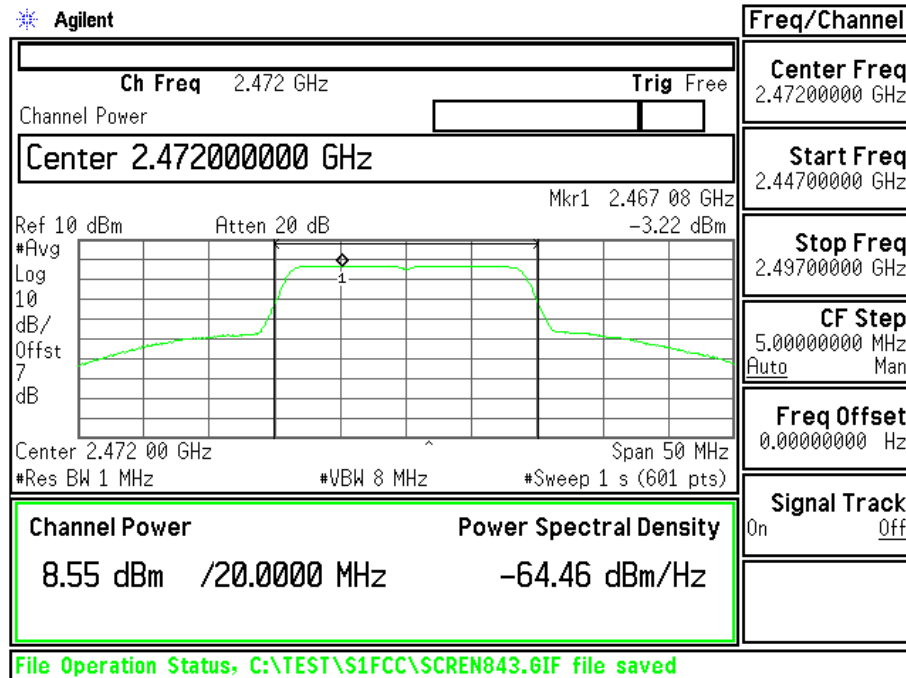
[2 412 MHz]



[2 442 MHz]



[2 472 MHz]



6.4 Bandwidth of Frequency Band Edges

Limit

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

Test Results

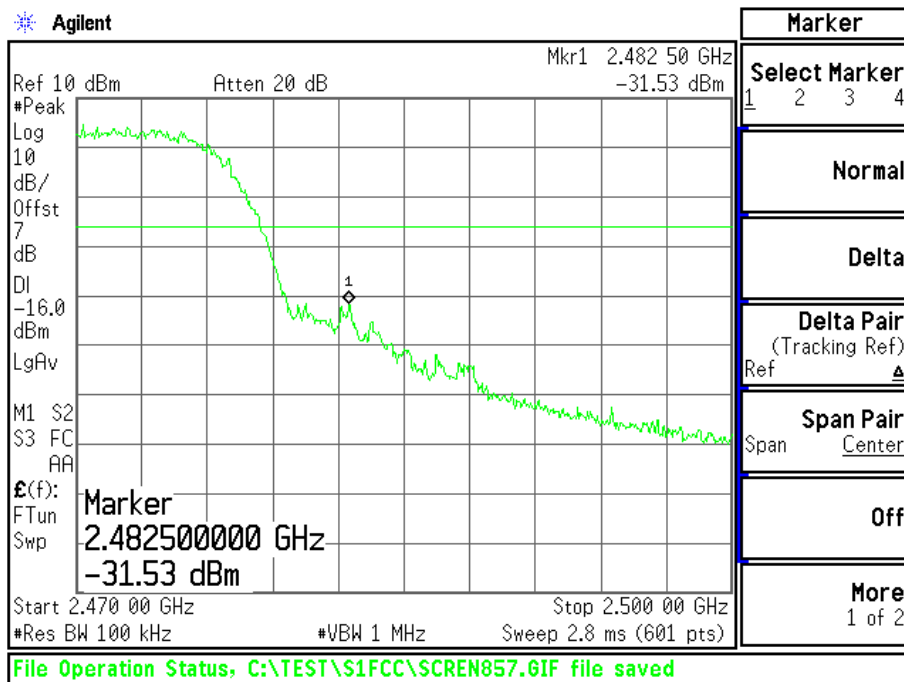
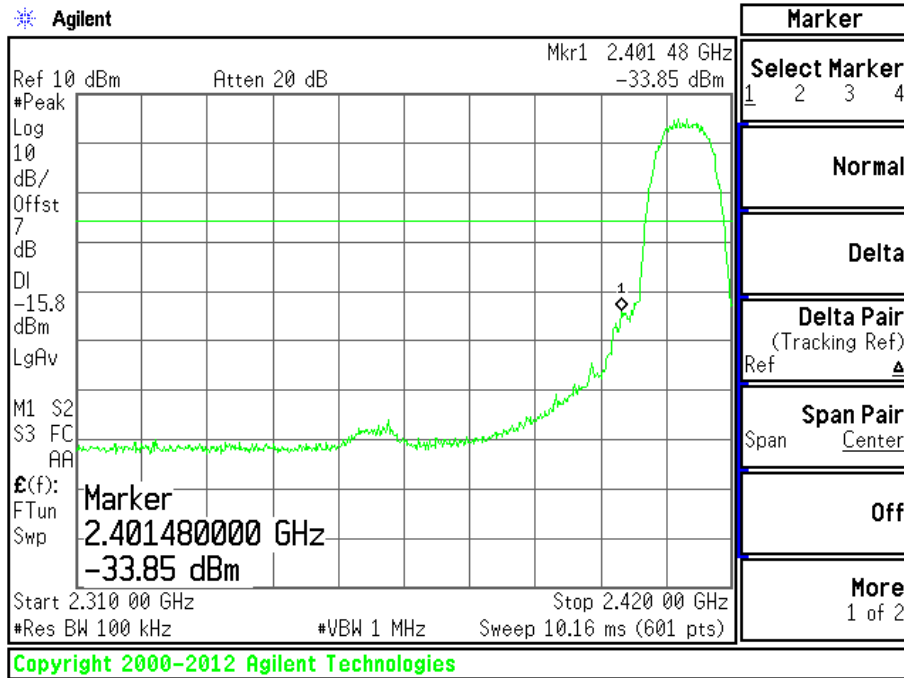
- Refer to see the measured plot in next page.

NOTES:

1. The test was performed to make a direct field strength measurement at the band edge frequencies.

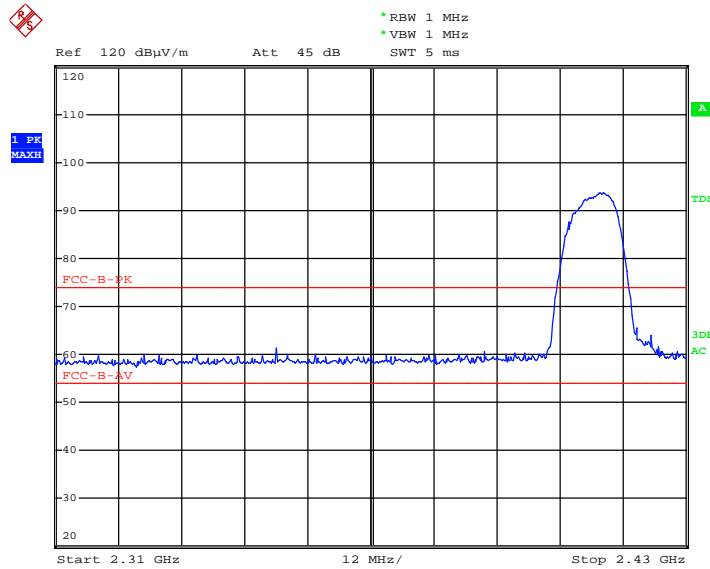
Plots of Bandwidth of Frequency Band Edges (802.11b)

Conducted



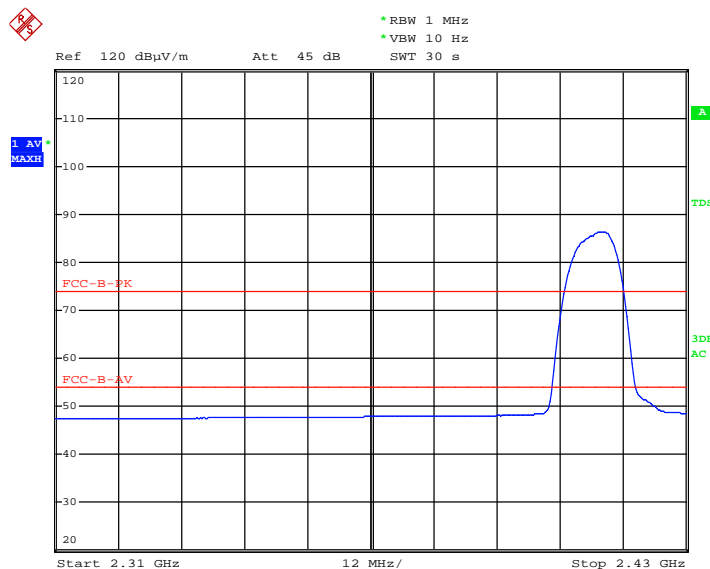
Radiated

Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



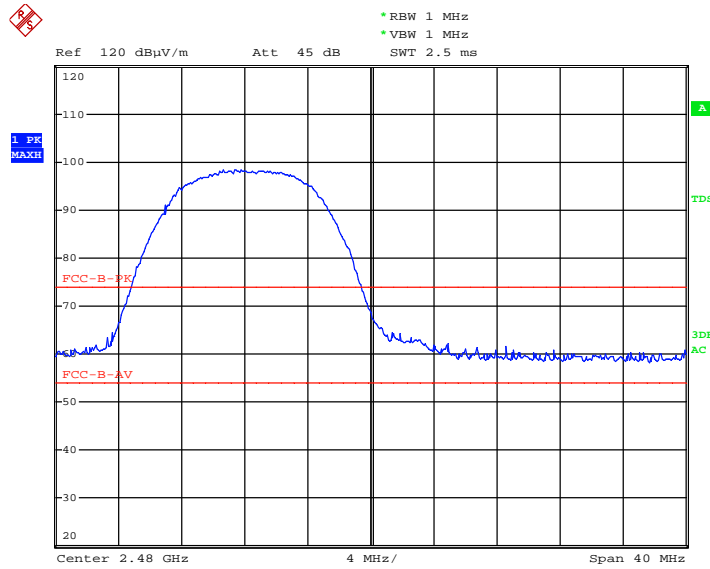
Date: 27.JUN.2016 14:38:38

AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



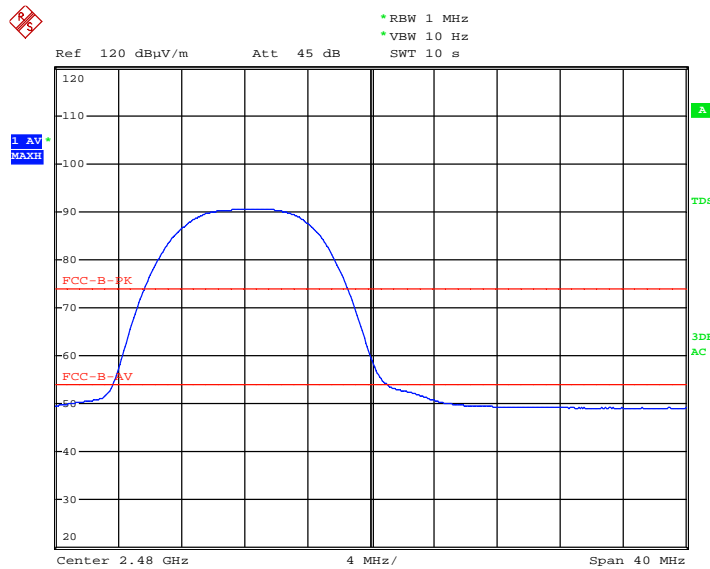
Date: 27.JUN.2016 14:40:14

Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)



Date: 27.JUN.2016 15:01:45

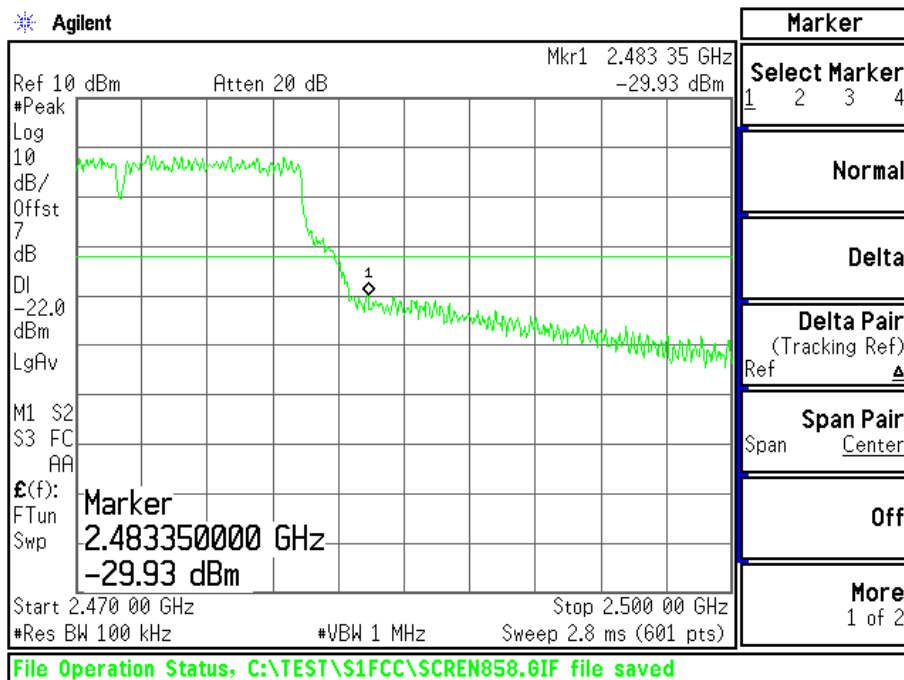
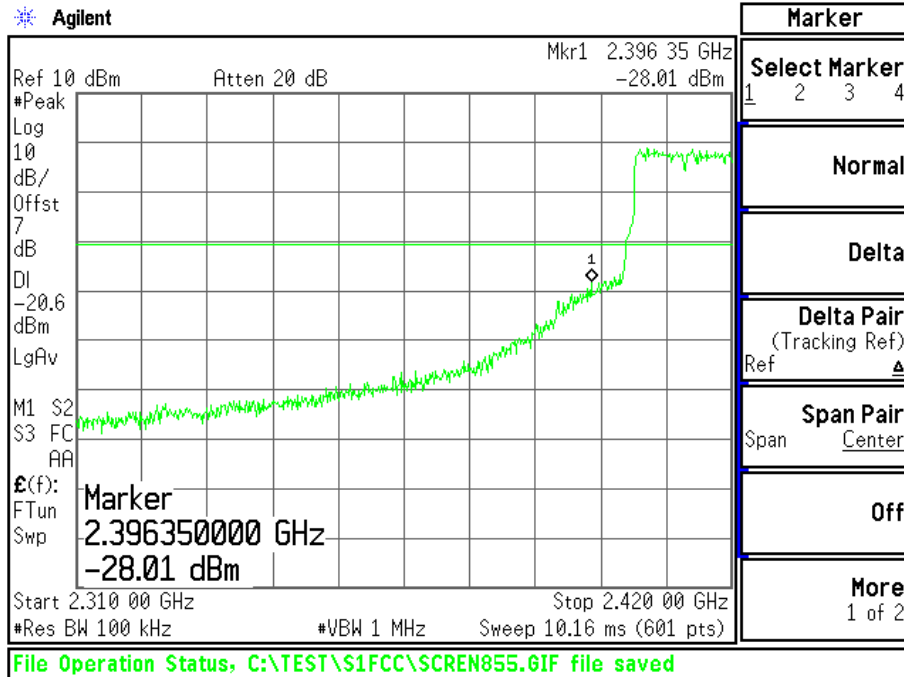
AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)



Date: 27.JUN.2016 15:03:22

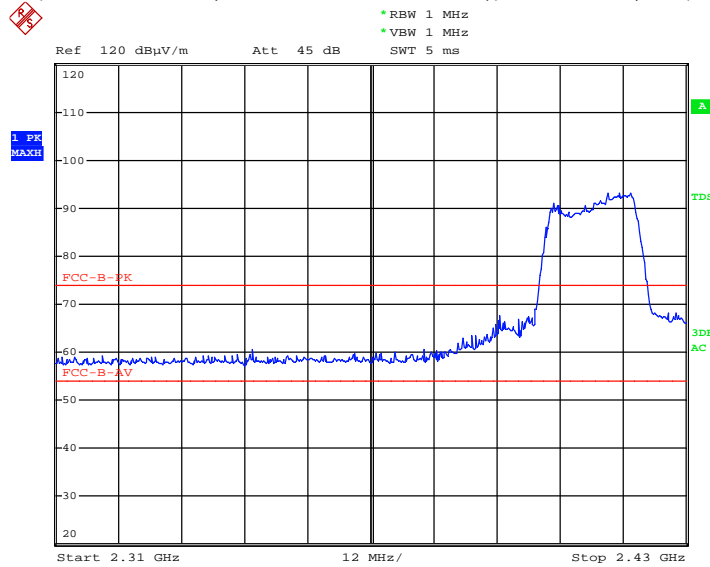
Plots of Bandwidth of Frequency Band Edges (802.11g)

Conducted



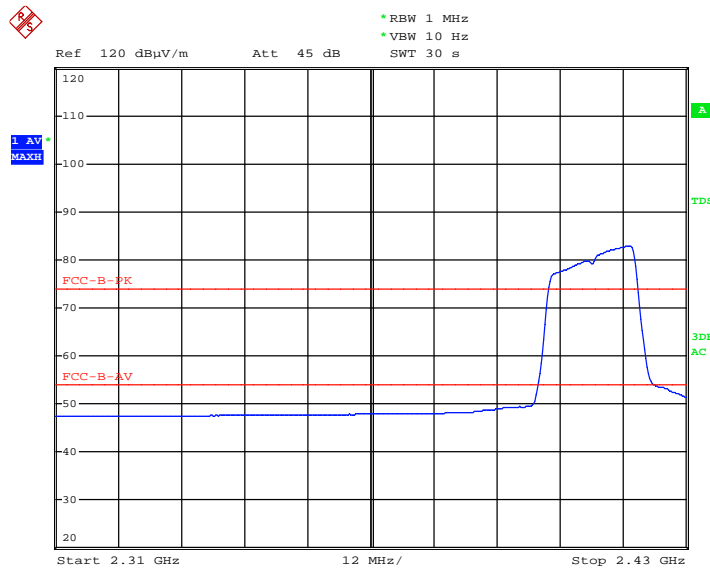
Radiated

Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



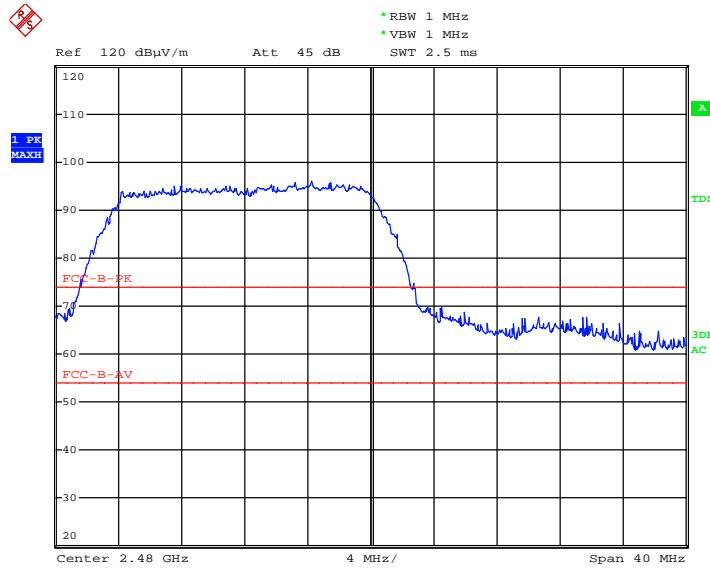
Date: 27.JUN.2016 14:43:33

AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



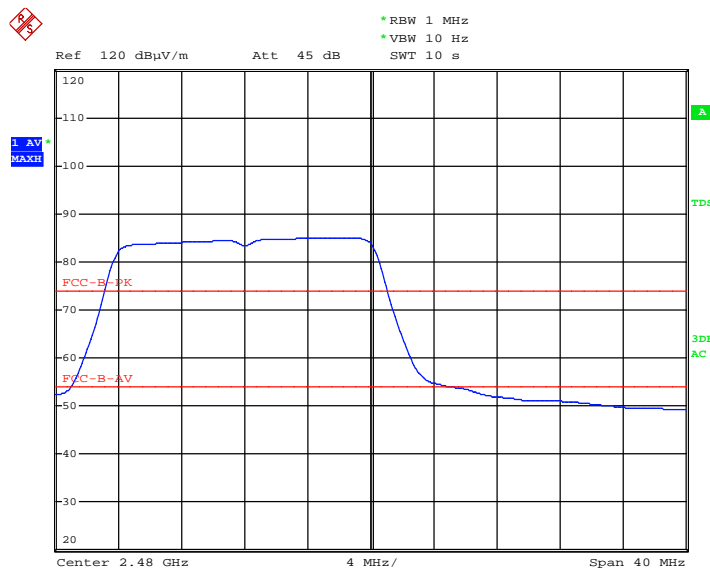
Date: 27.JUN.2016 14:44:50

Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)



Date: 27.JUN.2016 15:05:26

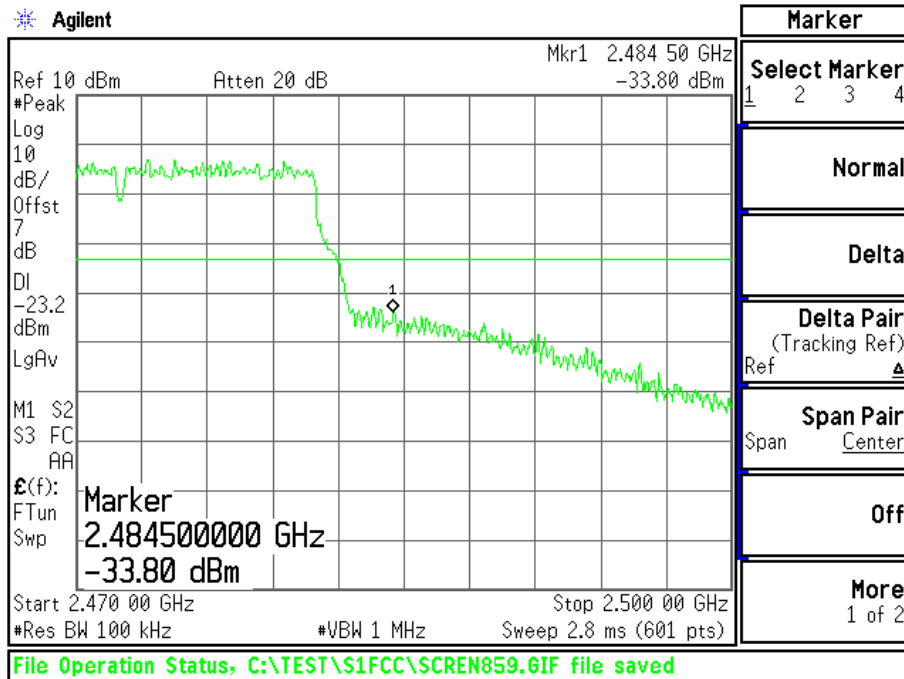
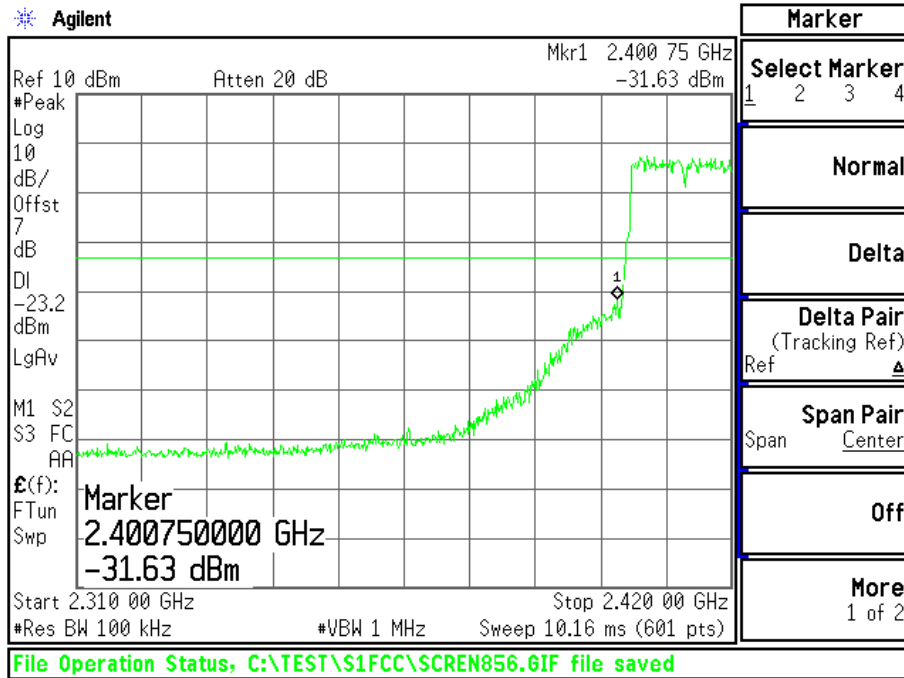
AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)



Date: 27.JUN.2016 15:06:26

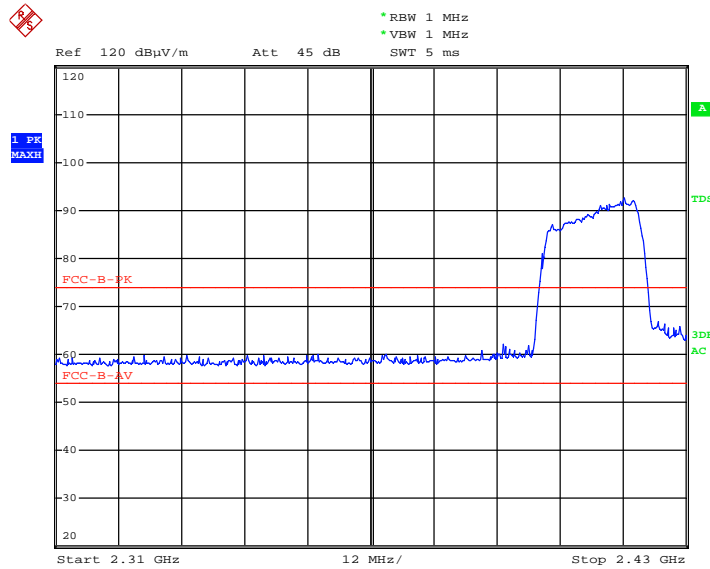
Plots of Bandwidth of Frequency Band Edges (802.11n(HT20))

Conducted



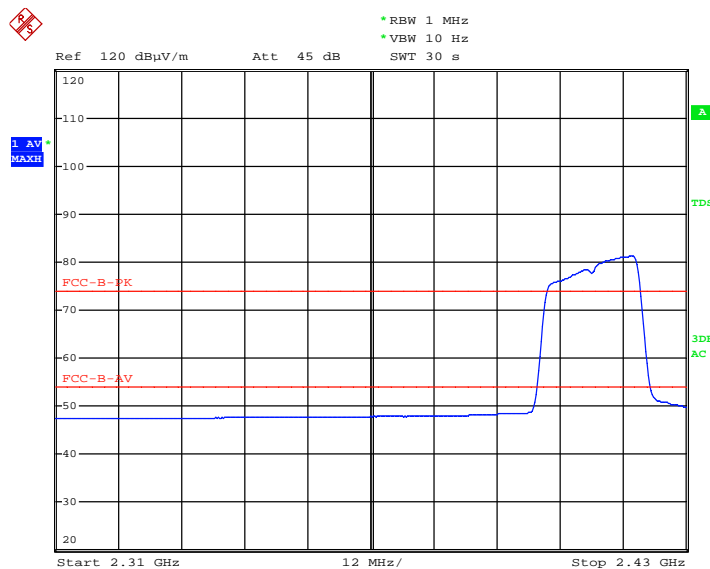
Radiated

Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



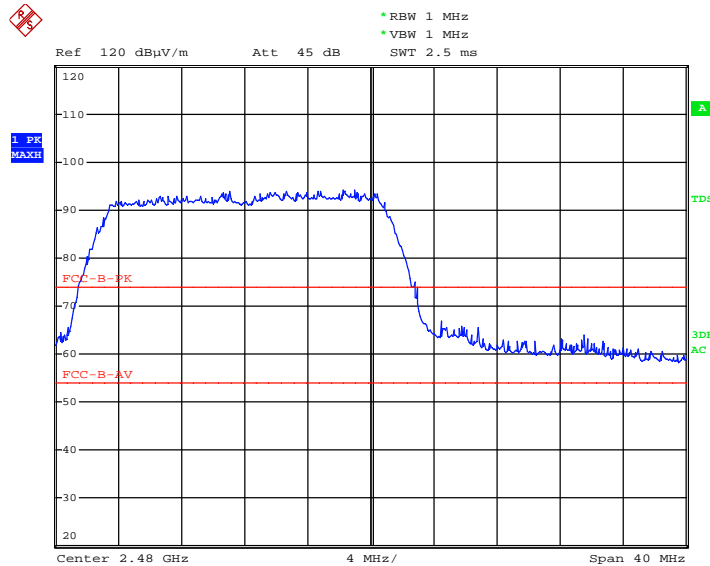
Date: 27.JUN.2016 14:48:08

AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



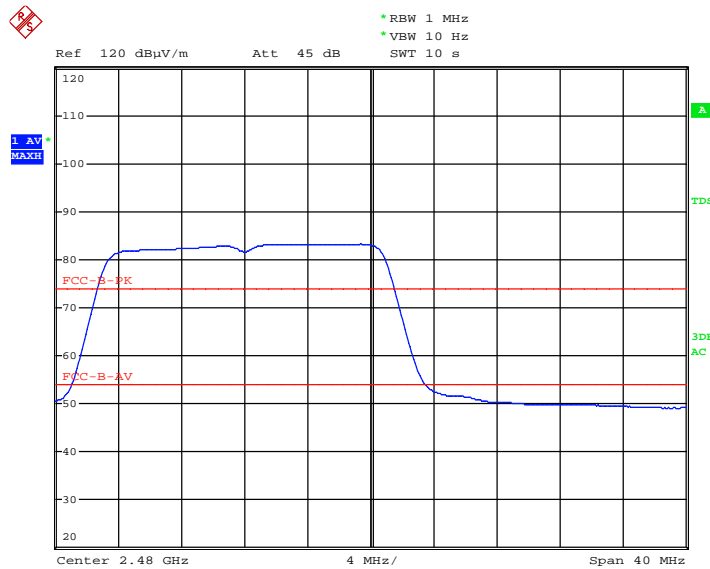
Date: 27.JUN.2016 14:49:43

Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)



Date: 27.JUN.2016 15:08:17

AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)



Date: 27.JUN.2016 15:08:42

6.5 Power Spectral Density

Limit

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

Test Data

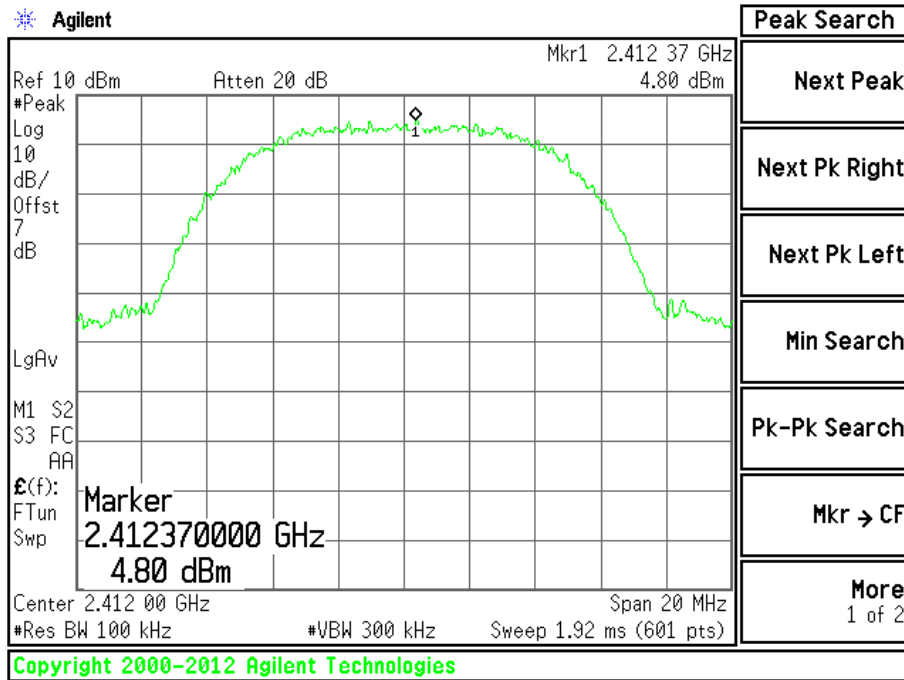
Mode	Frequency [MHz]	PSD [dBm]	Limit
802.11b	2 412	4.80	8.00 dBm
	2 442	4.16	
	2 472	4.66	
802.11g	2 412	-1.08	
	2 442	-1.81	
	2 472	-1.80	
802.11n(HT20)	2 412	-2.06	
	2 442	-2.63	
	2 472	-2.41	

NOTES:

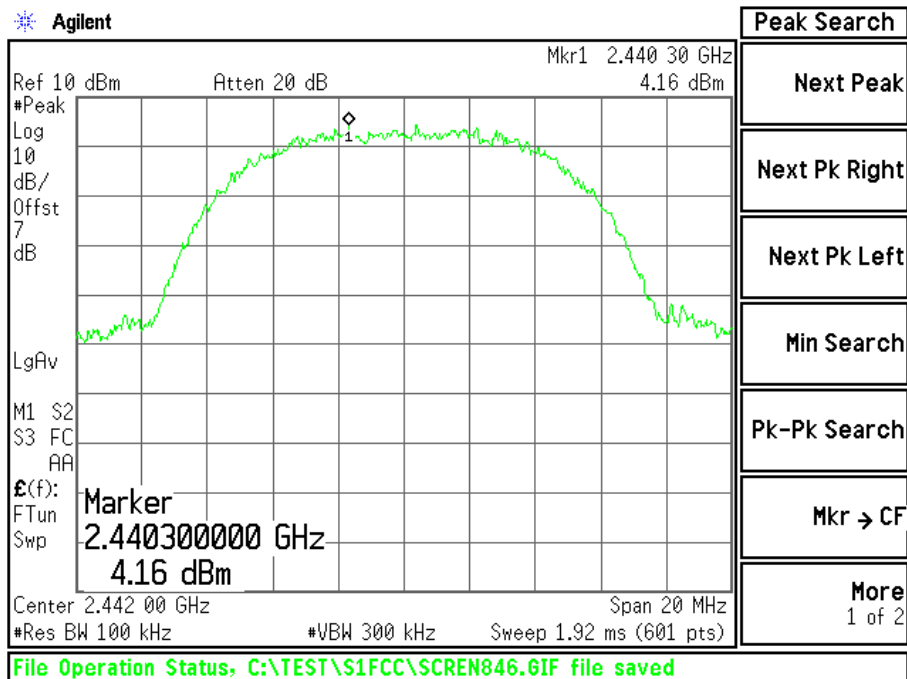
1. Measure power spectral density of relevant channel using spectrum analyzer.
2. RBW 100 kHz, VBW 300 kHz, span 1 MHz, Sweep time (= span / 3 kHz).
3. Please see the measured plot in next page.

Plots of Power Spectral Density (802.11b)

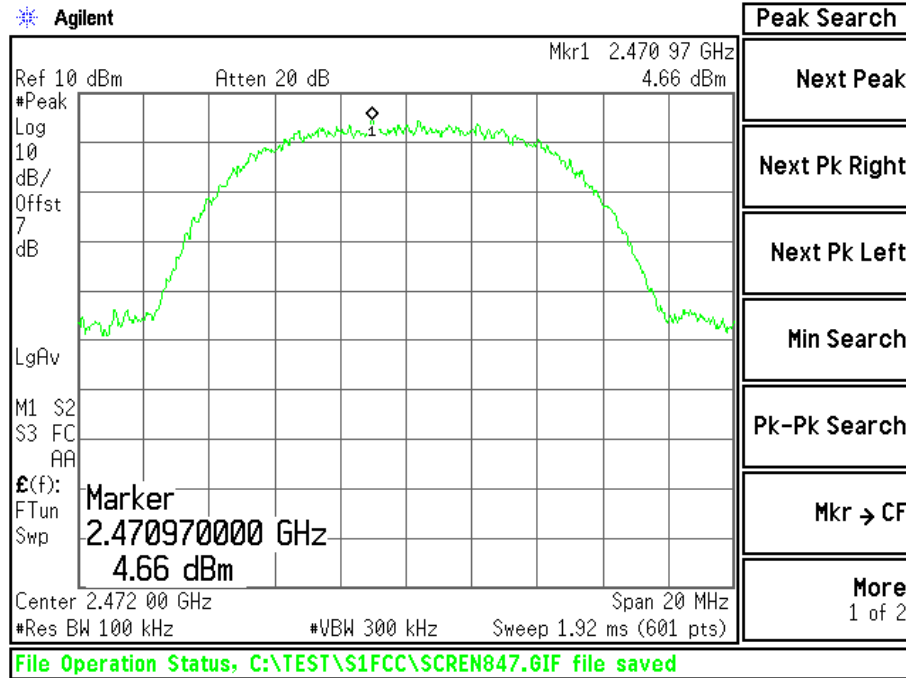
[2 412 MHz]



[2 442 MHz]

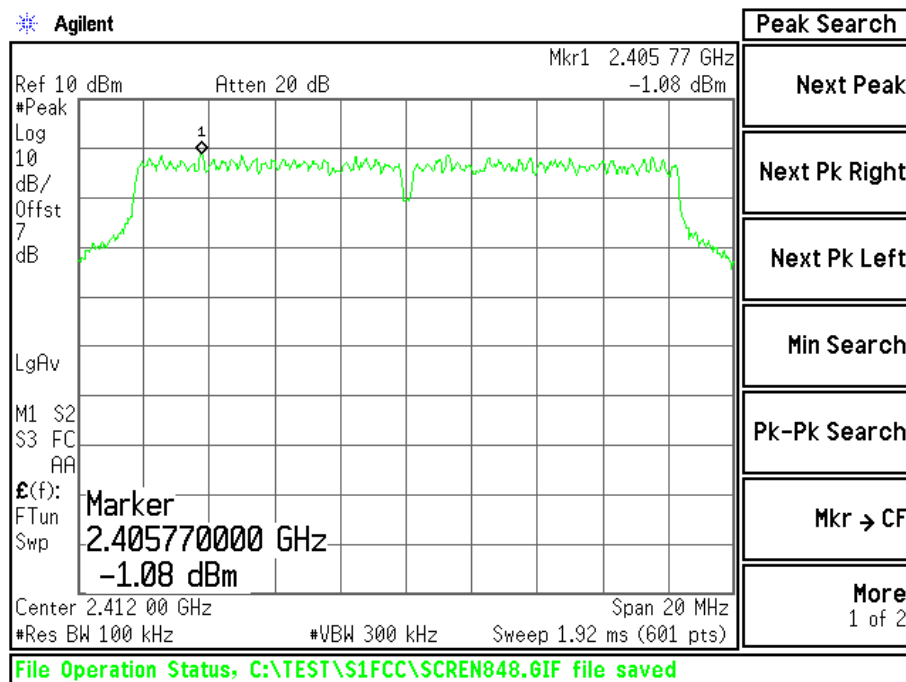


[2 472 MHz]

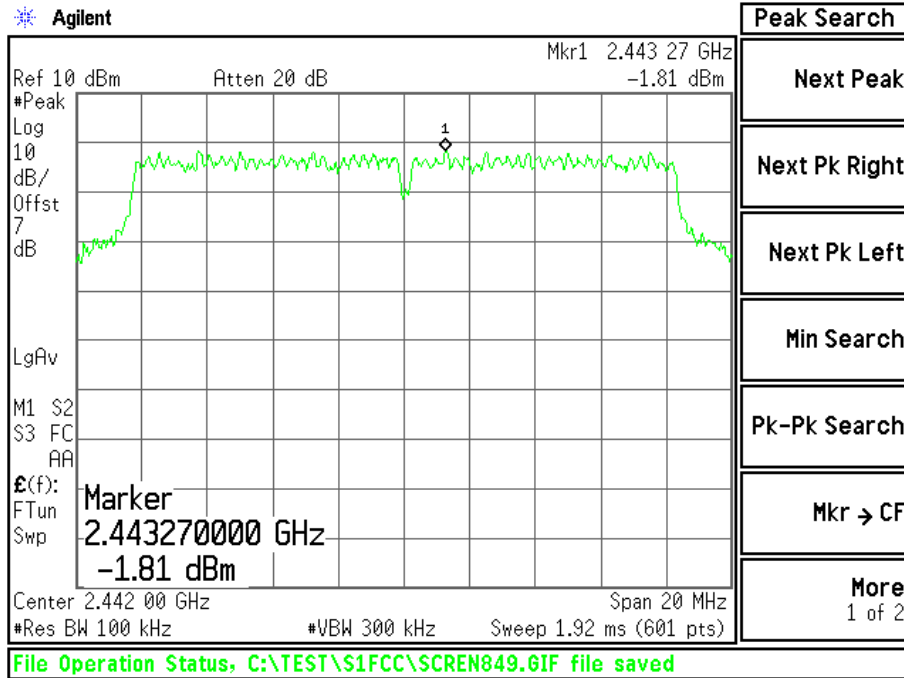


Plots of Power Spectral Density (802.11g)

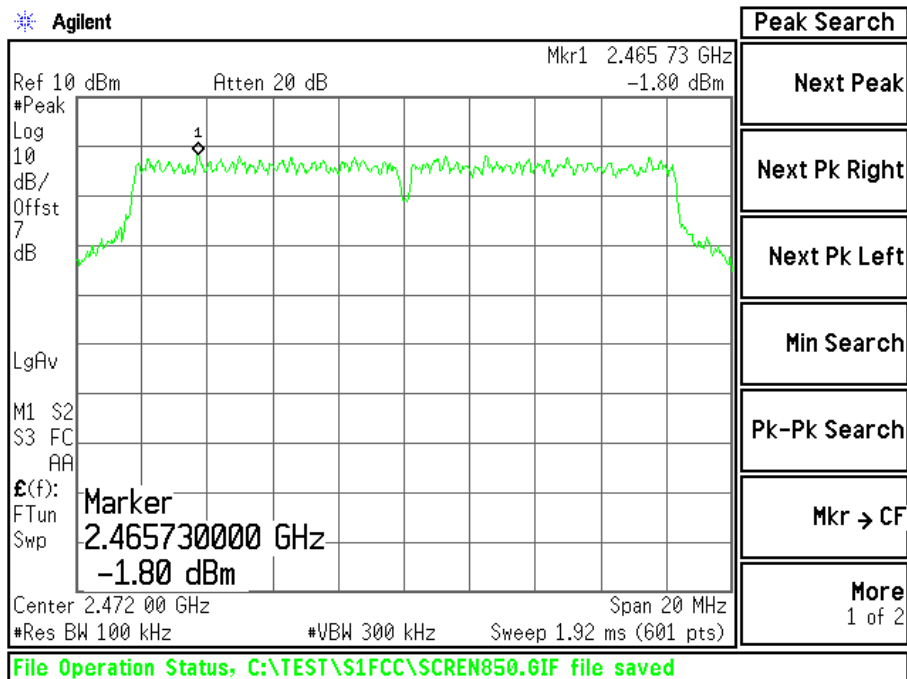
[2 412 MHz]



[2 442 MHz]

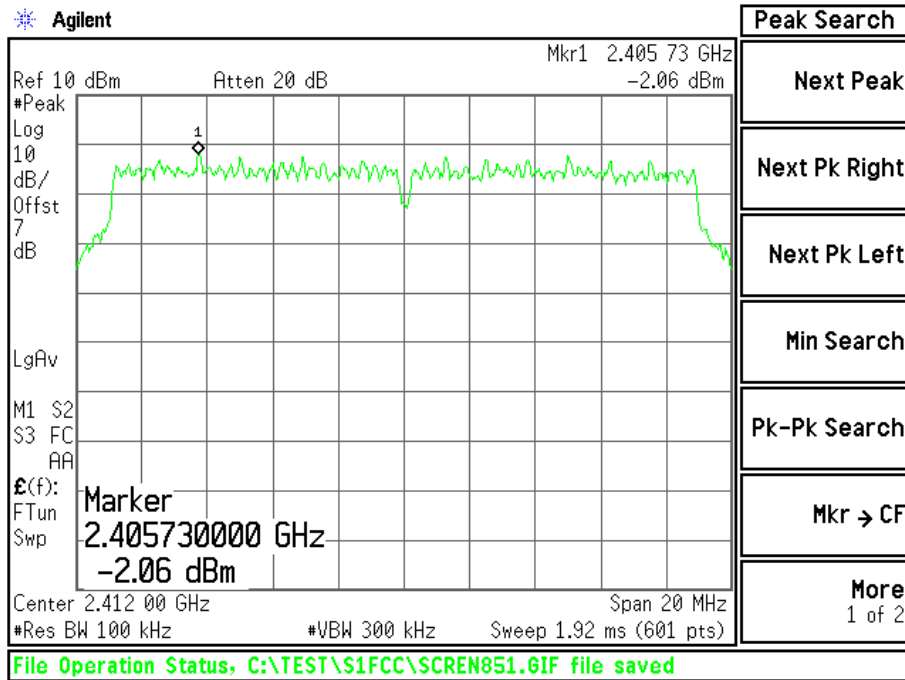


[2 472 MHz]

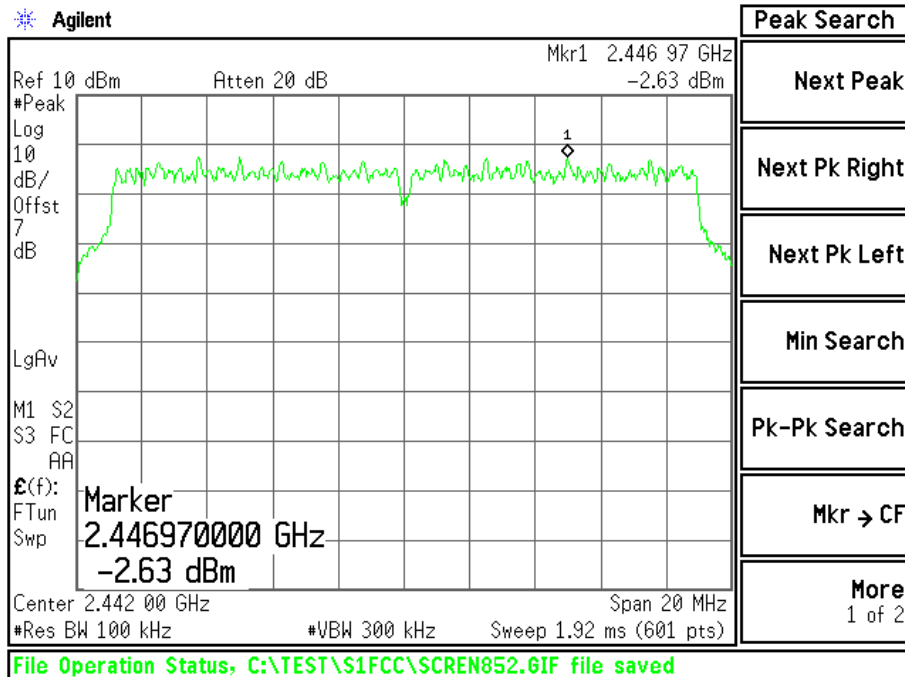


Plots of Power Spectral Density (802.11n(HT20))

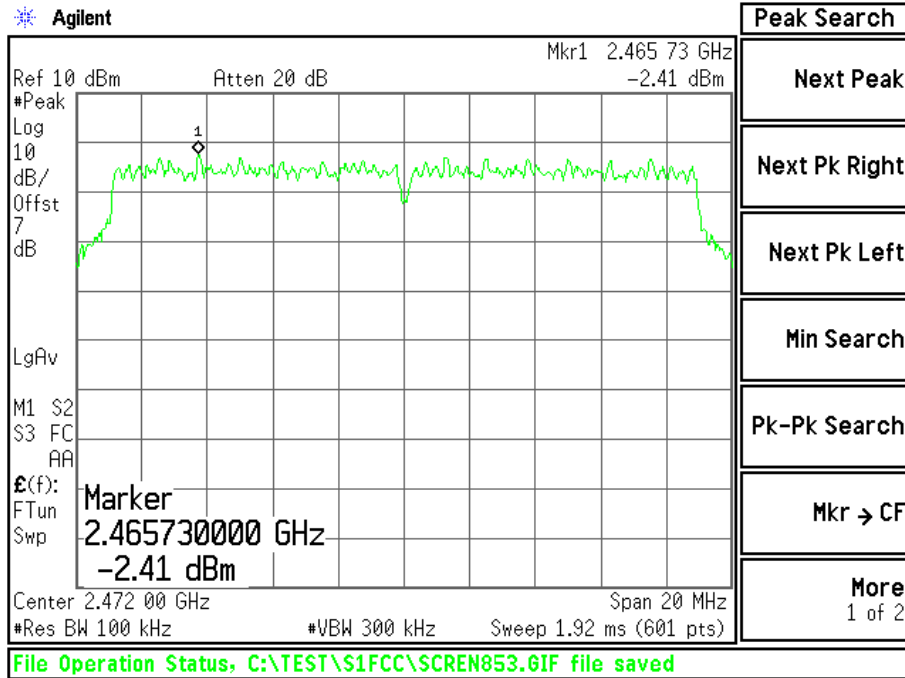
[2 412 MHz]



[2 442 MHz]



[2 472 MHz]



5.6 Spurious Emissions

Limit

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies [MHz]	Field Strength [μV/m]	Measurement Distance [m]
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 MHz - 72 MHz, 76 MHz - 88 MHz, 174 MHz - 216 MHz or 470 MHz - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Test Results

- Refer to see the measured plot in next page.

Radiated Emissions Test data

- 9 kHz to 30 MHz

- 802.11b, 802.11g, 802.11n(HT20)

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (100 Hz, 9 kHz)

Frequency [MHz]	Reading [dB(μV)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
	Emission attenuated more than 20 dB below the limit are not reported.						

Result: All emissions below noise floor of 20 dB(μV/m).

NOTES:

- * H : Horizontal polarization , ** V : Vertical polarization
- Result = Reading + Antenna factor + Cable loss
- Margin = Limit - Result
- The measurement was performed for the frequency range 9 kHz to 30 MHz according to FCC Part 15.209.

- Below 1 GHz (30 MHz to 1 GHz)

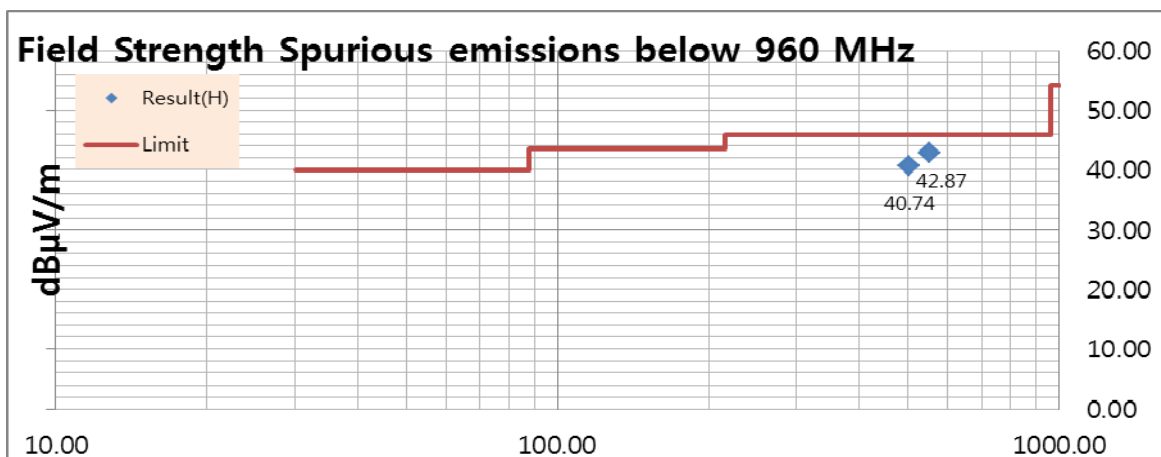
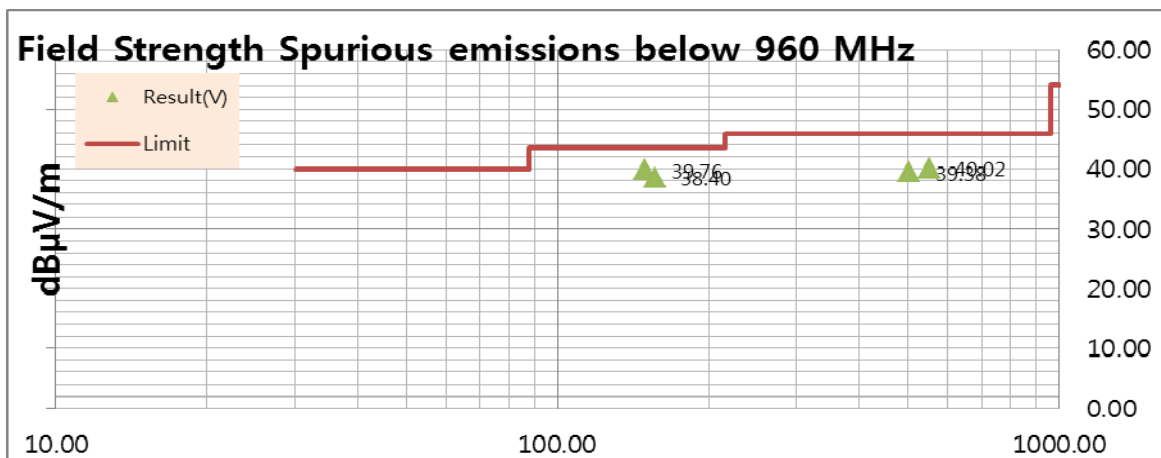
- 802.11b mode

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

Emission Frequency [MHz]	Measure Value [dBμV]	Antenna Pola V/H	Antenna Factor [dB/m]	Cable Loss [dB]	Field Strength dBμV/m @ 3m	Limit dBμV/m @ 3m	Margin [dB]
149.49	24.00	V	13.53	2.23	39.76	43.5	3.74
156.46	22.44	V	13.72	2.24	38.40	43.5	5.10
502.94	17.63	V	17.92	3.83	39.38	46.0	6.62
550.95	16.93	V	18.91	4.18	40.02	46.0	5.98
502.94	18.99	H	17.92	3.83	40.74	46.0	5.26
550.95	19.78	H	18.91	4.18	42.87	46.0	3.13

NOTES:

- * H : Horizontal polarization , ** V : Vertical polarization
- Result = Reading + Antenna factor + Cable loss
- Margin value = Limit - Result
- The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.



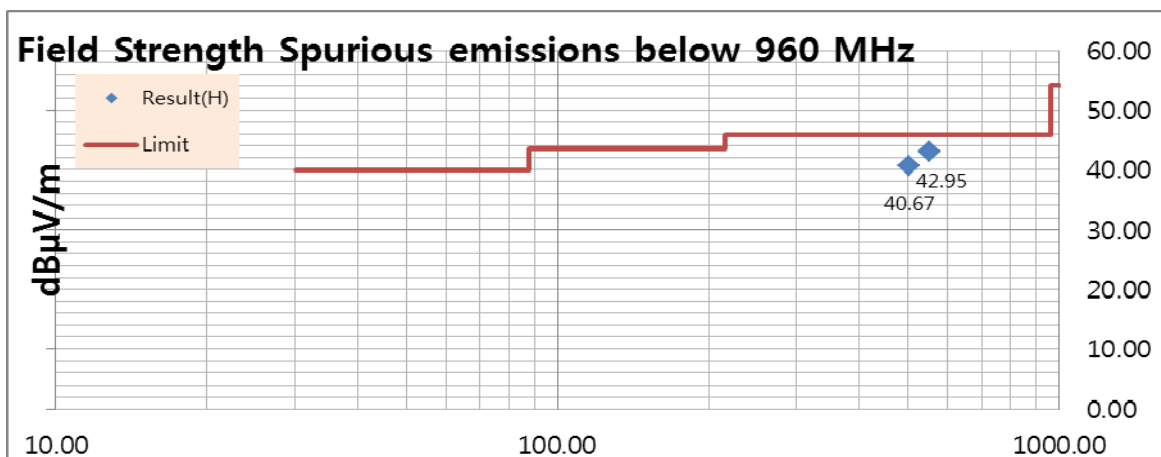
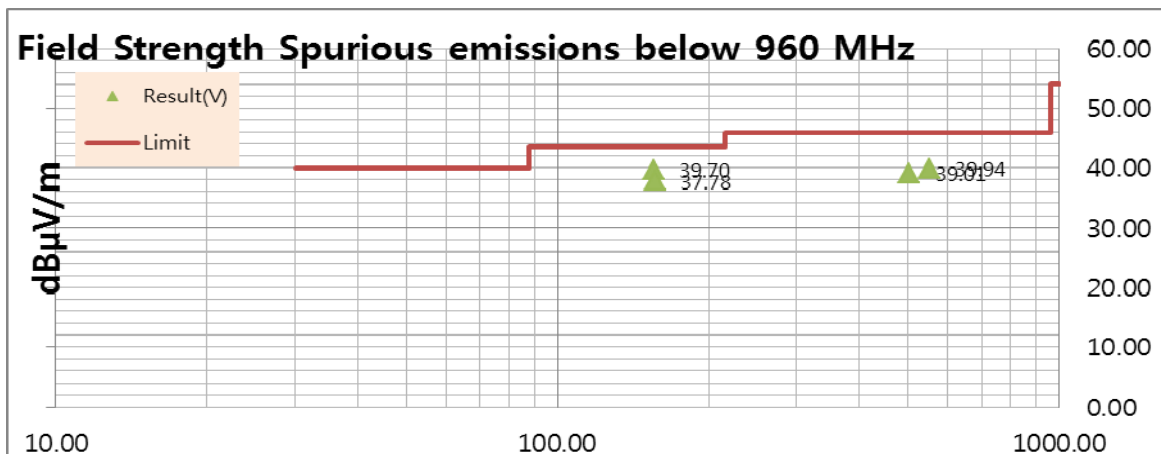
- 802.11g mode

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

Emission Frequency [MHz]	Measure Value [dBμV]	Antenna Pola V/H	Antenna Factor [dB/m]	Cable Loss [dB]	Field Strength dBμV/m @ 3m	Limit dBμV/m @ 3m	Margin [dB]
155.36	23.77	V	13.69	2.24	39.70	43.5	3.80
156.46	21.82	V	13.72	2.24	37.78	43.5	5.72
502.94	17.26	V	17.92	3.83	39.01	46.0	6.99
550.95	16.85	V	18.91	4.18	39.94	46.0	6.06
502.94	18.92	H	17.92	3.83	40.67	46.0	5.33
550.95	19.86	H	18.91	4.18	42.95	46.0	3.05

NOTES:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Result = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Result
4. The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.



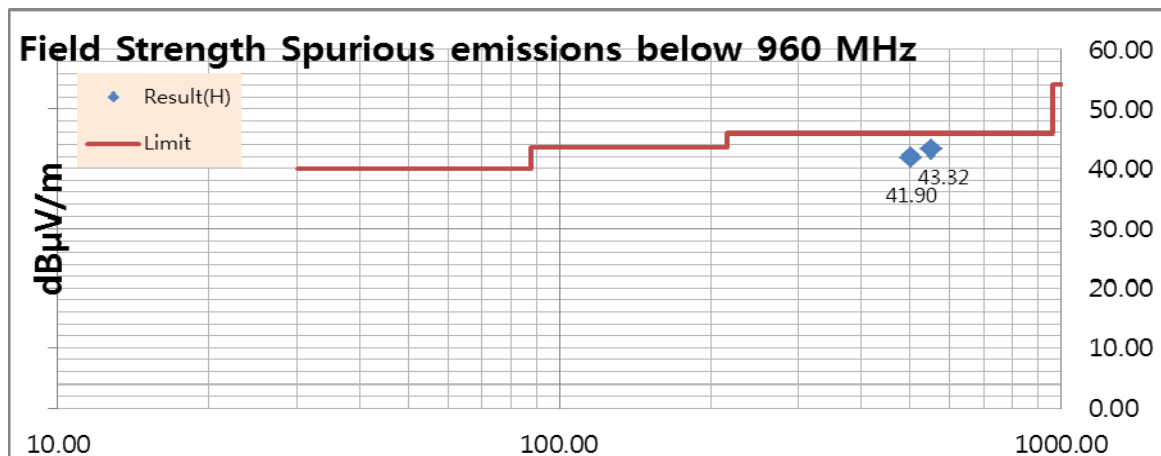
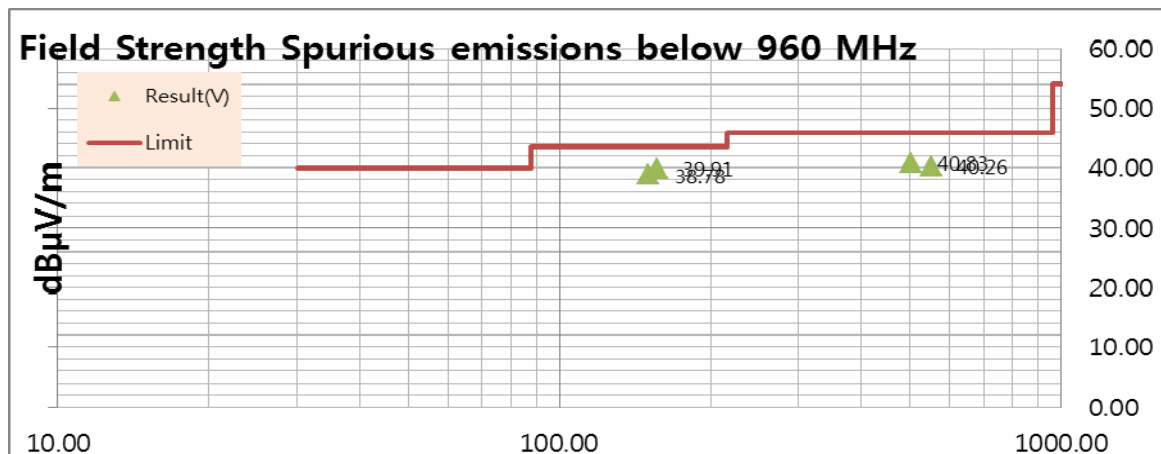
- 802.11n(HT20) mode

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

Emission Frequency [MHz]	Measure Value [dBμV]	Antenna Pola V/H	Antenna Factor [dB/m]	Cable Loss [dB]	Field Strength dBμV/m @ 3m	Limit dBμV/m @ 3m	Margin [dB]
150.54	22.99	V	13.56	2.23	38.78	43.5	4.72
156.46	24.11	V	13.56	2.24	39.91	43.5	3.59
502.94	19.08	V	17.92	3.83	40.83	46.0	5.17
550.95	17.17	V	18.91	4.18	40.26	46.0	5.74
502.94	20.15	H	17.92	3.83	41.90	46.0	4.10
550.95	20.23	H	18.91	4.18	43.32	46.0	2.68

NOTES:

1. This test was applied both to 802.11n(HT20) and 802.11n(HT40). (Worst case: 802.11n(HT20))
2. * H : Horizontal polarization , ** V : Vertical polarization
3. Result = Reading + Antenna factor + Cable loss
4. Margin value = Limit – Result
5. The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.



- Above 1 GHz (1 GHz to 25 GHz)

- 802.11b mode

1. Low CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4816.46	60.87	48.17	H	31.13	8.72	40.22	55.83	47.80	73.97	53.97	13.5	6.2

2. Middle CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4877.72	61.79	50.58	H	31.23	8.78	40.14	61.66	50.45	73.97	53.97	12.3	3.5

3. High CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4937.16	62.17	51.06	H	31.33	8.83	40.06	62.27	51.16	73.97	53.97	11.7	2.8

Result: No signal detect above second harmonic.

- 802.11g mode

1. Low CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4825.36	62.17	48.45	H	31.15	8.73	40.21	61.84	48.12	73.97	53.97	12.2	5.9

2. Middle CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4896.64	61.24	48.85	H	31.26	8.79	40.11	61.18	48.79	73.97	53.97	12.8	5.2

3. High CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4952.08	59.95	47.94	H	31.35	8.84	40.04	60.11	48.10	73.97	53.97	13.9	5.9

Result: No signal detect above second harmonic.

- 802.11n(HT20) mode

1. Low CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4816.14	55.54	43.78	H	31.13	8.72	40.22	55.17	43.41	73.97	53.97	18.8	10.6

2. Middle CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4888.23	60.92	48.95	H	31.25	8.79	40.12	60.83	48.86	73.97	53.97	13.2	5.1

3. High CH

Frequency [MHz]	Reading [dB(μV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Amp Gain [dB]	Result [dB(μV/m)]		Limit [dB(μV/m)]		Margin [dB]	
	Peak	Average					Peak	Average	Peak	Average	Peak	Average
4944.71	63.62	49.53	H	31.34	8.84	40.05	63.75	49.66	73.97	53.97	10.3	4.3

Result: No signal detect above second harmonic.

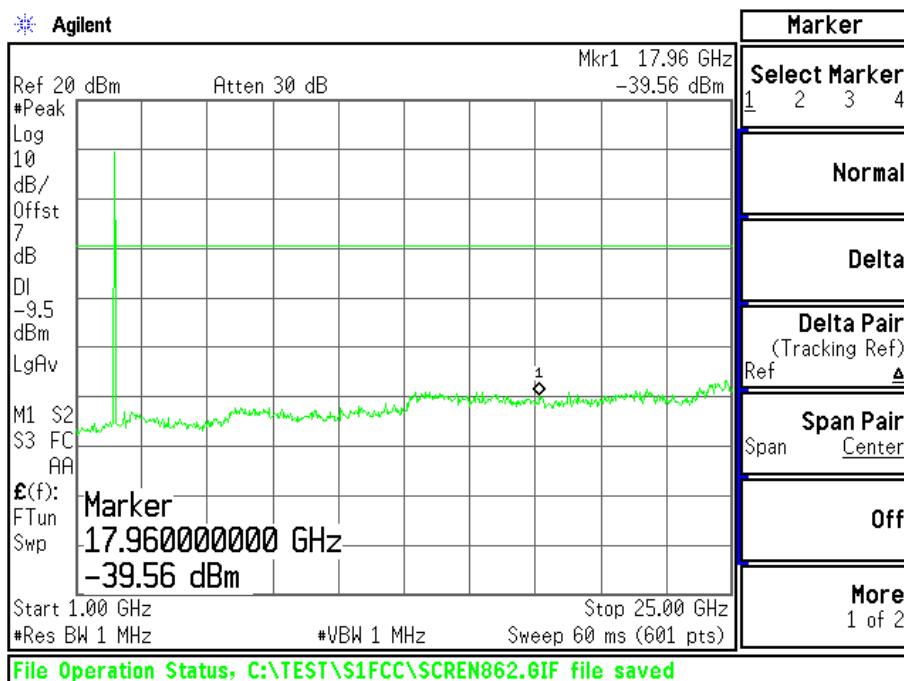
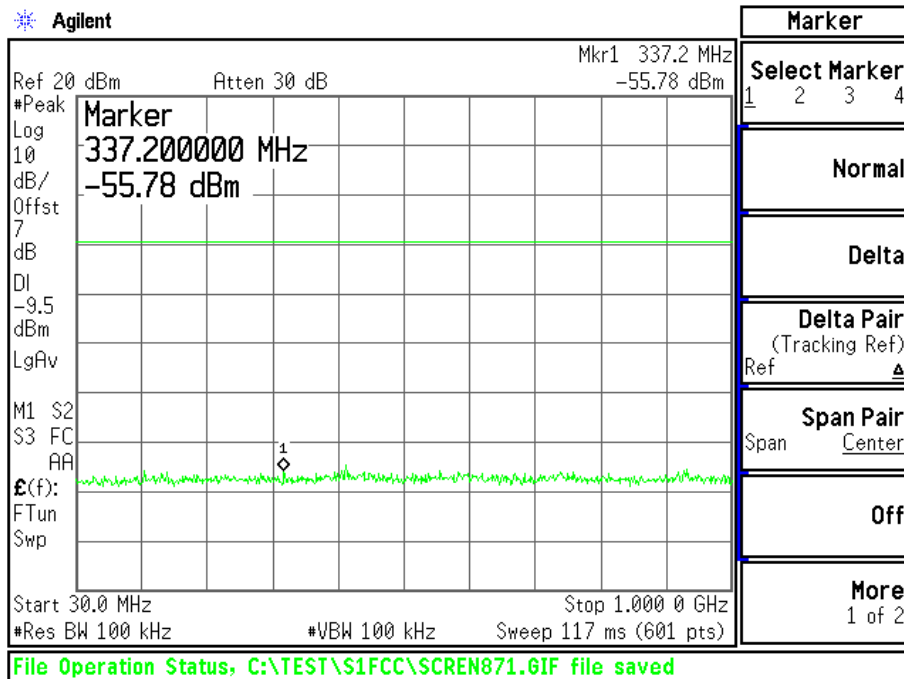
NOTES:

- * H : Horizontal polarization , ** V : Vertical polarization
- Result = Reading +Antenna Factor + Cable Loss +Amp Gain
- Margin = Limit - Result
- Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded(i.e: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
- Spectrum setting:
 - Peak Setting 1 GHz to 10th harmonics of fundamental, RBW = 1 MHz, VBW = 1 MHz, Sweep = Auto
 - AV Setting 1 GHz to 10th harmonics of fundamental, RBW = 1 MHz, VBW = 10 Hz, Sweep = Auto

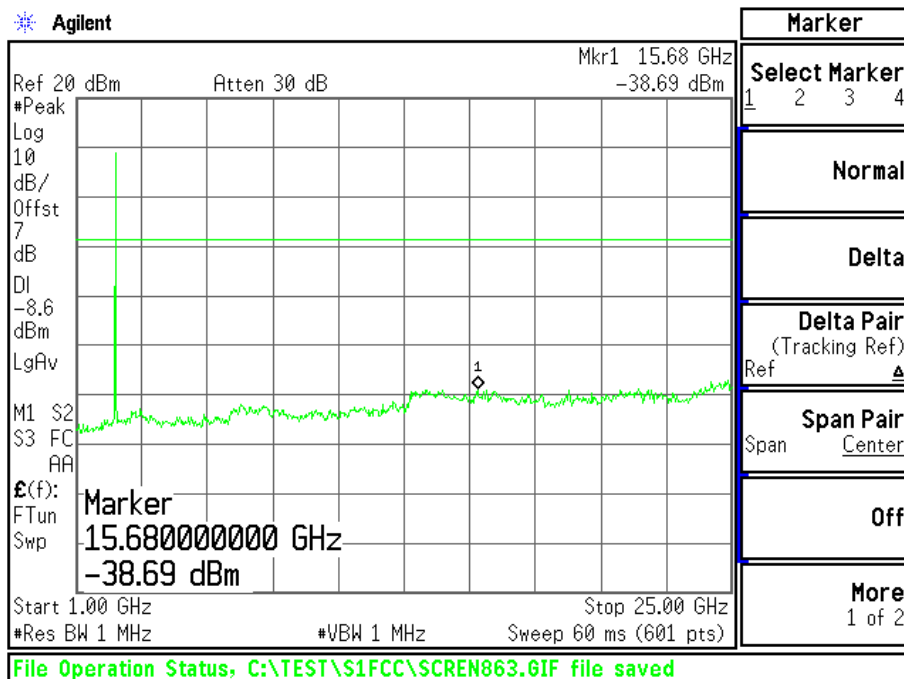
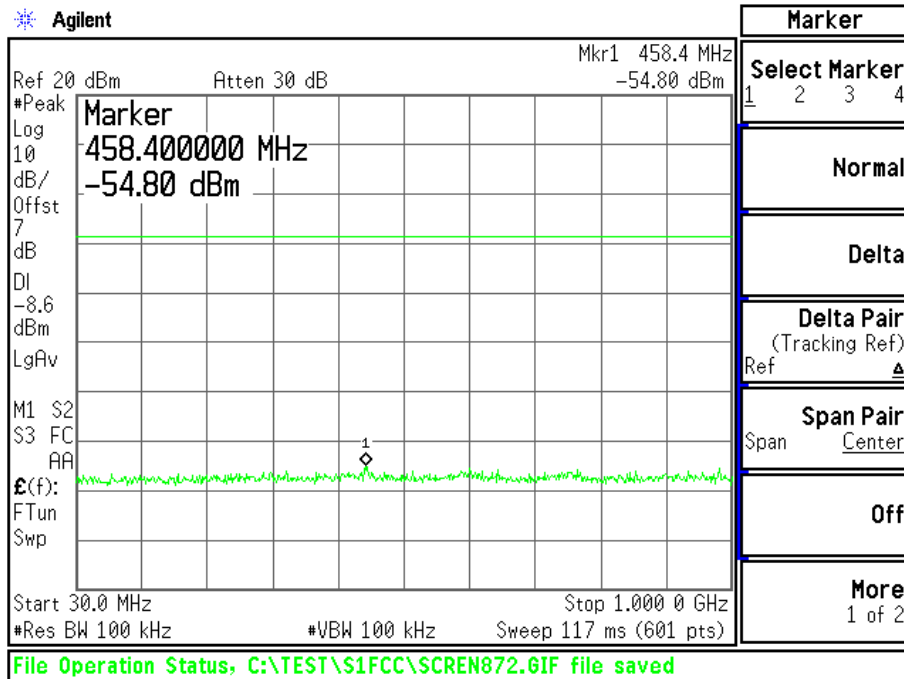
Plots of Spurious Emissions (Conducted Measurement)

- 802.11b mode

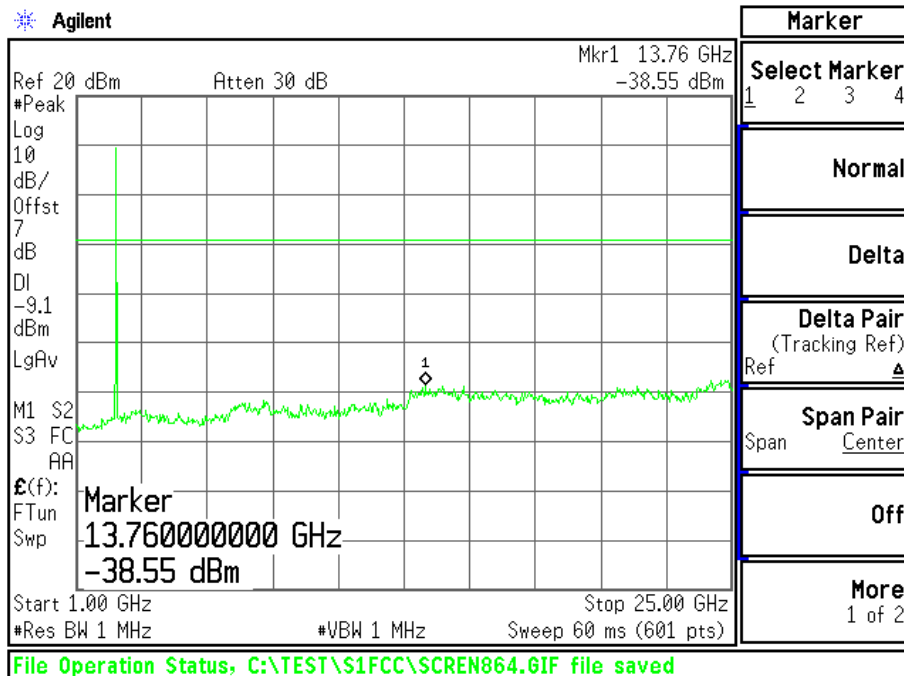
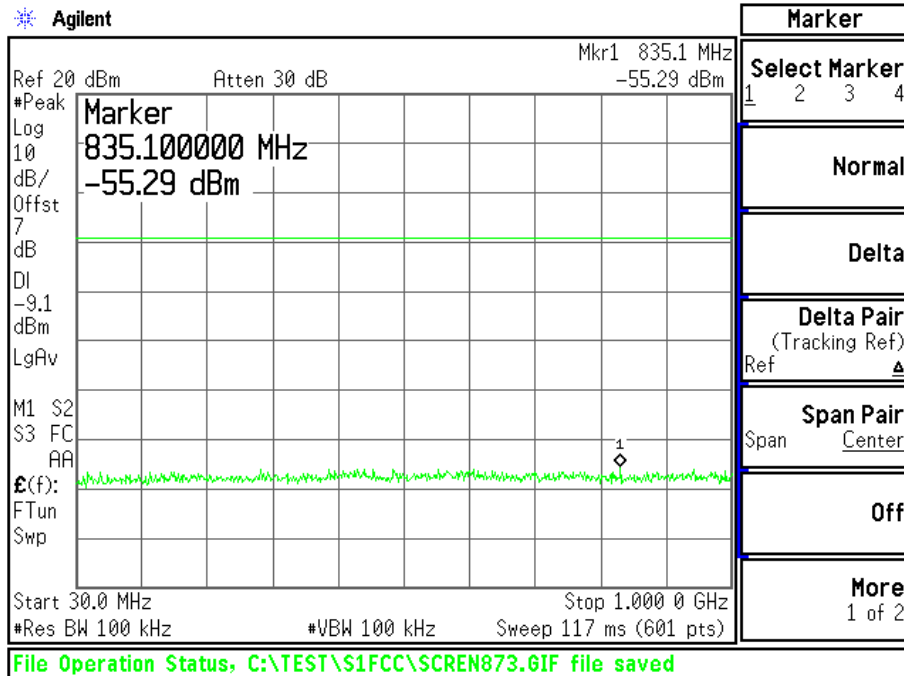
[CH Low]



[CH Mid]

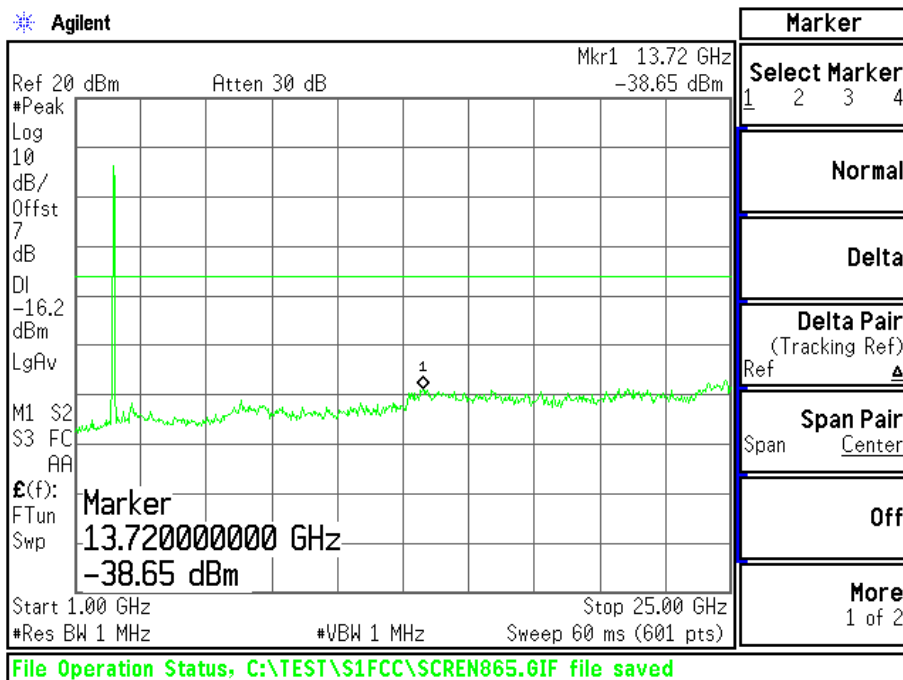
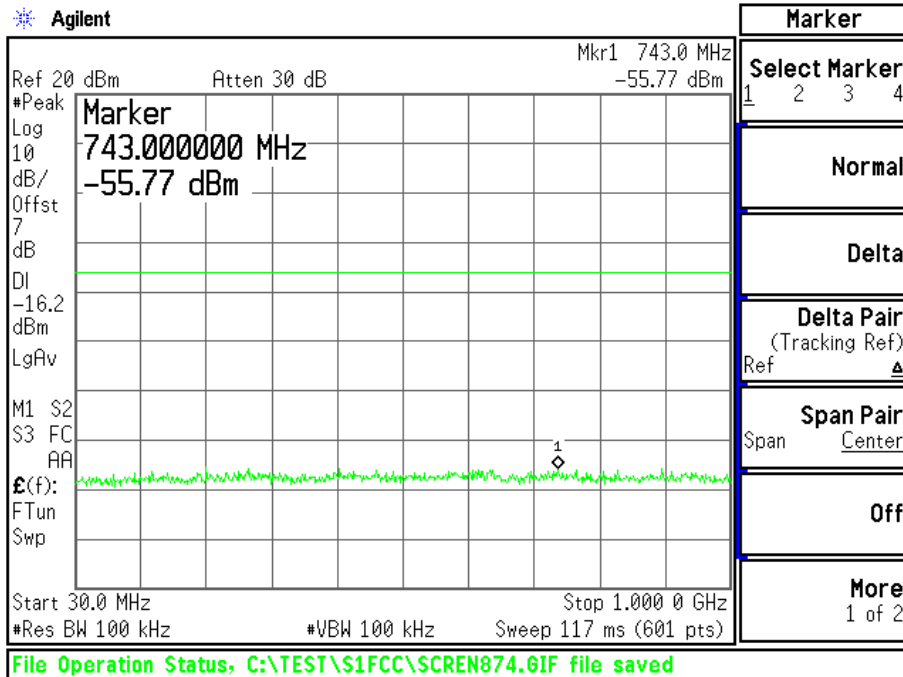


[CH High]

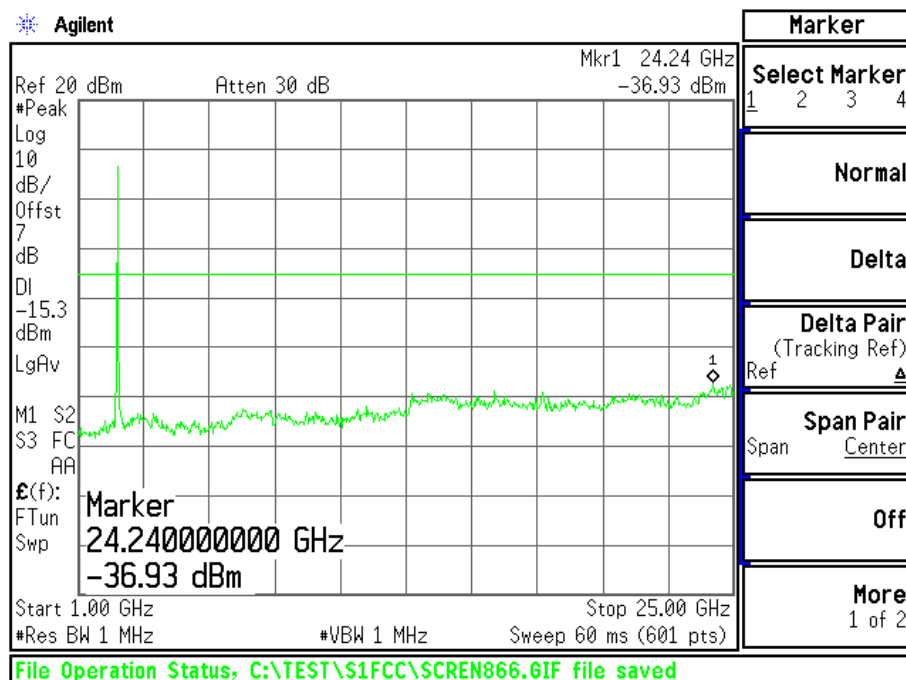
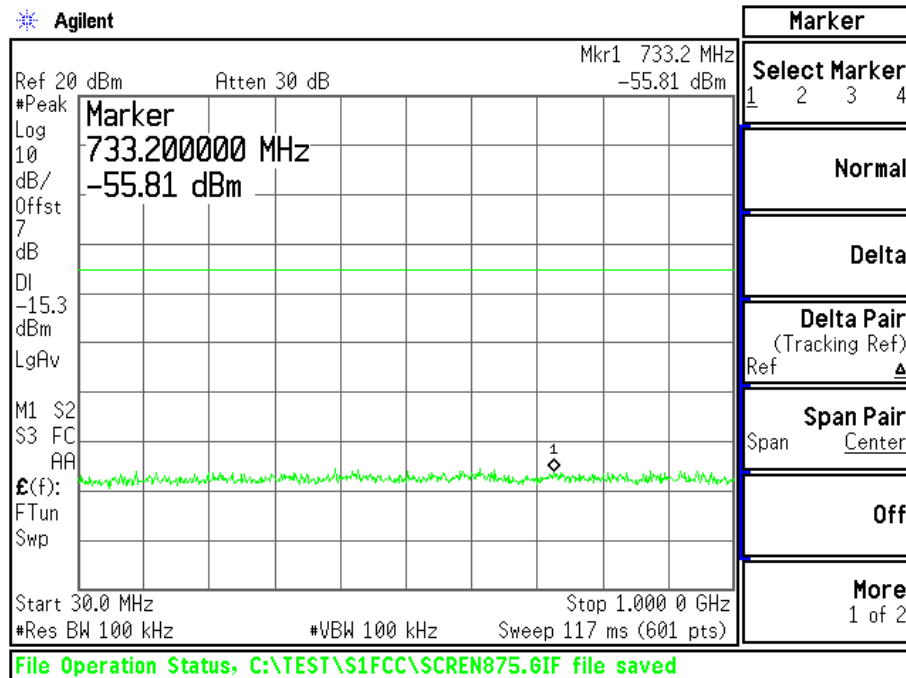


- 802.11g mode

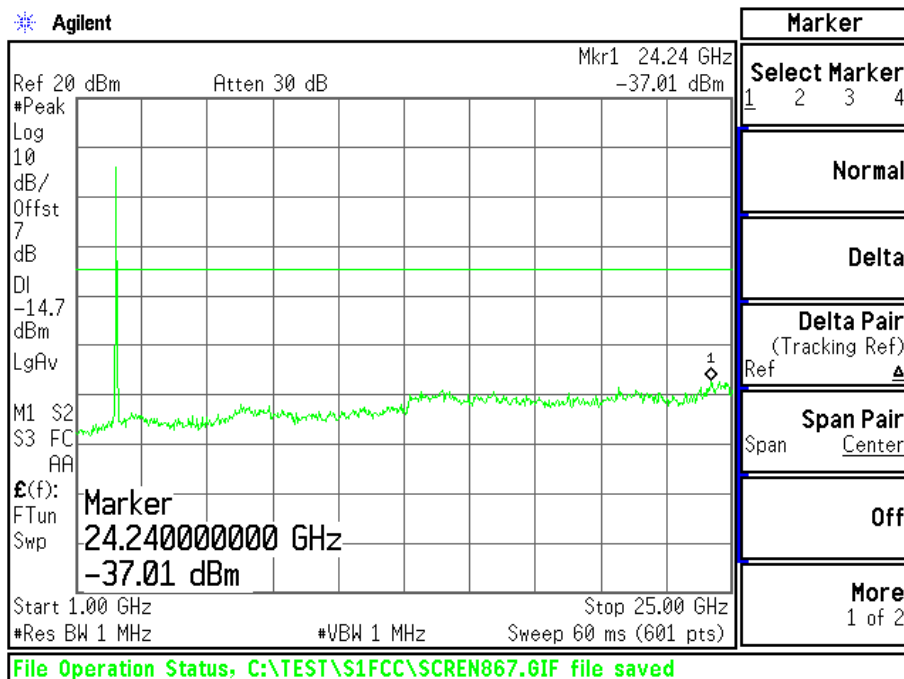
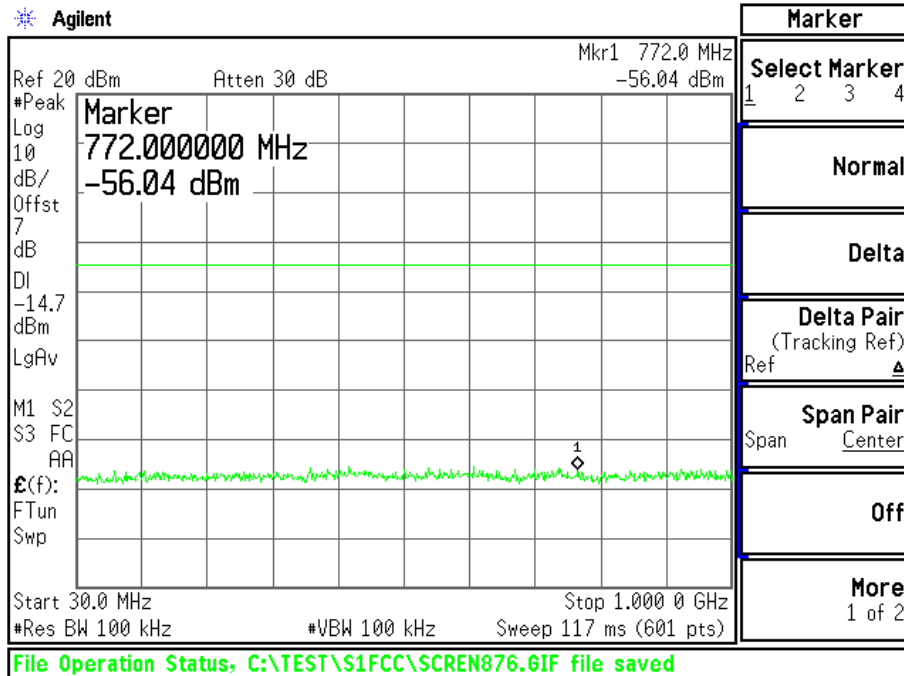
[CH Low]



[CH Mid]

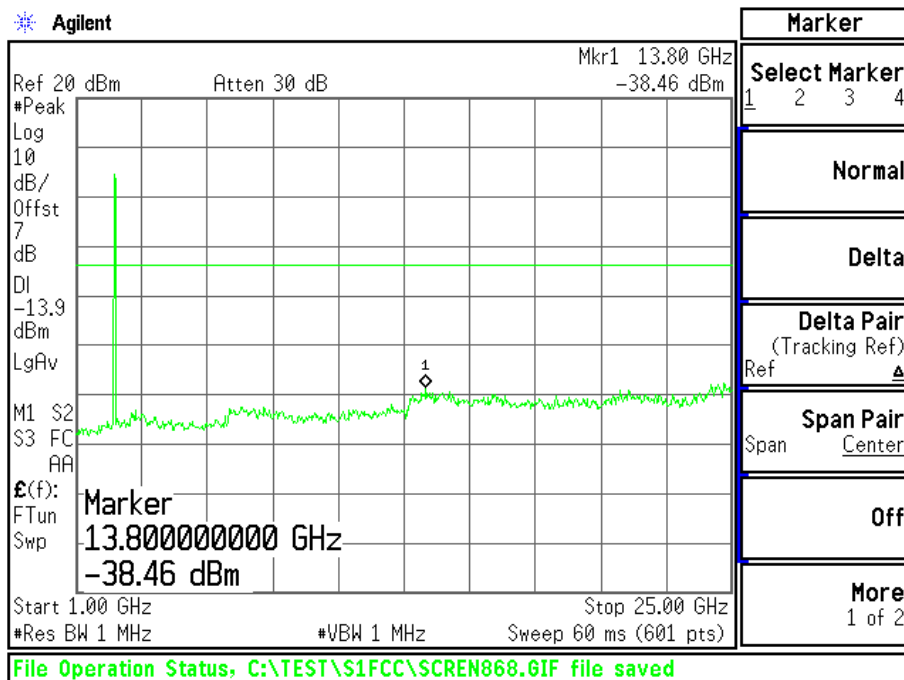
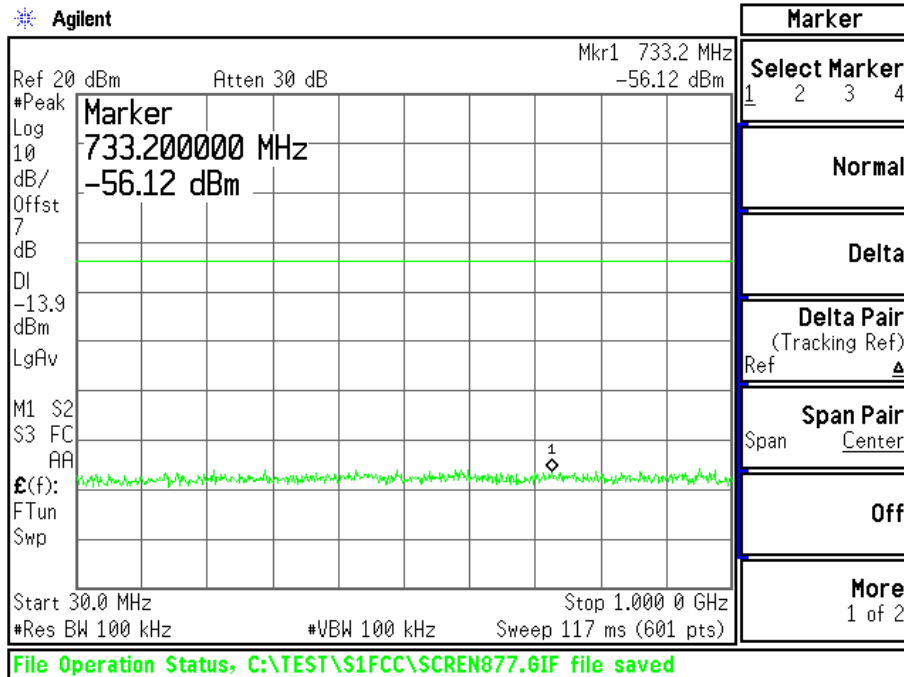


[CH High]

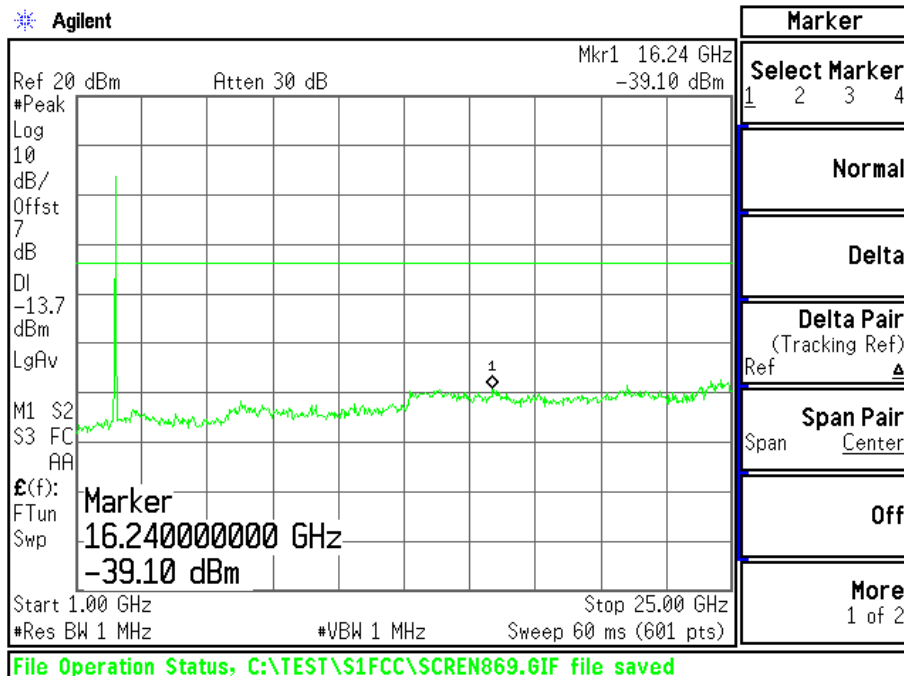
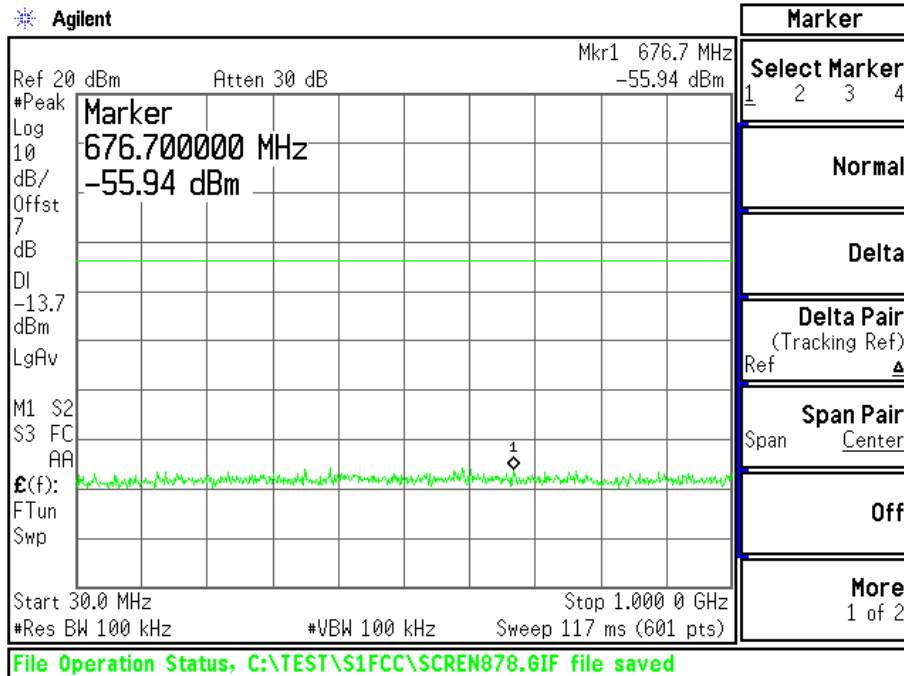


- 802.11n(HT20) mode

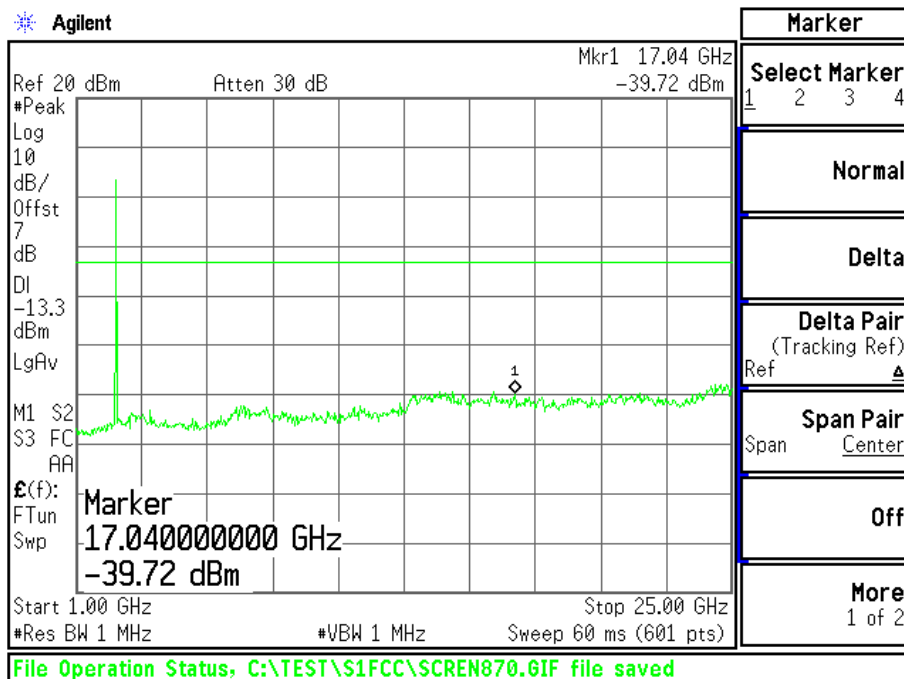
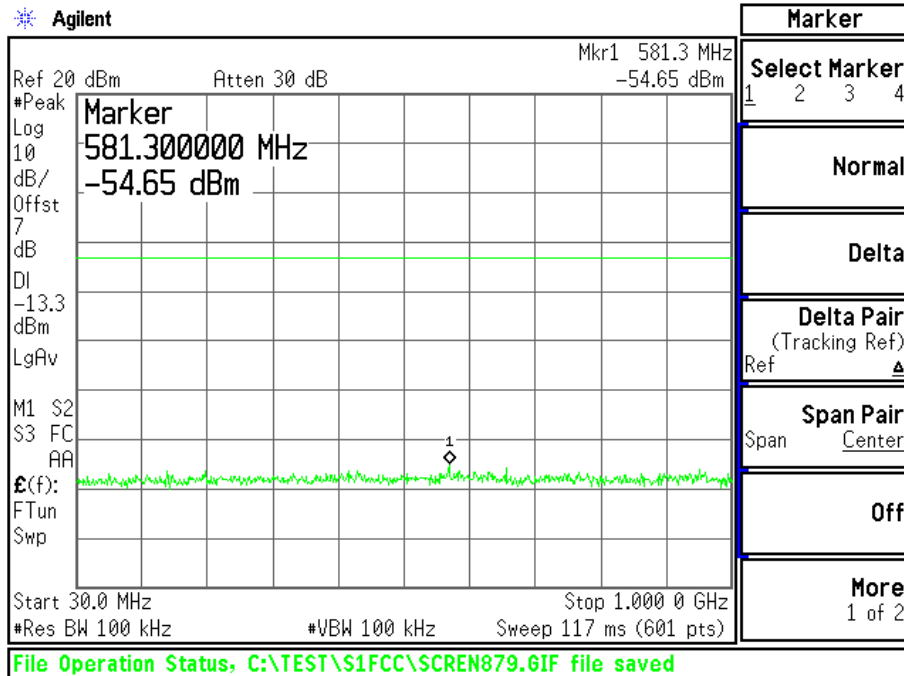
[CH Low]



[CH Mid]



[CH High]



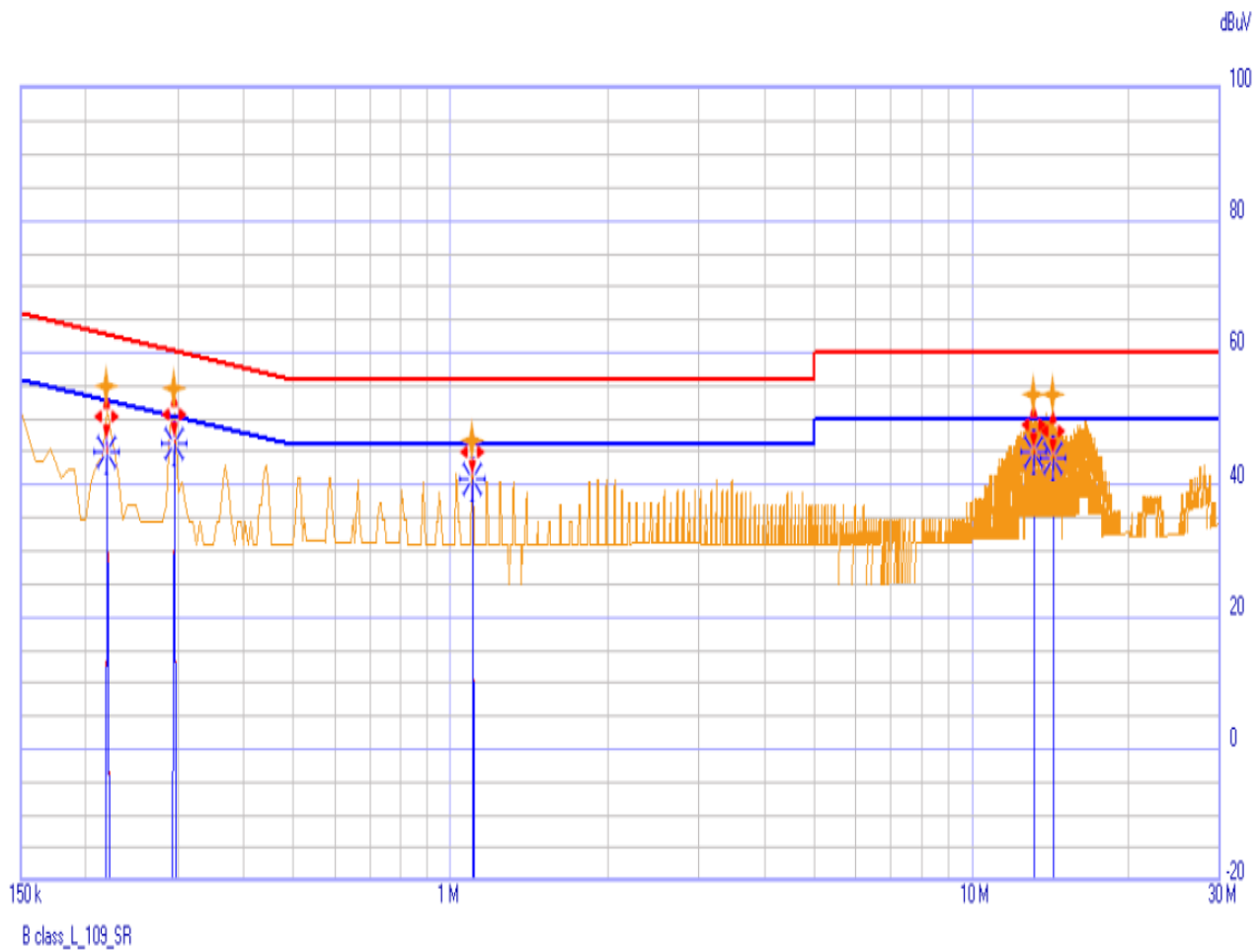
6.7 Conducted Emissions Measurement

Limit

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

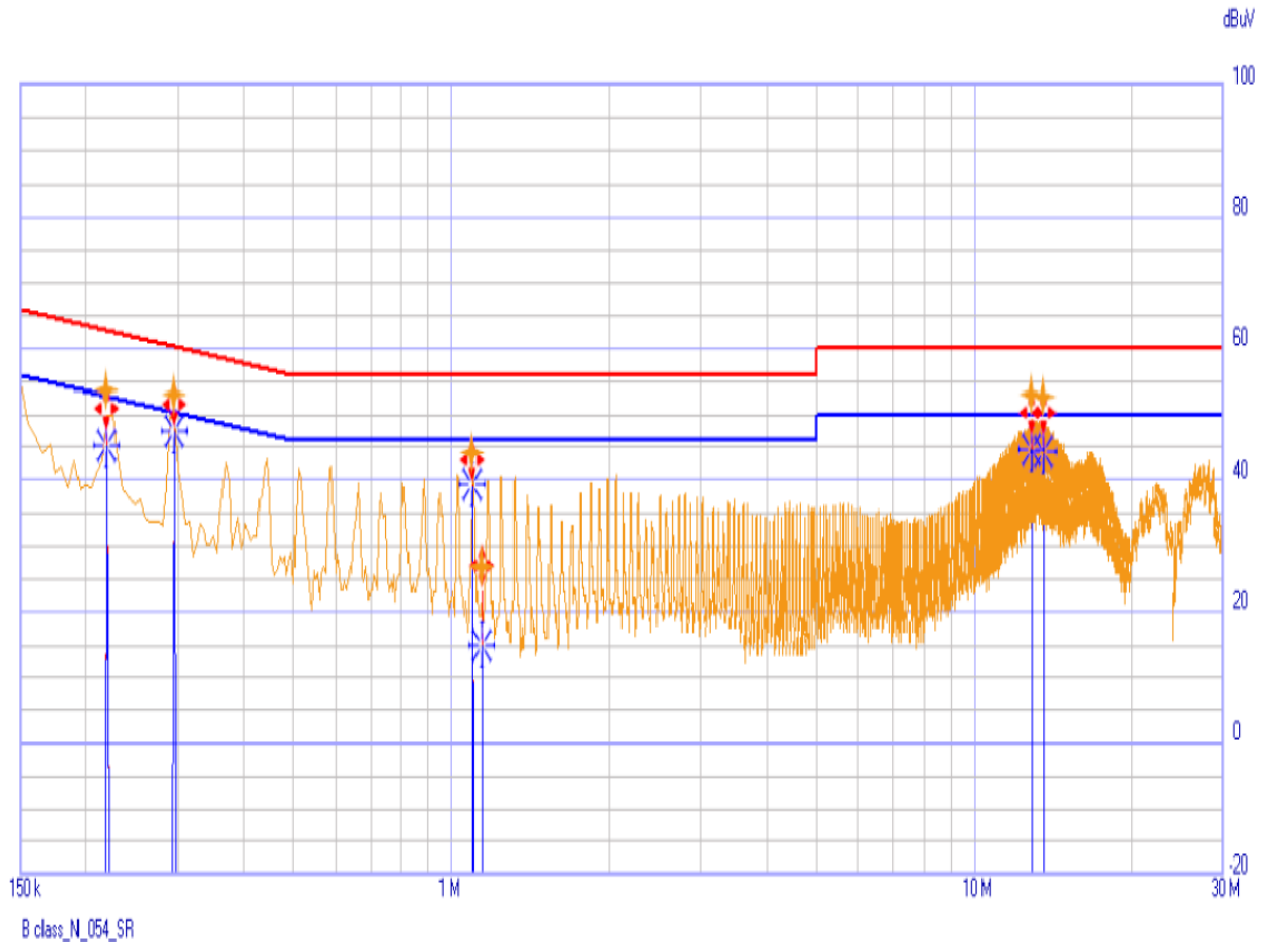
Frequency of Emission [MHz]	Conducted limit [dB(μ V)]	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency.



	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (5 kHz)	P.Q.C. Class B_QP Class B_CAV	1500 ms	9 kHz	10	OFF	ON

	Frequency [MHz]	QPeak [dBuV]	Limit Class B_QP [dBuV]	Delta [dB]	C-Avg [dBuV]	Limit Class B_CAV [dBuV]	Delta [dB]	Factor LISN_L [dB]	Factor Loop_Cabl.. [dB]
1	0.22	46.52	62.82	-16.30	44.60	52.82	-8.22	9.58	0.01
2	0.295	46.63	60.38	-13.75	46.10	50.38	-4.28	9.58	0.01
3	1.105	41.15	56.00	-14.85	40.70	46.00	-5.30	9.59	0.02
4	13.15	45.16	60.00	-14.84	44.59	50.00	-5.41	9.70	0.09
5	14.325	44.33	60.00	-15.67	43.89	50.00	-6.11	9.71	0.09



	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (5 kHz)	P Q C Class B_QP Class B_CAV	1500 ms	9 kHz	0	ON	ON

Frequency [MHz]	QPeak [dBuV]	Limit Class B_QP [dBuV]	Delta [dB]	C-Avg [dBuV]	Limit Class B_CAV [dBuV]	Delta [dB]	Factor LISN_N [dB]	Factor Loop_Cabl.. [dB]
1 0.22	46.96	62.82	-15.86	45.05	52.82	-7.77	9.57	0.01
2 0.295	47.70	60.38	-12.68	47.22	50.38	-3.16	9.58	0.01
3 1.1	39.25	56.00	-16.75	38.88	46.00	-7.12	9.59	0.02
4 1.145	22.93	56.00	-33.07	14.79	46.00	-31.21	9.59	0.02
5 12.85	46.37	60.00	-13.63	44.40	50.00	-5.60	9.70	0.08
6 13.585	46.30	60.00	-13.70	43.99	50.00	-6.01	9.71	0.09

6.8 Radio Frequency Exposure

Standard Applicable:

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limit

Limits for general population/Uncontrolled exposure

Frequency Range [MHz]	Electric Field Strength (E) [V/m]	Magnetic Field Strength (H) [A/m]	Power Density (S) [mW/cm ²]	Averaging Time E ² , H ² or S [minutes]
0.3 - 1.34	614	1.63	(100)	30
1.34 - 30	824/f	2.19/f	(180/f ²)	30
30 - 300	27.5	0.073	0.2	30
300 - 1 500	--	--	f/1 500	30
1 500 - 100 000	--	--	1.0	30

f = frequency in MHz

*Plane-wave equivalent power density

MPE Prediction

Predication of MPE limit at a given distance.

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Rated output power	: 15.05 dBm (31.99 mW) (with Ant.Gain)
Prediction distance	: 20 cm
Predication frequency	: 2 412 MHz
Antenna gain(Max)	: 2.54 dBi
Power density at predication frequency at 20 cm	: 0.006 367 44 mW/cm ²
MPE Limit for	: 1 mW/cm ²

Test Result

The power density level at 20 cm is 0.006 367 44 mW/cm² which is below the uncontrolled exposure limit of 1 mW/cm² at 2 412 MHz to 2 472 MHz.

7. SAMPLE CALCULATION

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - PA$$

Where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

PA* = Preamplifier Factor

* PA is only be used for the measuring frequency above 1 GHz.

$$dB(\mu V) = 20 \log_{10} (\mu V) : \text{Equation}$$

$$dB(\mu V) = dBm + 107$$

Example : @ 4 937.16 MHz

$$\text{Class B Limit} = 53.97 \text{ dB}(\mu V/m) \text{ (Average)}$$

$$\text{Reading} = 51.06 \text{ dB}(\mu V)$$

$$\text{Antenna Factor} + \text{Cable loss} + \text{Amp. Gain} = 31.33 + 8.83 + (-40.06) = 0.1 \text{ dB}(\mu V/m)$$

$$\text{Total} = 51.16 \text{ dB}(\mu V/m)$$

$$\text{Margin} = 53.97 - 51.16 = 2.81 \text{ dB}$$

$$= 2.81 \text{ dB below Limit}$$