

Test Report

Product	Electronic Control Unit for vehicle Integration
Name and address of the applicant	CPAC Systems AB Bergskroken 3 431 37 Mölndal, Sweden
Name and address of the manufacturer	CPAC Systems AB Bergskroken 3 431 37 Mölndal, Sweden
Model	SID 2.0M
Rating	24V_{DC}
Trademark	CPAC Systems AB
Additional information	WiFi, Bluetooth
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems ISED Canada RSS-247, Issue 3 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	PRJ0043386
Tested in period	2023-02-27 to 2023-06-06
Issue date	2023-11-15
Name and address of the testing laboratory	 Nemko Scandinavia AS Instituttveien 6 2007 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470 ISED No: 2040D-1   An accredited technical test executed under the Norwegian accreditation scheme
 Prepared by [Frode Sveinsen]  Approved by [Jan G Eriksen]	
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Revision history

Revision	Date	Comment	Sign
A	2023-11-15	First edition	FS

GENERAL REMARKS

This report applies only to the sample(s) tested. It is the manufacturer's responsibility to ensure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is solely responsible for any modifications to the product that could result in non-compliance with the relevant regulations.

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Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither are opinions expressed regarding model variants covered by the testing of this report.

CALIBRATION

All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Between calibrations all test set-ups are controlled and verified on a regular basis by periodic checks to ensure, with 95% confidence, that the instruments remain within the calibrated levels.

MEASUREMENT UNCERTAINTY

Measurement uncertainties are calculated or considered for all instruments and instrument set-ups used during these tests. Uncertainty figures are found in a separate clause in this report.

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1 INFORMATION

1.1 Test Item

Name	CPAC Systems AB
Model/version	SID 2.0M
FCC ID	AHV-SID2M
ISED ID	10111A-SID2M
Serial number	HYD-3891
Hardware identity and/or version	P-01
Software identity and/or version	Hydra_WLANSW_1.0
Frequency Range	2412 – 2462 MHz
Number of Channels	11
Operating Modes	DSSS, OFDM
Type of Modulation	Digital
Conducted Output Power	802.11b: 69.7 mW 802.11g/n HT20: 50.9 mW 802.11n HT40: 46.8 mW
Antenna Connector	Fakra
Number of Antennas	2 External Antenna Connectors for WiFi
Diversity or Smart Antennas	Diversity with all modulations, MIMO with 802.11n mode
Power Supply	External Power Supply, 8-32 V _{DC}

Description of Test Item

The EUT is an electronic control unit for vehicle integration. The EUT contains WiFi, Bluetooth, and LTE modules.

This model is electrically identical to the model SID 2.0 (FCC ID: AHV-SID2B, IC: 10111A-SID2B), the model with 5GHz WiFi is in the process of being certified.

Model Overview						
Model Name	U-NII	Marine	LTE	FCC ID	IC ID	Description
SID 2.0	☐	☐	☒	AHV-SID2	10111A-SID2	Model without 5GHz WiFi
SID 2.0	☒	☐	☒	AHV-SID2B	10111A-SID2B	Model with 5GHz WiFi
SID 2.0M	☒	☒	☐	AHV-SID2M	10111A-SID2M	Marine Model without LTE
SID 2.0MLTE	☒	☒	☒	AHV-SID2MLTE	10111A-SID2MLTE	Marine Model with LTE

All models are electrically identical, except SID 2.0M does not have the LTE module installed.

1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	24 V DC

The values are the limit registered during the test period.

The EUT was powered from a regulated power supply during all tests.

1.3 Test Engineer

Frode Sveinsen

1.4 Antenna Types

Name	P/N	Function	Number of inputs	Description
2J 2x 4G/3G/2G MIMO, +2x 2.4/5.0 GHz MIMO and GNSS	2J #2J4A50PCFa	2.4GHz Wifi+BT	2	COMBI ANT
		2G+3G+4G	2	
TE ANTENNA BASE FULL FEAT	Volvo #23311779	2.4GHz Wifi+BT	1	WHIP ANT
		2G+3G+4G	1	
TE ANTENNA INTERIOR WLAN	Volvo #23311706	2.4GHz Wifi+BT	1	PATCH ANT

1.5 Antenna Requirement

Does the EUT have detachable antenna(s)?	☒ YES	☐ NO
If detachable, is the antenna connector(s) non-standard?	☒ YES	☐ NO
The tested equipment has FAKRA connectors.		

Requirement: FCC 15.203, 15.204

1.6 EUT Operating Modes

Operating modes	Radiated Emissions and Power Line Conducted Emissions were performed with the EUT set to transmit at the channel with the highest output power as worst-case scenario.
Additional information	The worst case data rates were: 802.11b mode : 1 Mbps 802.11g mode : 6 Mbps 802.11n HT20 mode : MCS0 802.11n HT40 mode : MCS0

1.7 Power Settings

Power Setting										
Channel	11b 1M	11b 11M	11g 6M	11g 54M	11n HT20 MCS0	11n HT20 MCS7	11n HT40 MCS0 SISO	11n HT40 MCS7 SISO	11n HT40 MCS0 MIMO	11n HT40 MCS7 MIMO
Ch01 Ch02	11	11	11	11	11	11				
Ch03	15	15	17	17	17	16	11	11	8	7
Ch04							14	14	12	12
Ch05							16	16	13	13
Ch06							16	16	13	13
Ch07							14	14	13	13
Ch08							12	12	12	12
Ch09			13	13	13	13	11	11	8	8
Ch10 Ch11	11	11	11	11	11	11				

1.8 Comments

All ports were populated during spurious emission measurements.

2 TEST REPORT SUMMARY

2.1 General

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and ISED Canada RSS-247 Issue 3 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were performed in a semi-anechoic chamber at measuring distances of 3m and 1m.

A description of the test facility is on file with the FCC and ISED.

☒ New Submission	☒ Production Unit
☐ Class II Permissive Change	☐ Pre-production Unit
DTS Equipment Code	☐ Family Listing

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 3, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	Complies
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	Complies
DTS Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	11.8 Option 2	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	11.10.2 PKPSD (DTS)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 11.11 (DTS)	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	3.3 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10 11.12, 11.13 (DTS)	Complies

3 TEST RESULTS

3.1 Occupied Bandwidth (99% BW)

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.2

Test Results: Complies

Measurement Data:

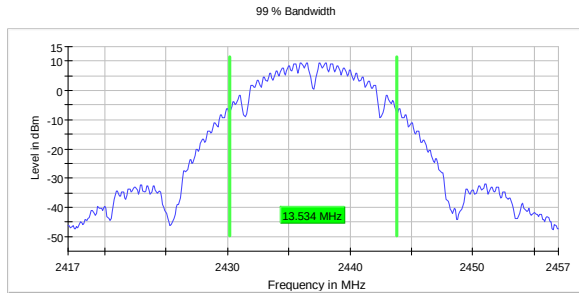
Carrier Frequency, Modulation and Data Rate	Occupied Bandwidth (99% BW)
2437 MHz, 802.11b	13.5 MHz
2437 MHz, 802.11g	16.6 MHz
2437 MHz, 802.11n SISO	17.8 MHz
2437 MHz, 802.11n MIMO	17.8 MHz
2437 MHz, 802.11n HT40 SISO	36.4 MHz
2437 MHz, 802.11n HT40 MIMO	36.4 MHz

Occupied Bandwidth is the same for all channels.

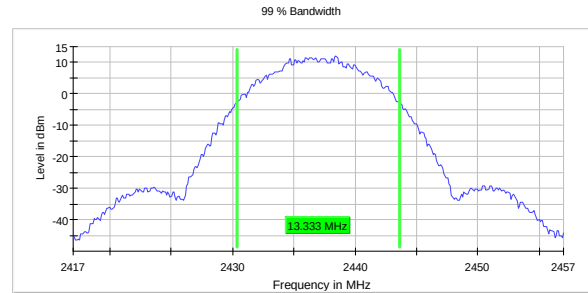
See attached plots.

Requirements:

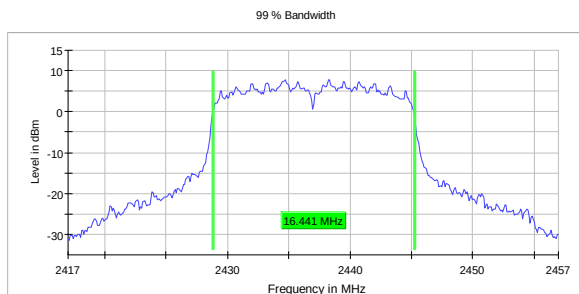
No requirement for 99% BW, reported for information only.



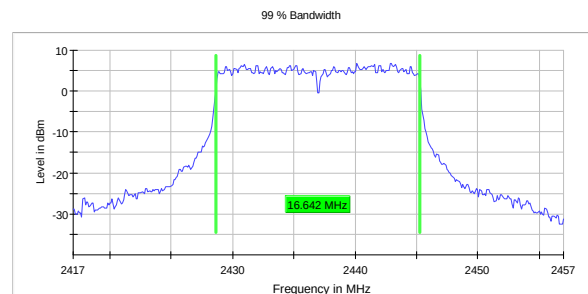
99% Occupied BW, 802.11b 1M



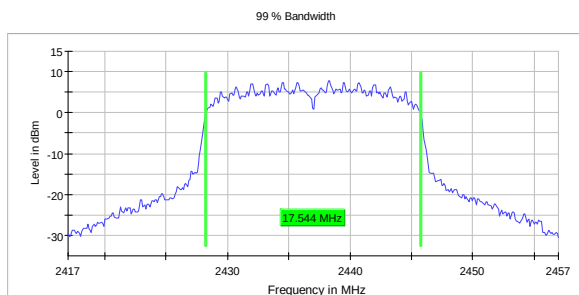
99% Occupied BW, 802.11b 11M



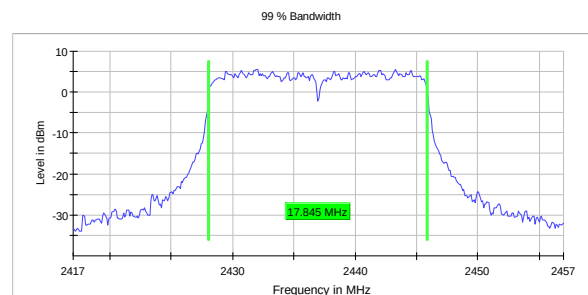
99% Occupied BW, 802.11g 6M



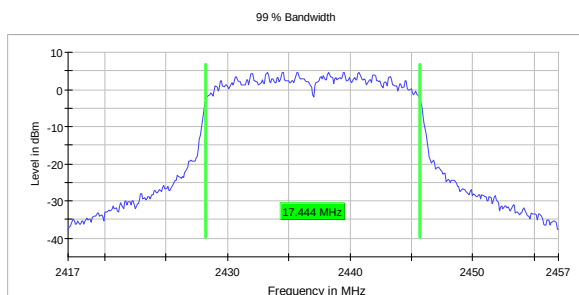
99% Occupied BW, 802.11g 54M



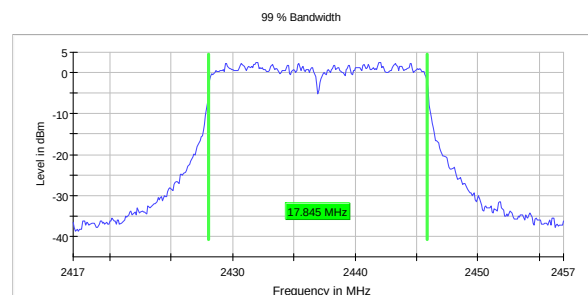
99% Occupied BW, 802.11n SISO MCS0



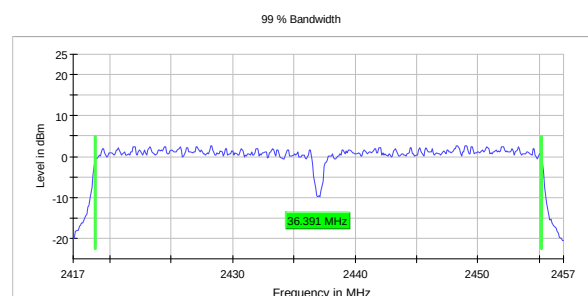
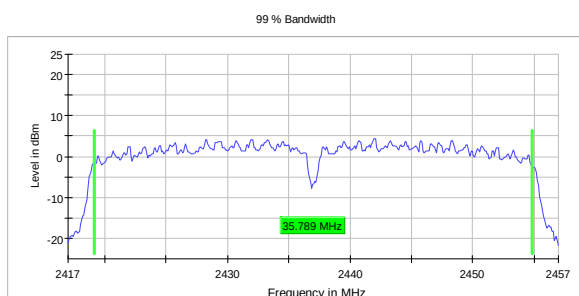
99% Occupied BW, 802.11n SISO MCS7

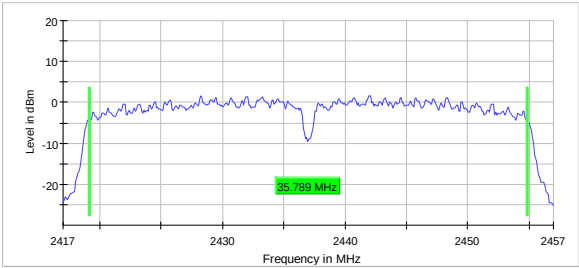
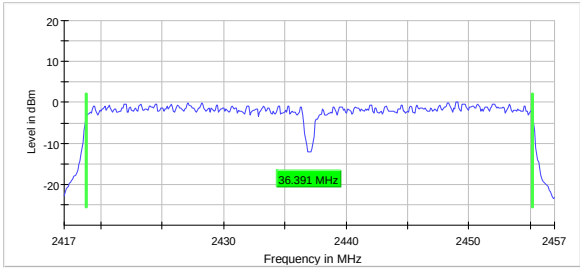


99% Occupied BW, 802.11n MIMO MCS8



99% Occupied BW, 802.11n MIMO MCS15



99% Occupied BW, 802.11n HT40 SISO MCS0  99% Occupied BW, 802.11n HT40 MIMO MCS8	99% Occupied BW, 802.11n HT40 SISO MCS7  99% Occupied BW, 802.11n HT40 MIMO MCS15
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3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 3, Clause 5.2 (a)

Measurement procedure: ANSI C63.10-2013 Clause 11.8

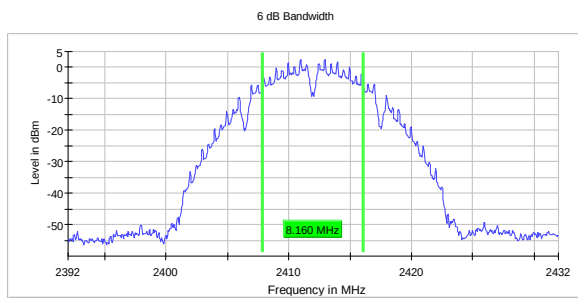
Test Results: Complies

Measurement Data:

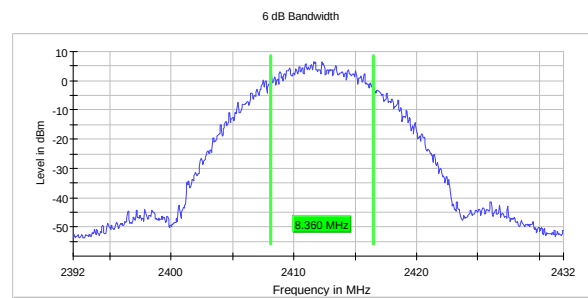
Modulation type	Measured DTS Bandwidth (MHz)		
	2412 MHz	2437 MHz	2462 MHz
802.11b	8.36	9.06	9.06
802.11g	16.6	16.6	16.6
802.11n HT20 SISO	17.8	17.8	17.8
802.11n HT20 MIMO	17.8	17.8	17.8
802.11n HT40 SISO	36.5	36.6	36.6
802.11n HT40 MIMO	36.6	36.6	36.6

Power supply variations within 85 % to 115% of nominal value has no influence on measured value.

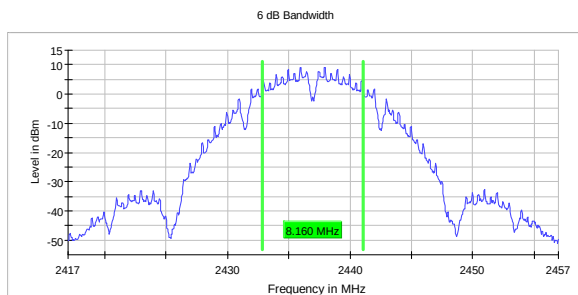
Frequency Band	Requirement for systems using Digital Modulation
902-928 MHz	The minimum 6 dB bandwidth shall be at least 500 kHz.
2400-2483.5 MHz	
5725-5850 MHz	



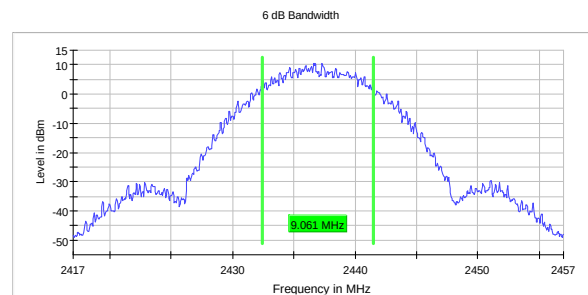
DTS BW, 2412 MHz, 802.11b 1M



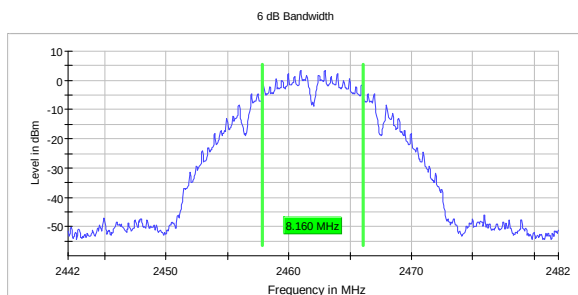
DTS BW, 2412 MHz, 802.11b 11M



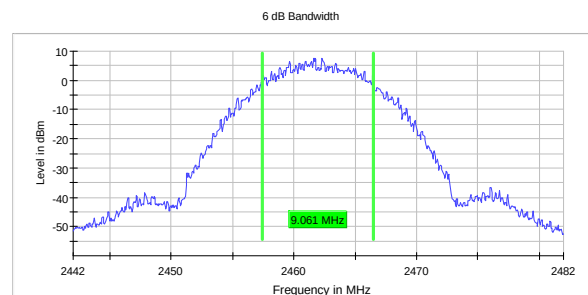
DTS BW, 2437 MHz, 802.11b 1M



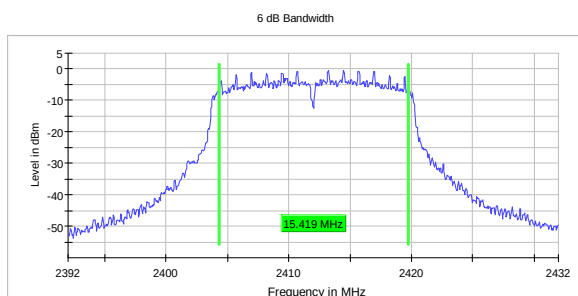
DTS BW, 2437 MHz, 802.11b 11M



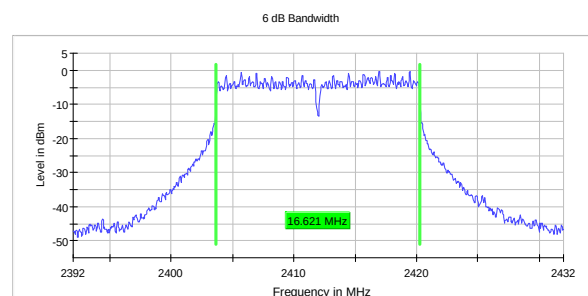
DTS BW, 2462 MHz, 802.11b 1M



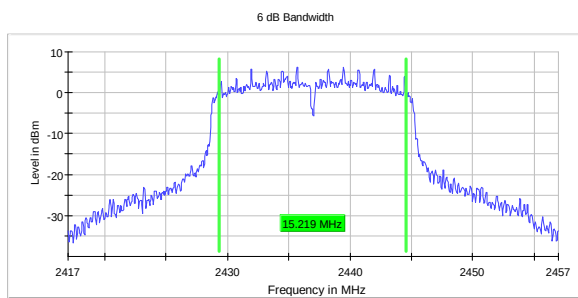
DTS BW, 2462 MHz, 802.11b 11M



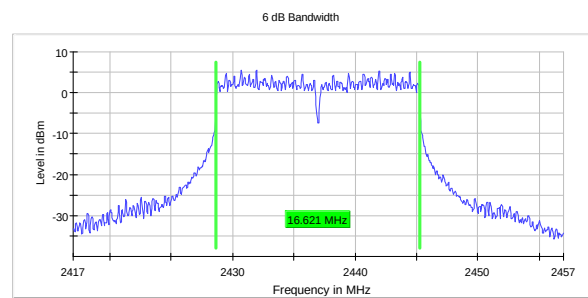
DTS BW, 2412 MHz, 802.11g 6M



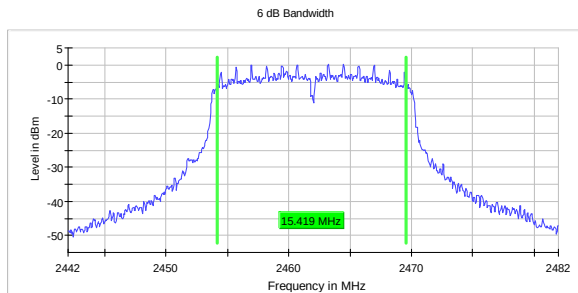
DTS BW, 2412 MHz, 802.11g 54M



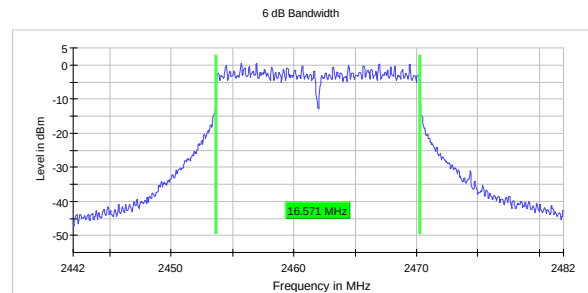
DTS BW, 2437 MHz, 802.11g 6M



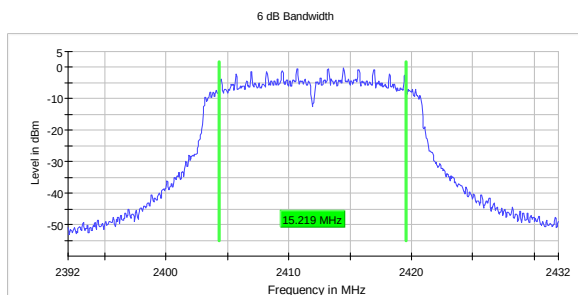
DTS BW, 2437 MHz, 802.11g 54M



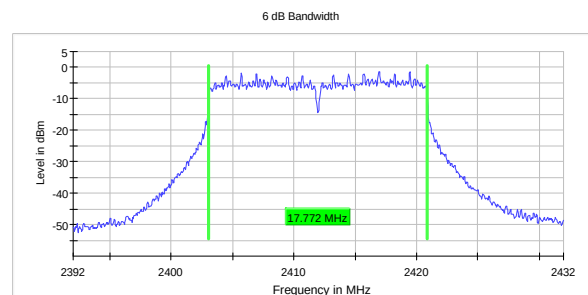
DTS BW, 2462 MHz, 802.11g 6M



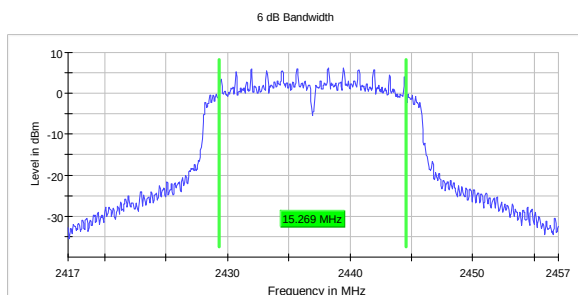
DTS BW, 2462 MHz, 802.11g 54M



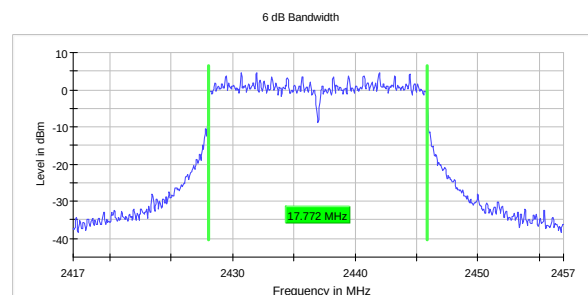
DTS BW, 2412 MHz, 802.11n SISO MCS0



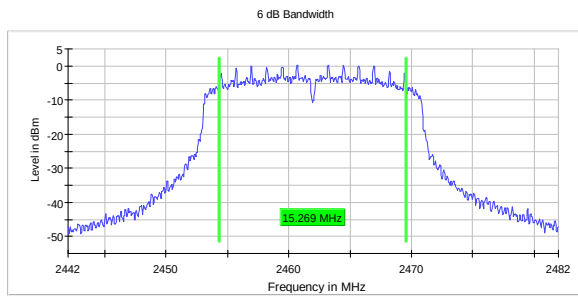
DTS BW, 2412 MHz, 802.11n SISO MCS7



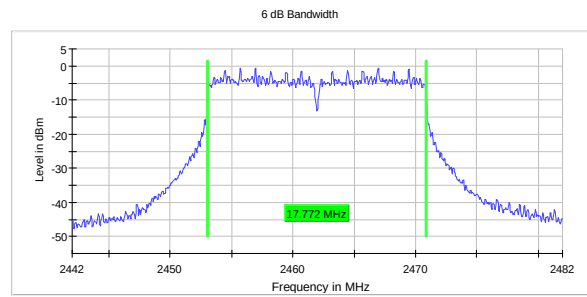
DTS BW, 2437 MHz, 802.11n SISO MCS0



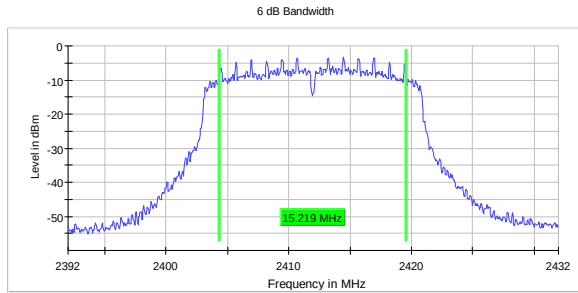
DTS BW, 2437 MHz, 802.11n SISO MCS7



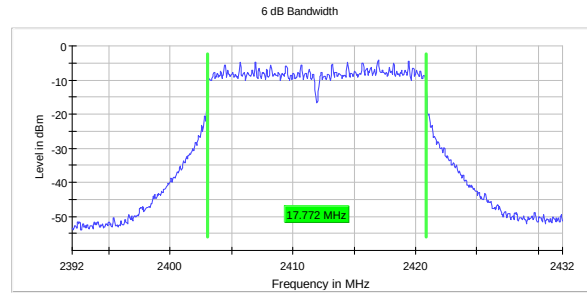
DTS BW, 2462 MHz, 802.11n SISO MCS0



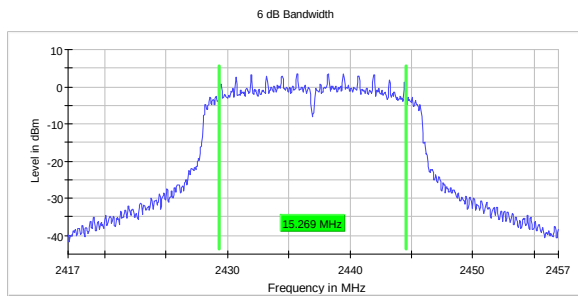
DTS BW, 2462 MHz, 802.11n SISO MCS7



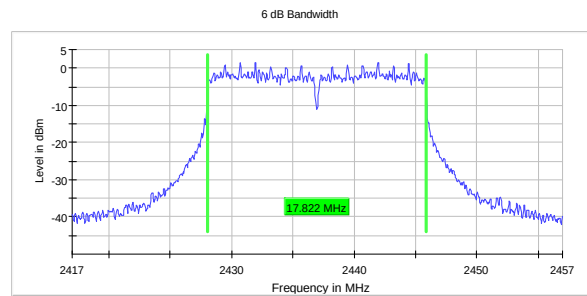
DTS BW, 2412 MHz, 802.11n MIMO MCS8



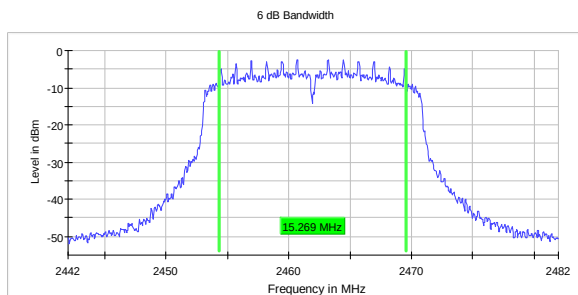
DTS BW, 2412 MHz, 802.11n MIMO MCS15



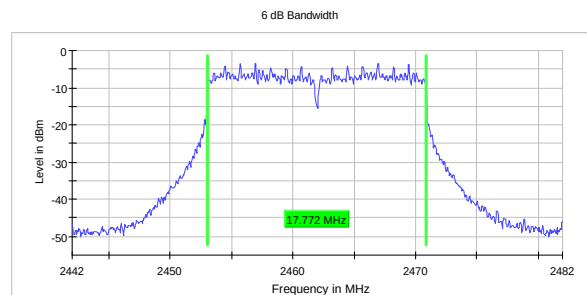
DTS BW, 2437 MHz, 802.11n MIMO MCS8



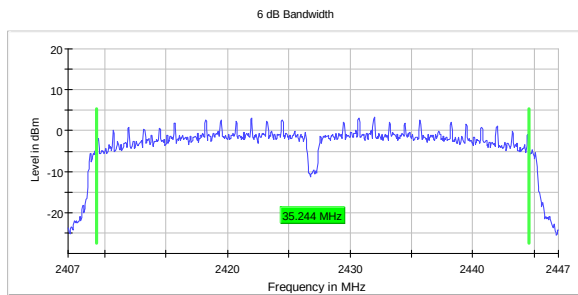
DTS BW, 2437 MHz, 802.11n MIMO MCS15



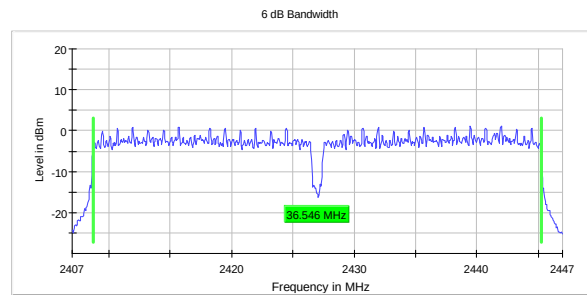
DTS BW, 2462 MHz, 802.11n MIMO MCS8



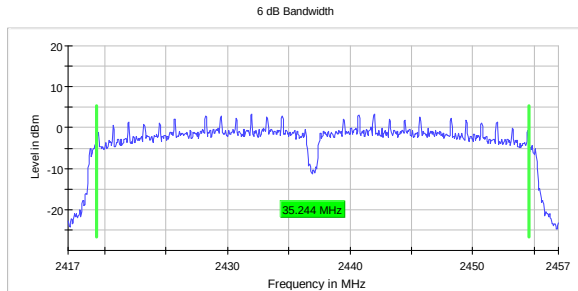
DTS BW, 2462 MHz, 802.11n MIMO MCS15



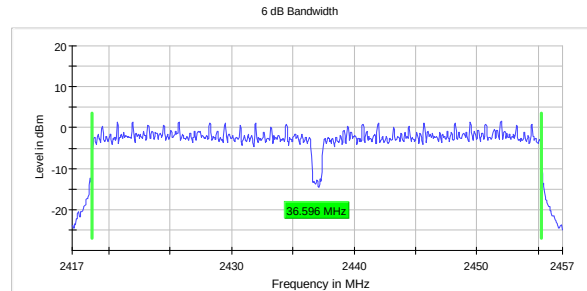
DTS BW, 2427 MHz, 802.11n HT40 SISO MCS0



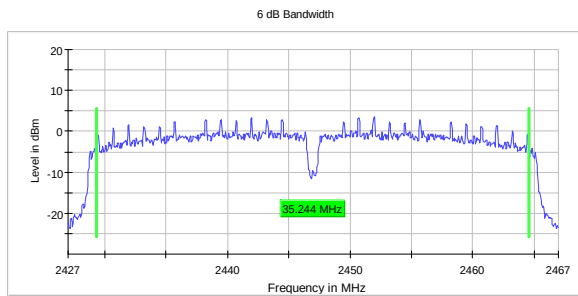
DTS BW, 2427 MHz, 802.11n HT40 SISO MCS7



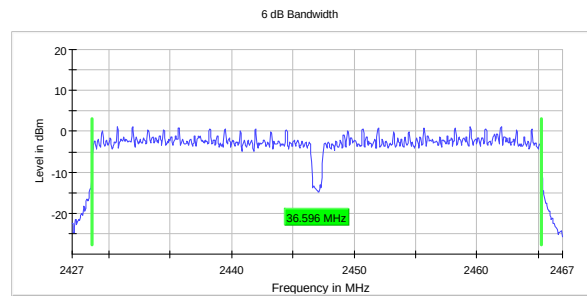
DTS BW, 2437 MHz, 802.11n HT40 SISO MCS0



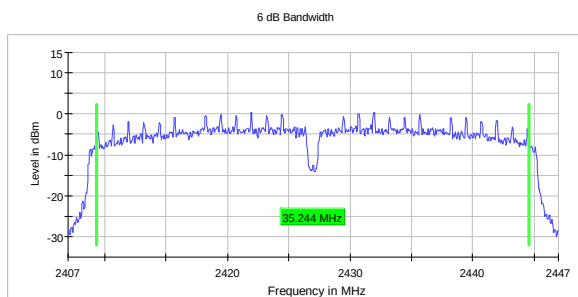
DTS BW, 2437 MHz, 802.11n HT40 SISO MCS7



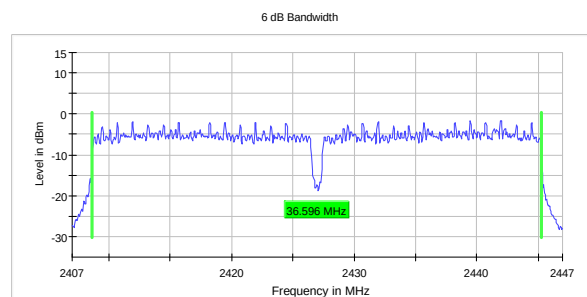
DTS BW, 2447 MHz, 802.11n HT40 SISO MCS0



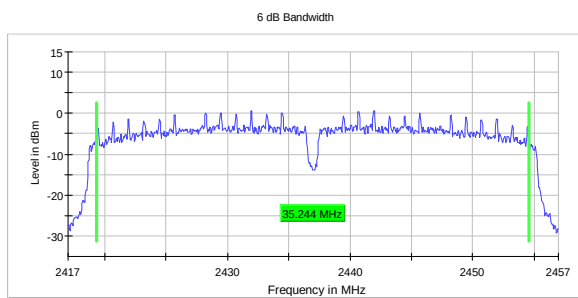
DTS BW, 2447 MHz, 802.11n HT40 SISO MCS7



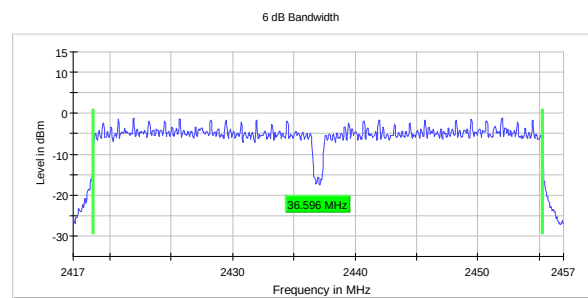
DTS BW, 2427 MHz, 802.11n HT40 MIMO MCS8



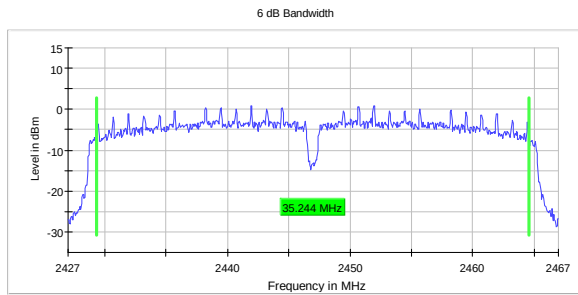
DTS BW, 2427 MHz, 802.11n HT40 MIMO MCS15



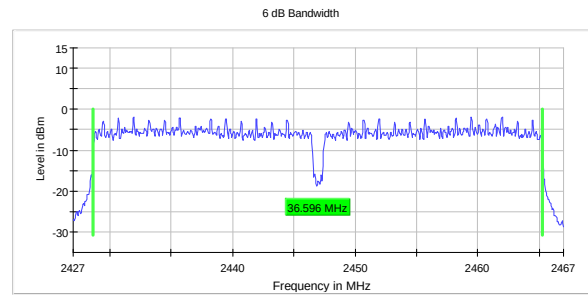
DTS BW, 2437 MHz, 802.11n HT40 MIMO MCS8



DTS BW, 2437 MHz, 802.11n HT40 MIMO MCS15



DTS BW, 2447 MHz, 802.11n HT40 MIMO MCS8



DTS BW, 2447 MHz, 802.11n HT40 MIMO MCS15

3.3 Output Power

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 3, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

Carrier Frequency	Conducted Output Power, dBm					
	802.11b 11M	802.11g 6M	802.11n HT20 SISO MCS0	802.11n HT20 MIMO MCS0	802.11n HT40 SISO MCS0	802.11n HT40 MIMO MCS0
2412 MHz	14.35	10.58	9.92	10.29		
2417 MHz	18.13	16.20	15.96	16.43		
2422 MHz					10.07	10.41
2427 MHz					15.32	16.55
2432 MHz					15.34	
2437 MHz	18.23	16.76	16.54	16.66	16.48	16.61
2442 MHz					16.54	
2447 MHz					15.69	16.68
2452 MHz					10.48	10.38
2457 MHz	18.43	17.07	16.86	16.76		
2462 MHz	15.24	11.57	10.74	10.52		

Output Power reported is RMS Power.

Power is measured with a high-speed sampling power meter and the RMS value is calculated.

MIMO value is measured on both antenna connectors simultaneously, and the sum is calculated.

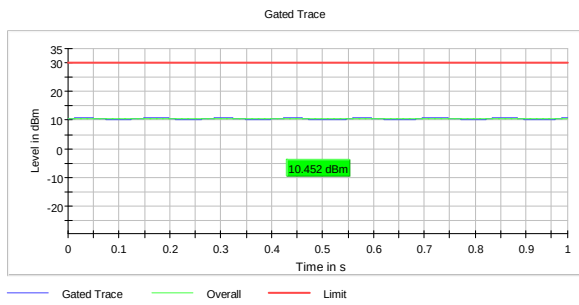
Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

According to the submitted Antenna Datasheets, Maximum Antenna Gain is 12.0 dBi in MIMO mode and 8.0 dBi in SISO mode.

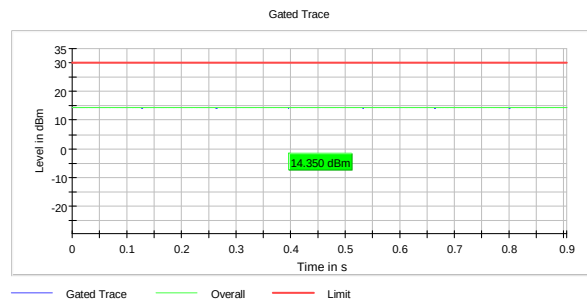
Maximum allowed Output Power is reduced by 6.0 dB to 24.0 dBm in MIMO mode and by 2.0 dB to 28.0 dBm in SISO mode.

See attached plots.

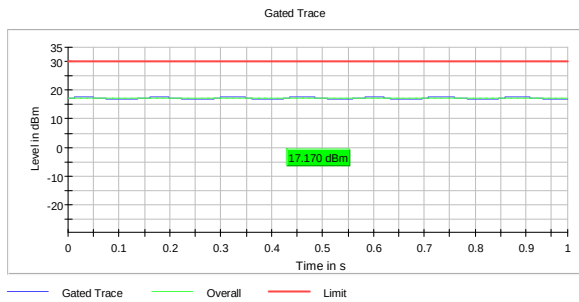
Requirements for Digital Modulation systems
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.
As an alternative to a peak power measurement, compliance with the 1 Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the <i>maximum conducted output power</i> is the highest total transmit power occurring in any mode.
Maximum Antenna Gain
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



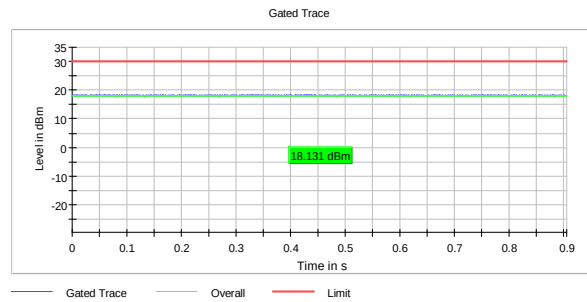
RMS Power, 2412 MHz, 802.11b 1M



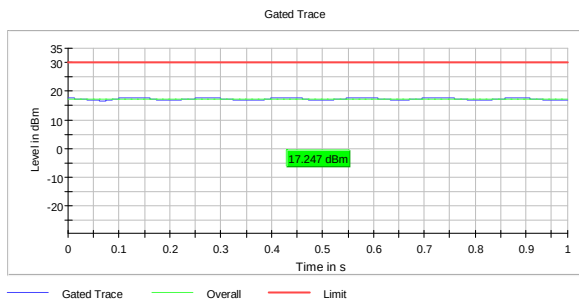
RMS Power, 2412 MHz, 802.11b 11M



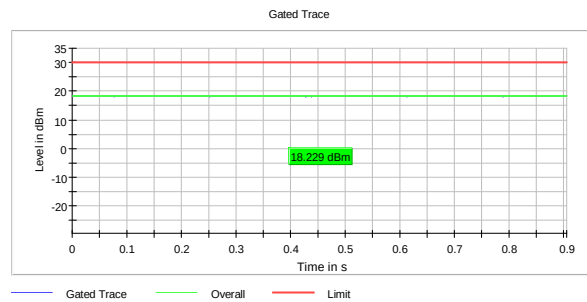
RMS Power, 2417 MHz, 802.11b 1M



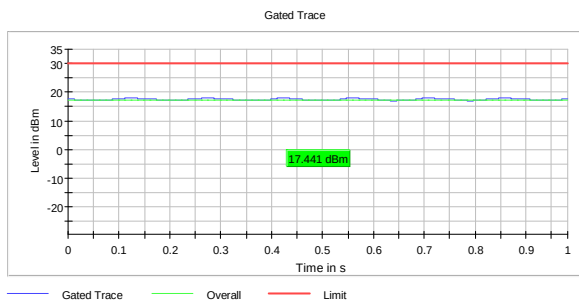
RMS Power, 2417 MHz, 802.11b 11M



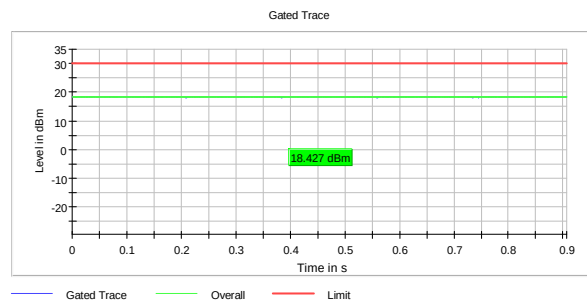
RMS Power, 2437 MHz, 802.11b 1M



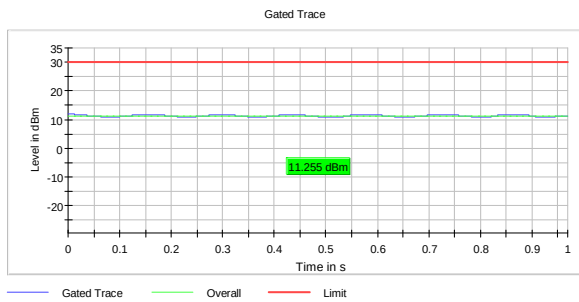
RMS Power, 2437 MHz, 802.11b 11M



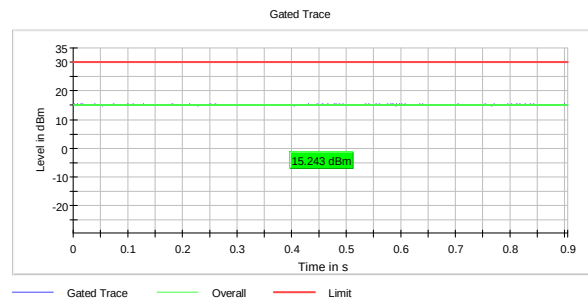
RMS Power, 2457 MHz, 802.11b 1M



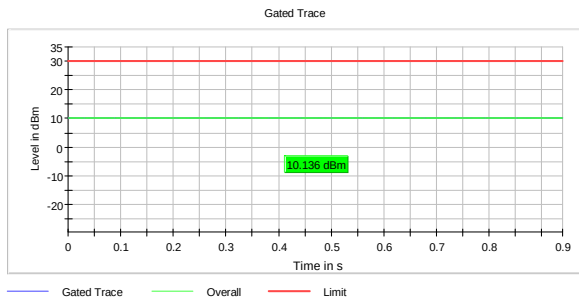
RMS Power, 2457 MHz, 802.11b 11M



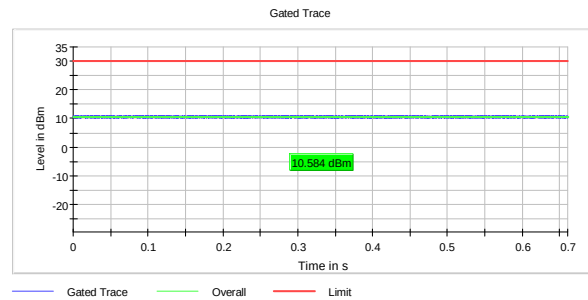
RMS Power, 2462 MHz, 802.11b 1M



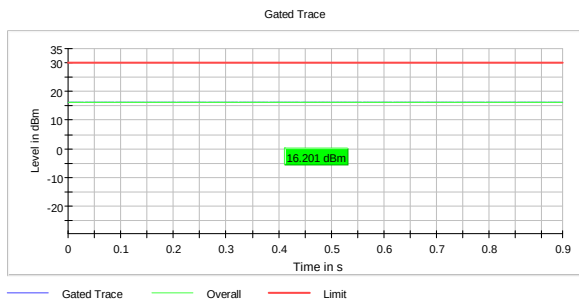
RMS Power, 2462 MHz, 802.11b 11M



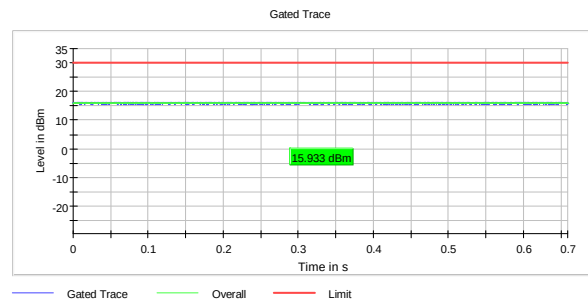
RMS Power, 2412 MHz, 802.11g 6M



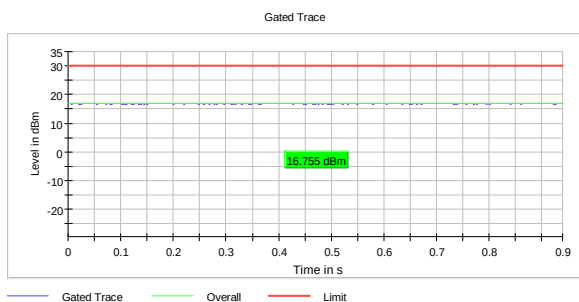
RMS Power, 2412 MHz, 802.11g 54M



RMS Power, 2417 MHz, 802.11g 6M



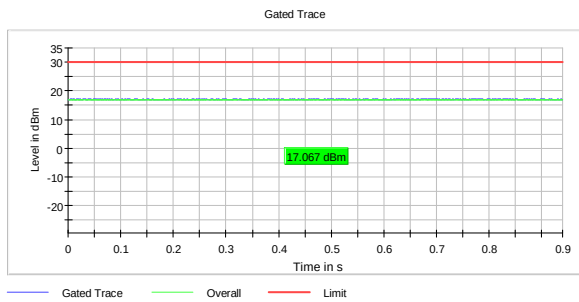
RMS Power, 2417 MHz, 802.11g 54M



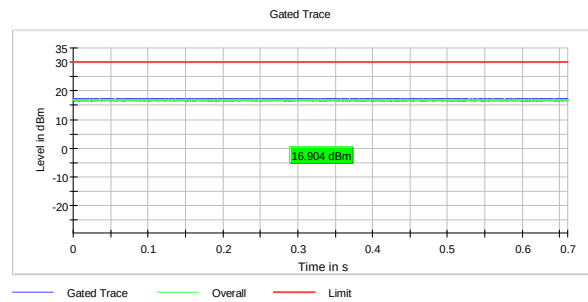
RMS Power, 2437 MHz, 802.11g 6M



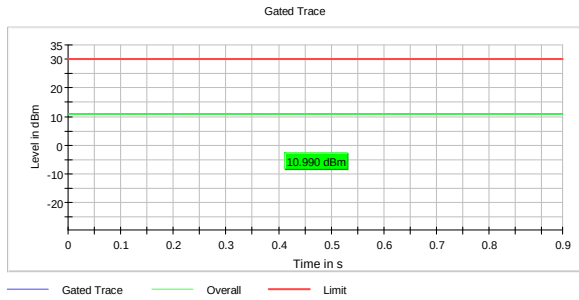
RMS Power, 2437 MHz, 802.11g 54M



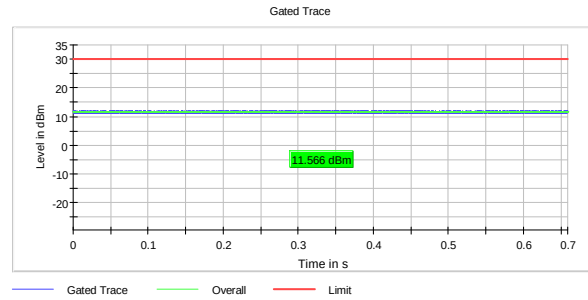
RMS Power, 2457 MHz, 802.11g 6M



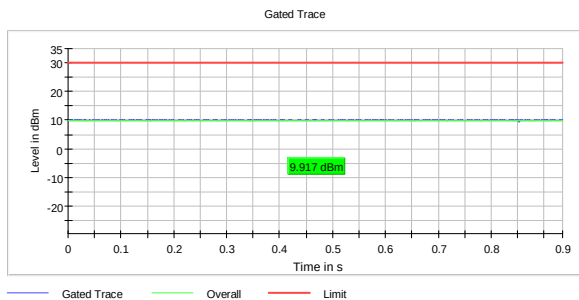
RMS Power, 2457 MHz, 802.11g 54M



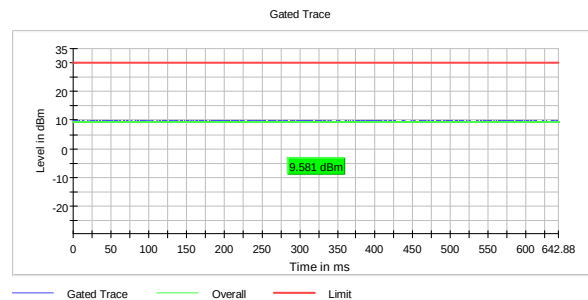
RMS Power, 2462 MHz, 802.11g 6M



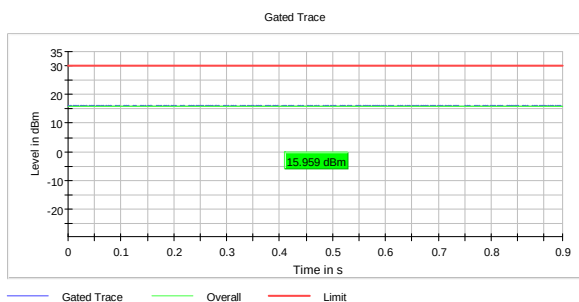
RMS Power, 2462 MHz, 802.11g 54M



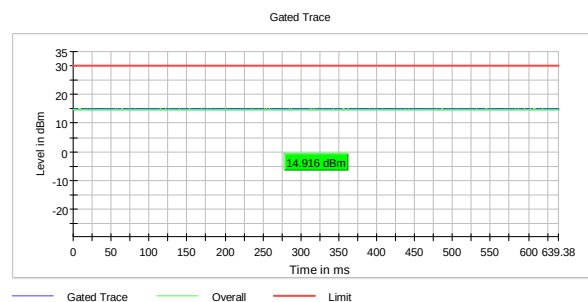
RMS Power, 2412 MHz, 802.11n SISO MCS0



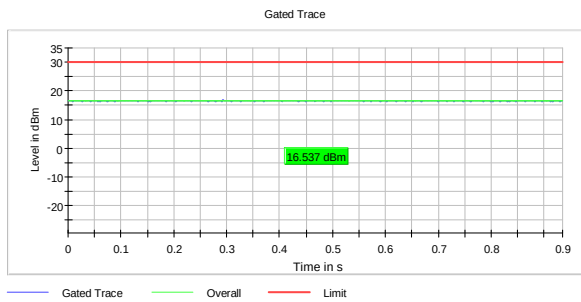
RMS Power, 2412 MHz, 802.11n SISO MCS7



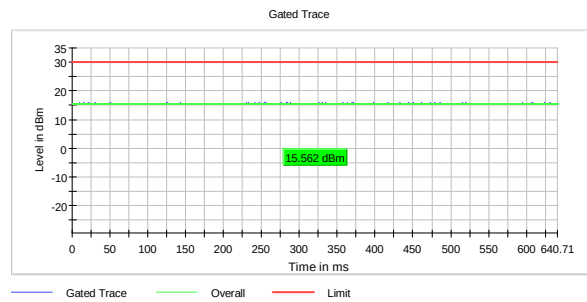
RMS Power, 2417 MHz, 802.11n SISO MCS0



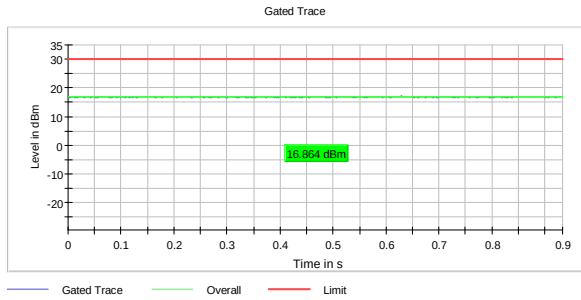
RMS Power, 2417 MHz, 802.11n SISO MCS7



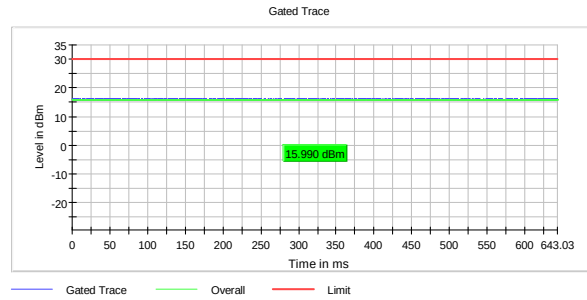
RMS Power, 2437 MHz, 802.11n SISO MCS0



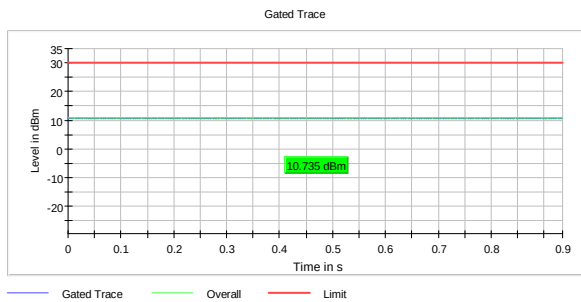
RMS Power, 2437 MHz, 802.11n SISO MCS7



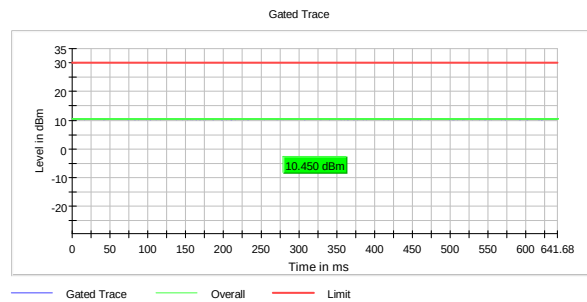
RMS Power, 2457 MHz, 802.11n SISO MCS0



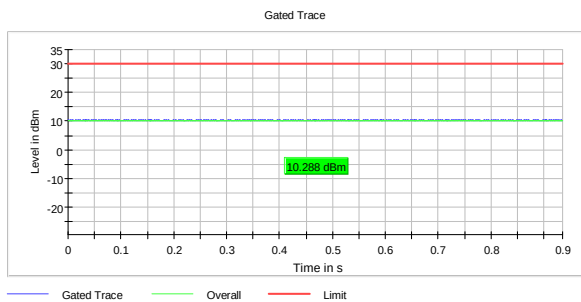
RMS Power, 2457 MHz, 802.11n SISO MCS7



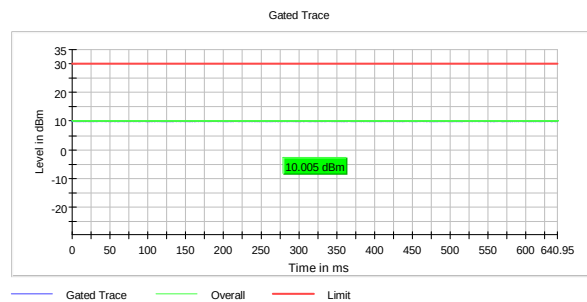
RMS Power, 2462 MHz, 802.11n SISO MCS0



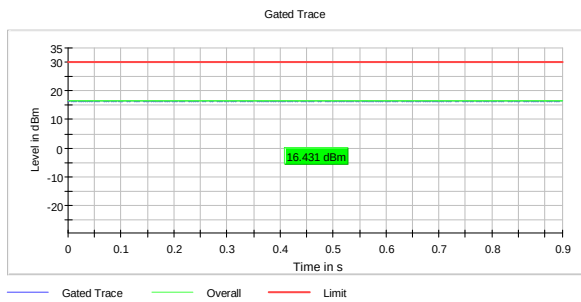
RMS Power, 2462 MHz, 802.11n SISO MCS7



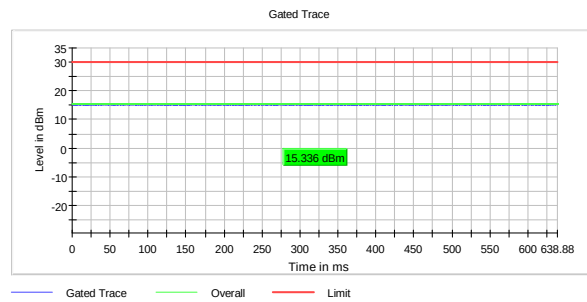
RMS Power, 2412 MHz, 802.11n MIMO MCS8



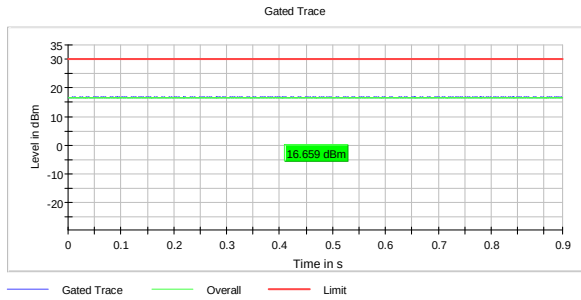
RMS Power, 2412 MHz, 802.11n MIMO MCS15



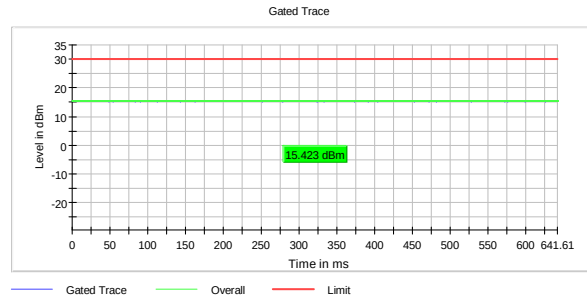
RMS Power, 2417 MHz, 802.11n MIMO MCS8



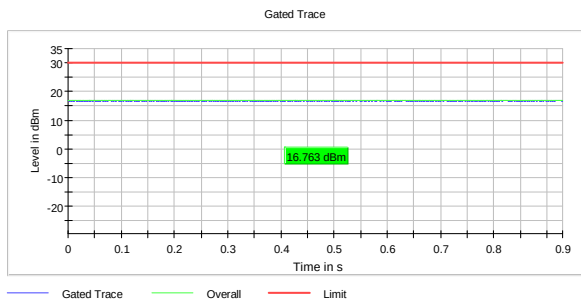
RMS Power, 2417 MHz, 802.11n MIMO MCS15



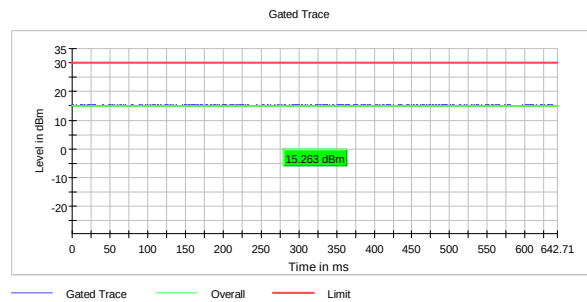
RMS Power, 2437 MHz, 802.11n MIMO MCS8



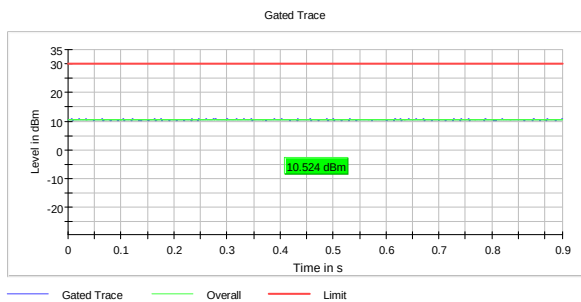
RMS Power, 2437 MHz, 802.11n MIMO MCS15



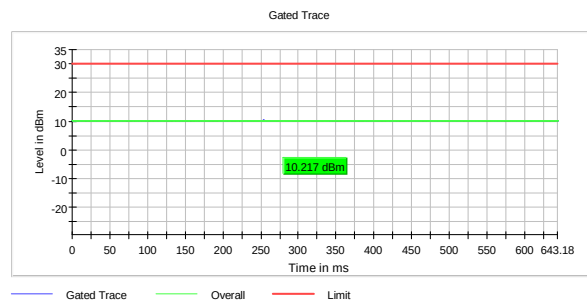
RMS Power, 2457 MHz, 802.11n MIMO MCS8



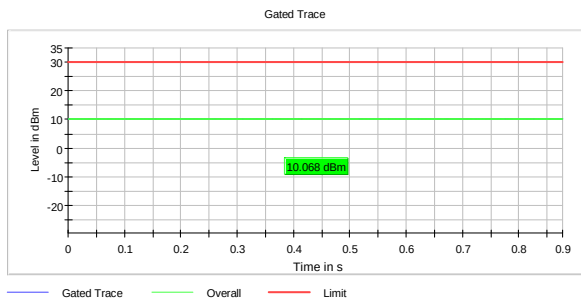
RMS Power, 2457 MHz, 802.11n MIMO MCS15



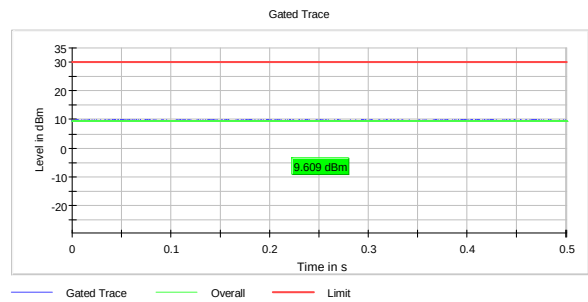
RMS Power, 2462 MHz, 802.11n MIMO MCS8



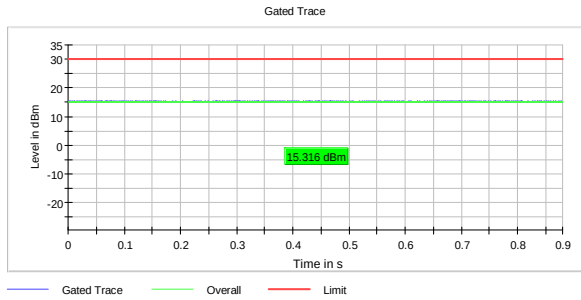
RMS Power, 2462 MHz, 802.11n MIMO MCS15



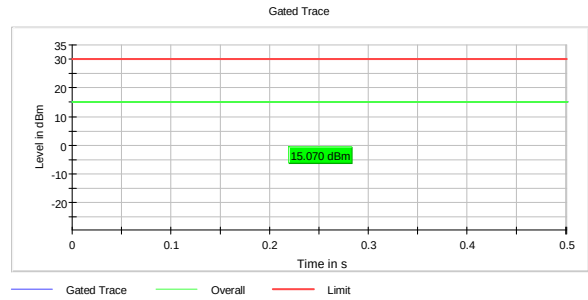
RMS Power, 2422 MHz, 802.11n HT40 SISO MCS0



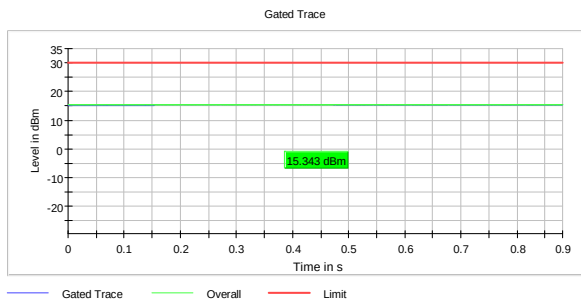
RMS Power, 2422 MHz, 802.11n HT40 SISO MCS7



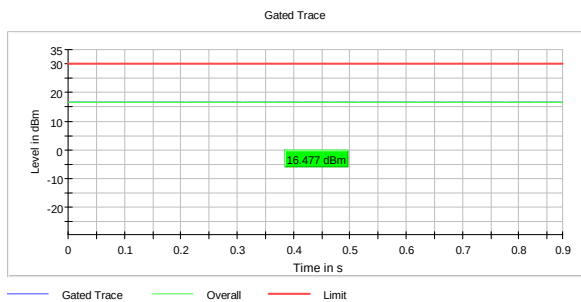
RMS Power, 2427 MHz, 802.11n HT40 SISO MCS0 PL16



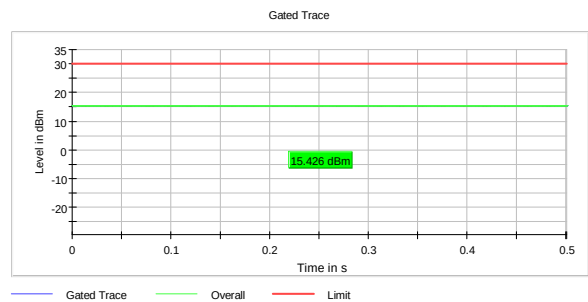
RMS Power, 2427 MHz, 802.11n HT40 SISO MCS7



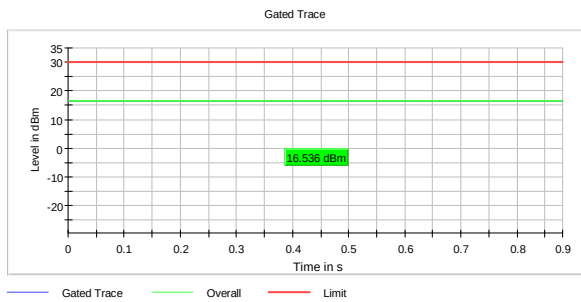
RMS Power, 2432 MHz, 802.11n HT40 SISO MCS0 PL16



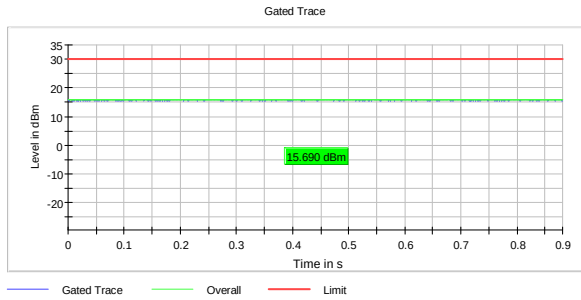
RMS Power, 2437 MHz, 802.11n HT40 SISO MCS0



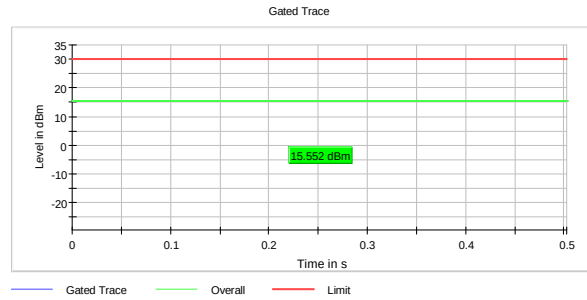
RMS Power, 2437 MHz, 802.11n HT40 SISO MCS7



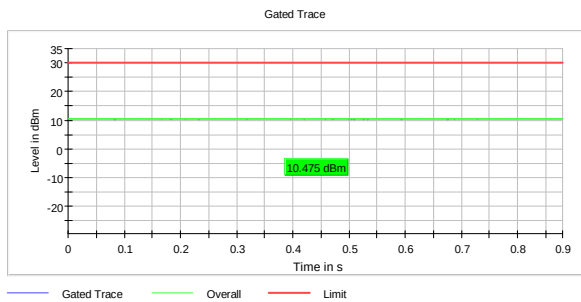
RMS Power, 2442 MHz, 802.11n HT40 SISO MCS0



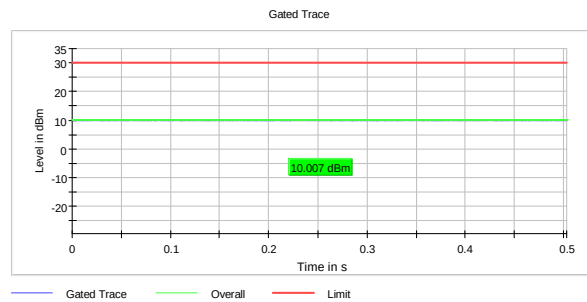
RMS Power, 2447 MHz, 802.11n HT40 SISO MCS0 PL16



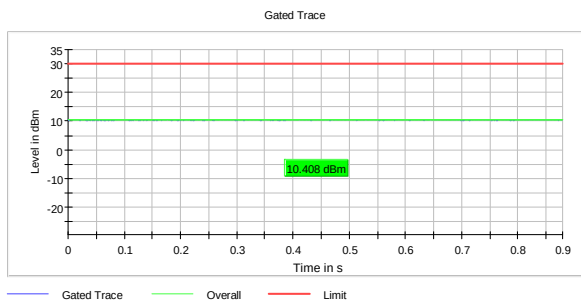
RMS Power, 2447 MHz, 802.11n HT40 SISO MCS7



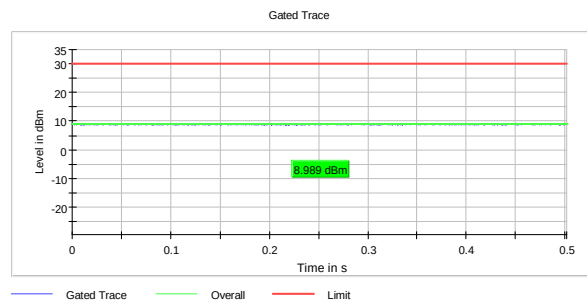
RMS Power, 2452 MHz, 802.11n HT40 SISO MCS0



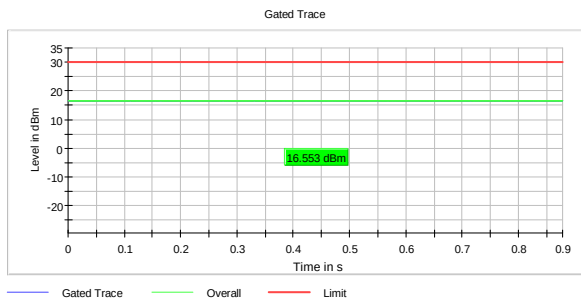
RMS Power, 2452 MHz, 802.11n HT40 SISO MCS7



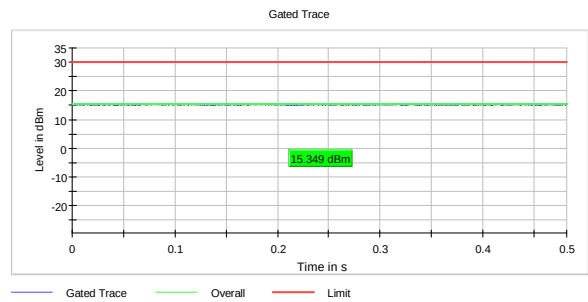
RMS Power, 2422 MHz, 802.11n HT40 MIMO MCS8



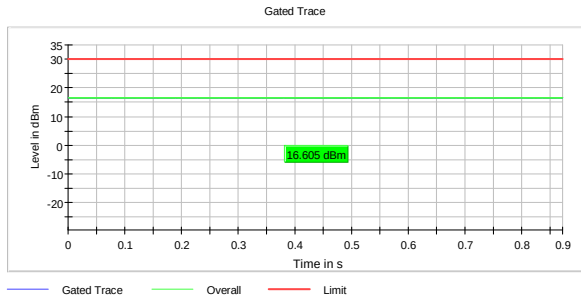
RMS Power, 2422 MHz, 802.11n HT40 MIMO MCS15 PL7



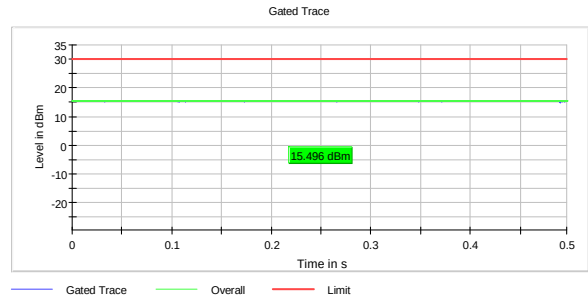
RMS Power, 2427 MHz, 802.11n HT40 MIMO MCS8



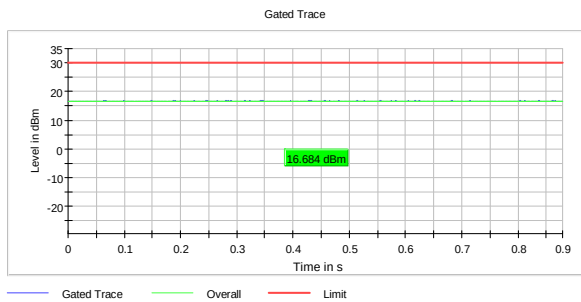
RMS Power, 2427 MHz, 802.11n HT40 MIMO MCS15



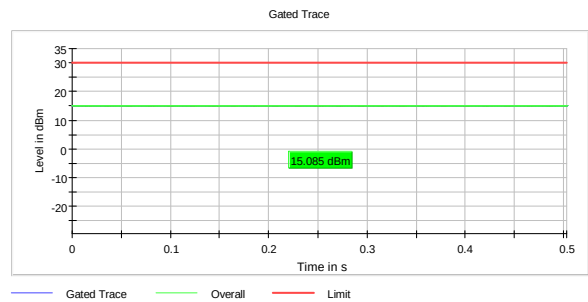
RMS Power, 2437 MHz, 802.11n HT40 MIMO MCS8



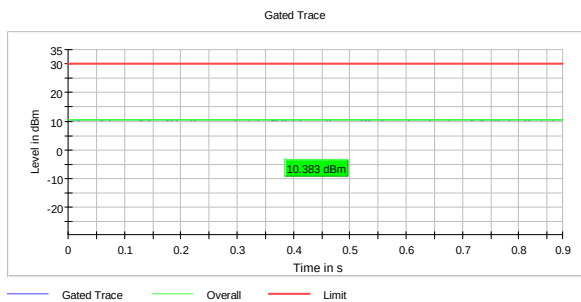
RMS Power, 2437 MHz, 802.11n HT40 MIMO MCS15



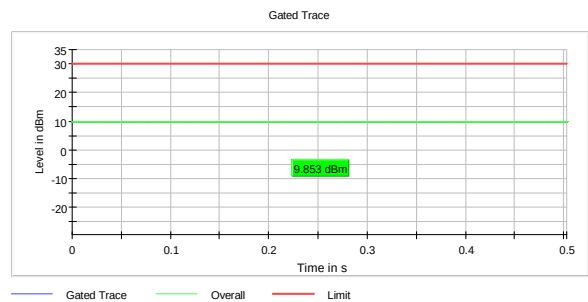
RMS Power, 2447 MHz, 802.11n HT40 MIMO MCS8



RMS Power, 2447 MHz, 802.11n HT40 MIMO MCS15



RMS Power, 2452 MHz, 802.11n HT40 MIMO MCS8



RMS Power, 2452 MHz, 802.11n HT40 MIMO MCS15

3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 3, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

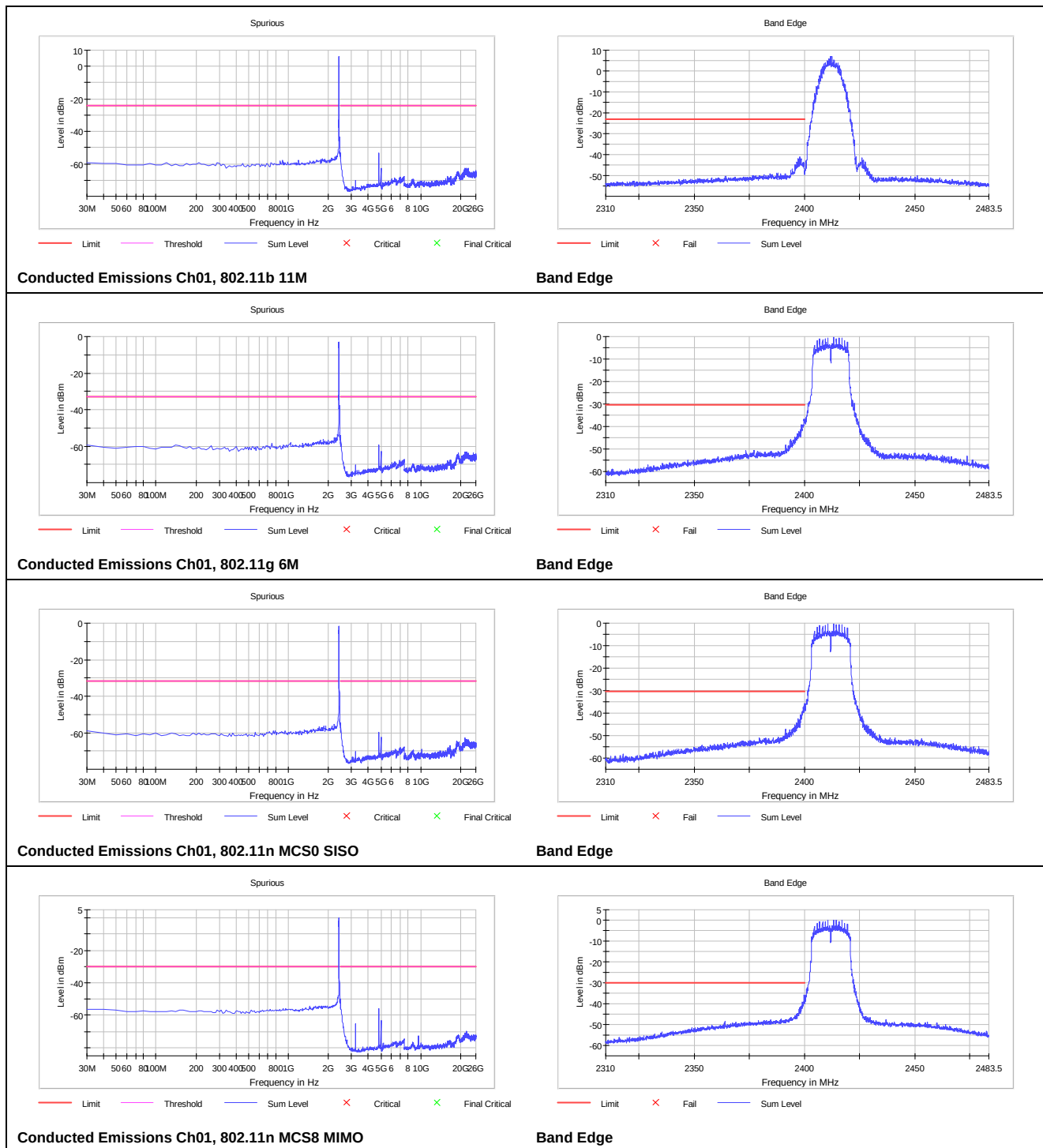
Measurement Data:

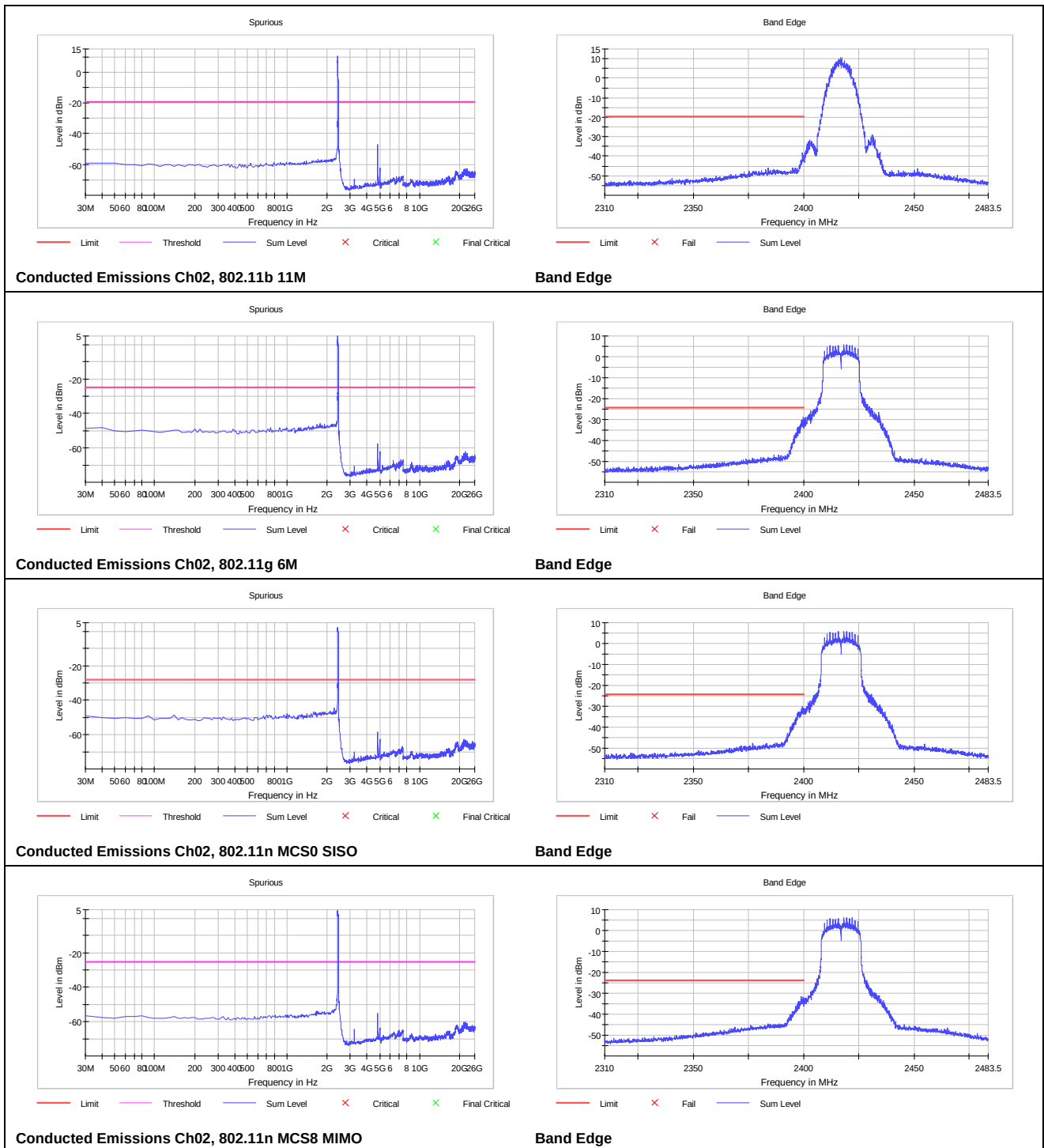
Carrier Frequency	Highest Value (dBc)	Margin	Verdict
Any Channel and Modulation	≥ 30 dBc	≥ 10 dB	Pass

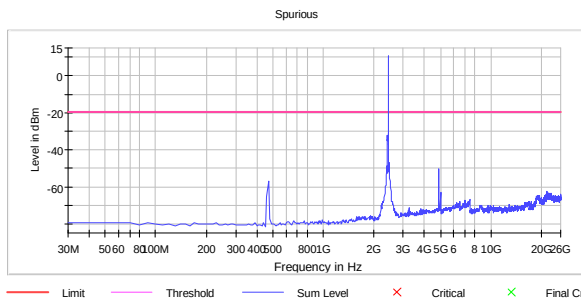
Measured with Peak Detector

RF conducted power to 25 GHz: see attached plots.

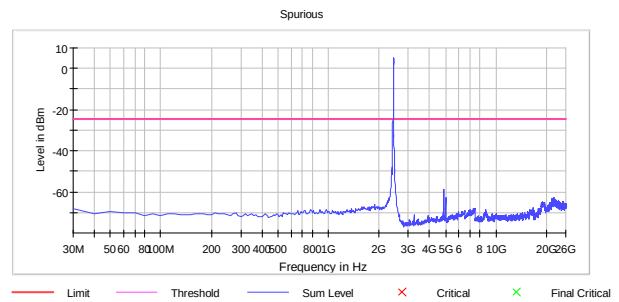
Requirements for all systems	
Peak measurement	RMS averaging (alternative measurement)
20 dB or more below carrier measured in 100 kHz bandwidth	30 dB or more below carrier measured in 100 kHz bandwidth
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required.	



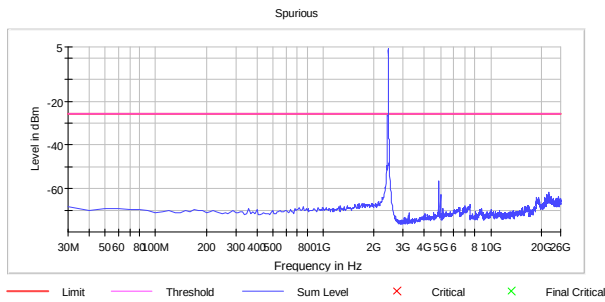




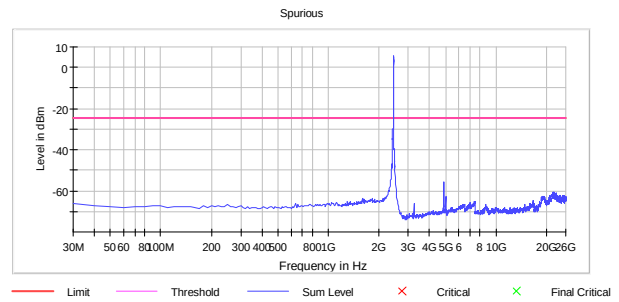
Conducted Emissions Ch06, 802.11b 11M



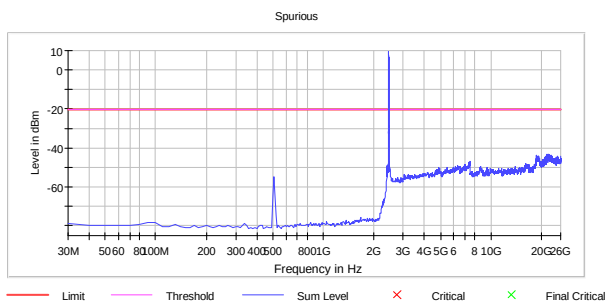
Conducted Emissions Ch06, 802.11g 6M



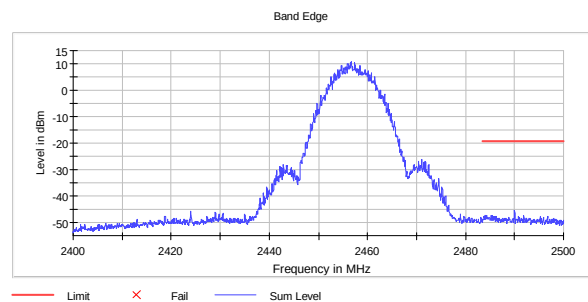
Conducted Emissions Ch06, 802.11n MCS0 SISO



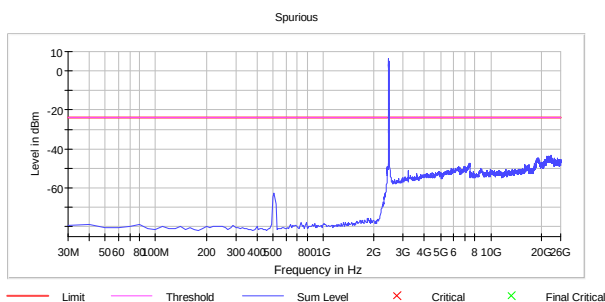
Conducted Emissions Ch06, 802.11n MCS8 MIMO



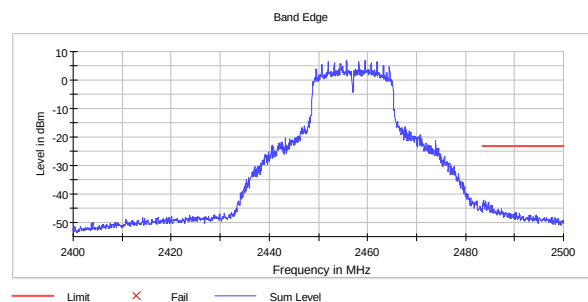
Conducted Emissions Ch10, 802.11b 11M



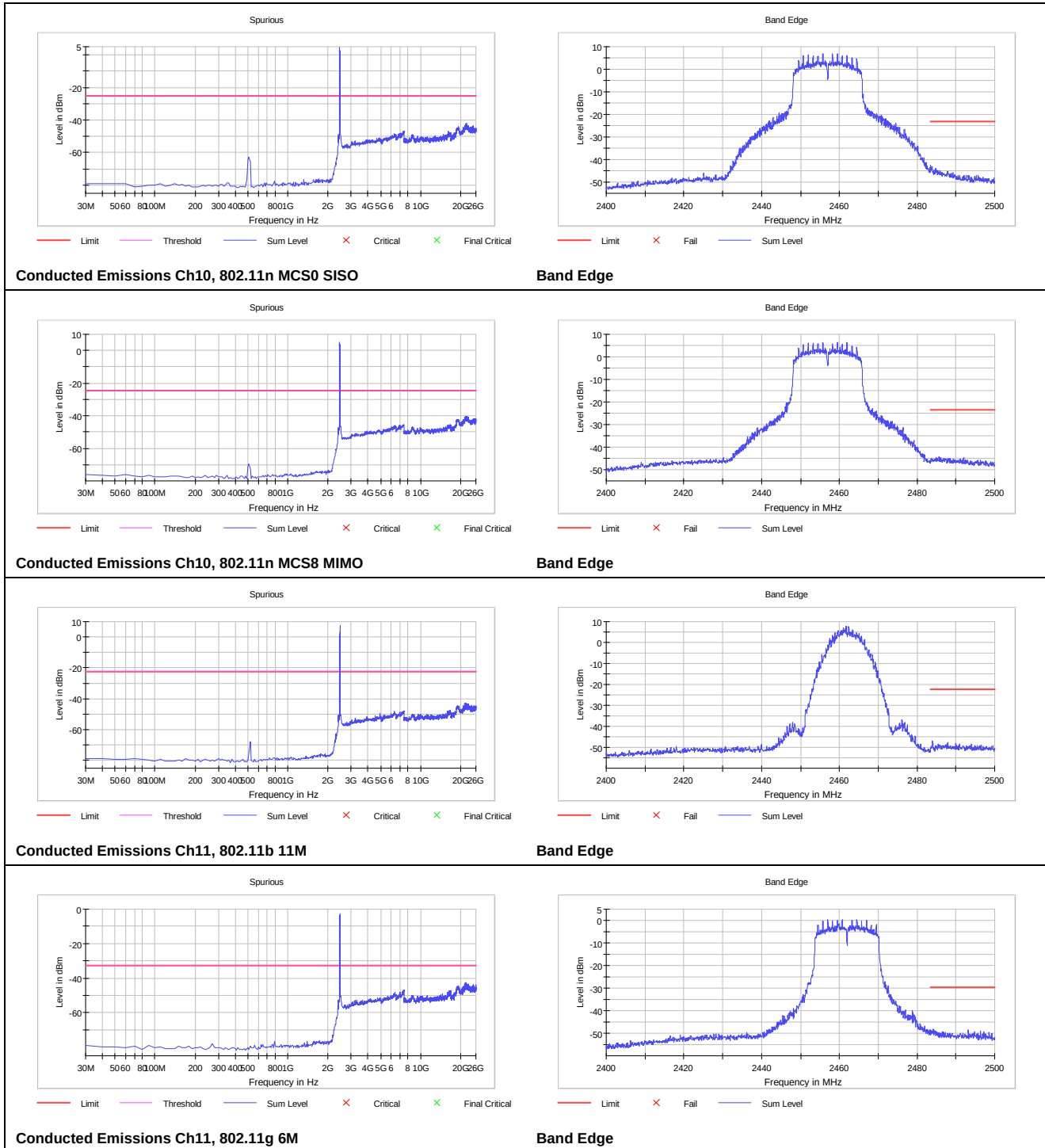
Band Edge

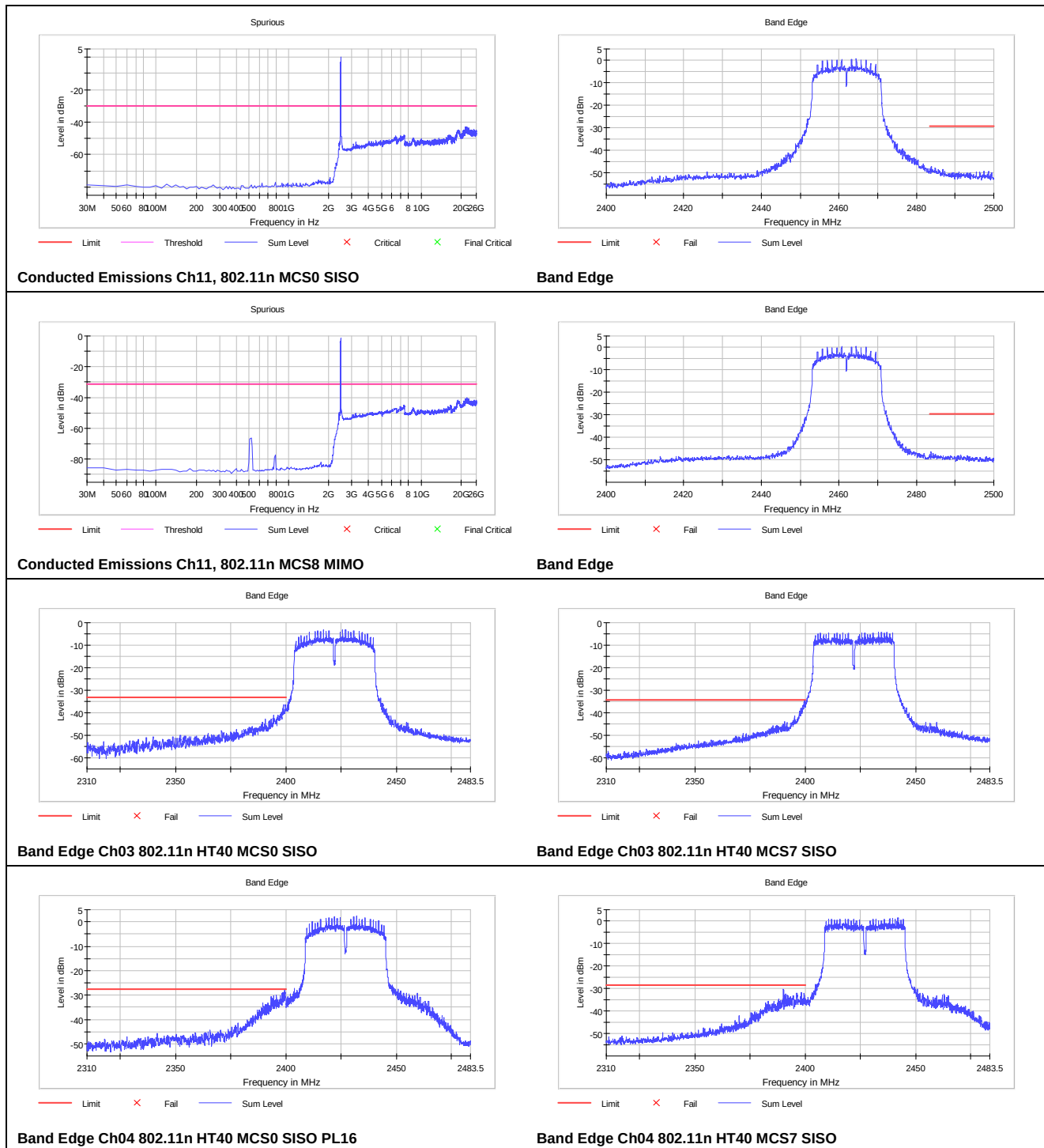


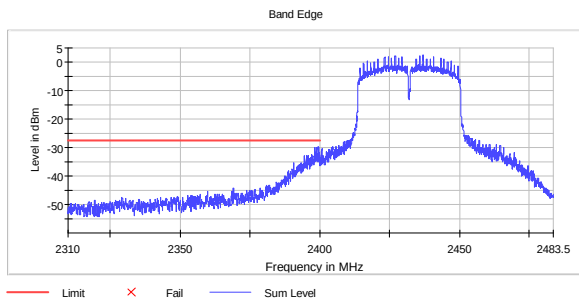
Conducted Emissions Ch10, 802.11g 6M



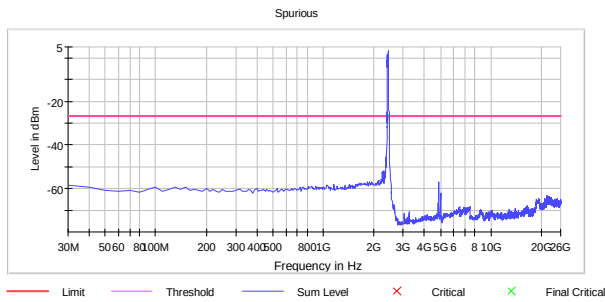
Band Edge



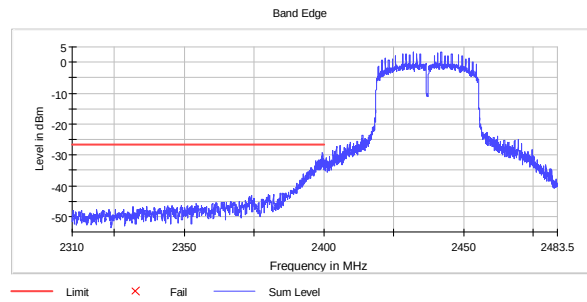




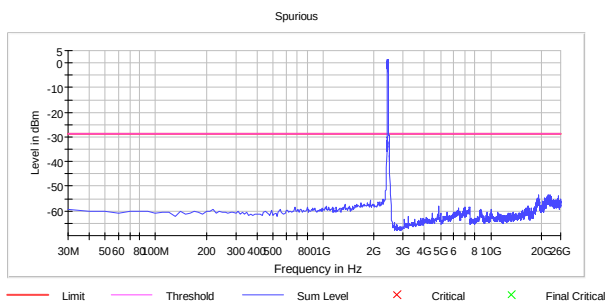
Band Edge Ch05 802.11n HT40 MCS0 SISO PL16



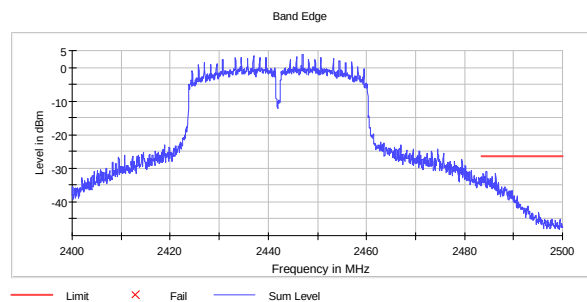
Conducted Emissions Ch06 802.11n HT40 MCS0 SISO



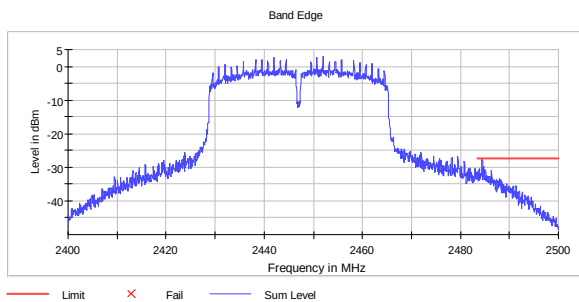
Band Edge Ch06 802.11n HT40 MCS0 SISO



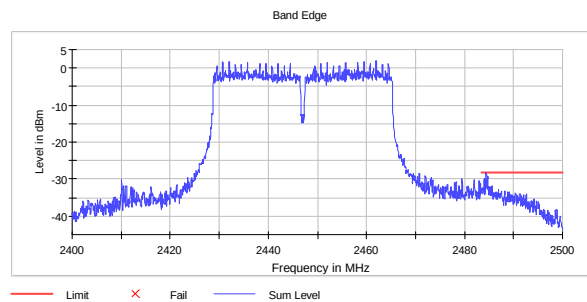
Conducted Emissions Ch07 802.11n HT40 MCS0 SISO



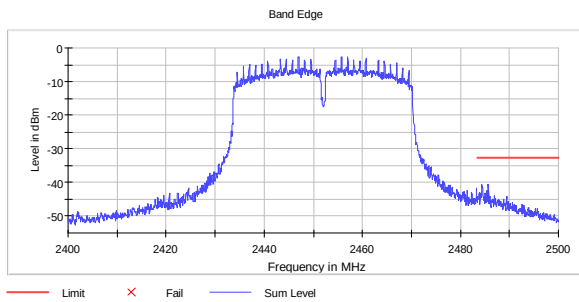
Band Edge Ch07 802.11n HT40 MCS0 SISO



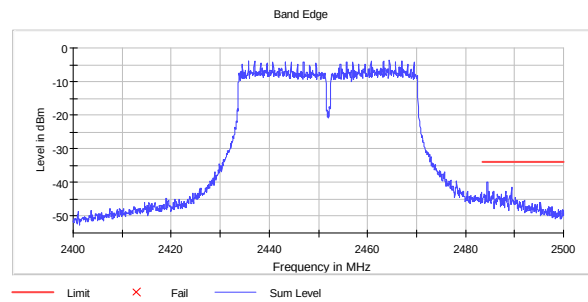
Band Edge Ch08 802.11n HT40 MCS0 SISO PL16



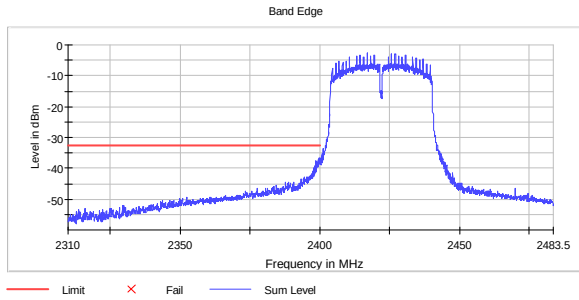
Band Edge Ch08 802.11n HT40 MCS7 SISO



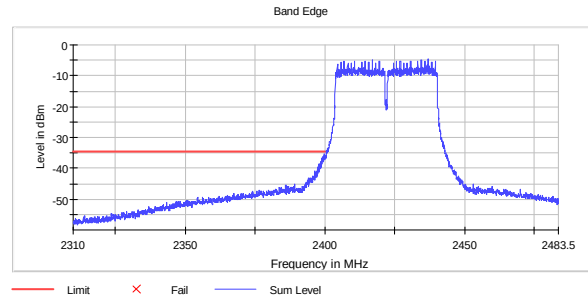
Band Edge Ch09 802.11n HT40 MCS0 SISO



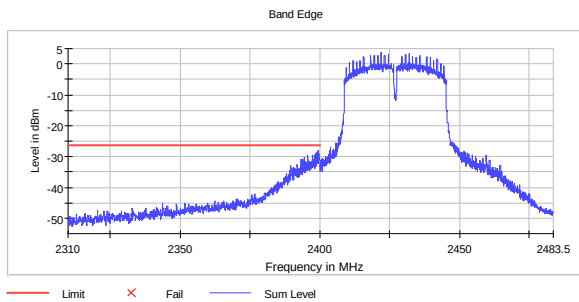
Band Edge Ch09 802.11n HT40 MCS7 SISO



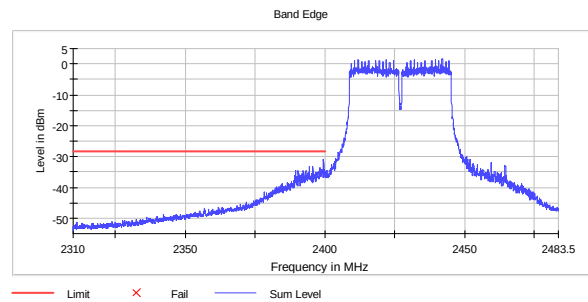
Band Edge Ch03 802.11n HT40 MCS8 MIMO



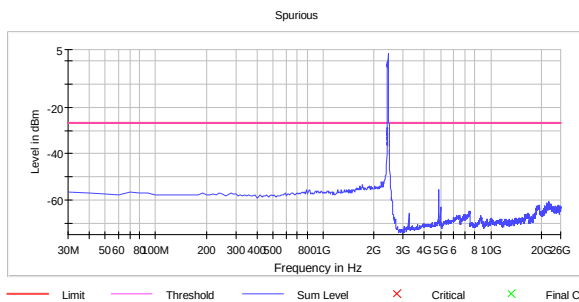
Band Edge Ch03 802.11n HT40 MCS15 MIMO PL7



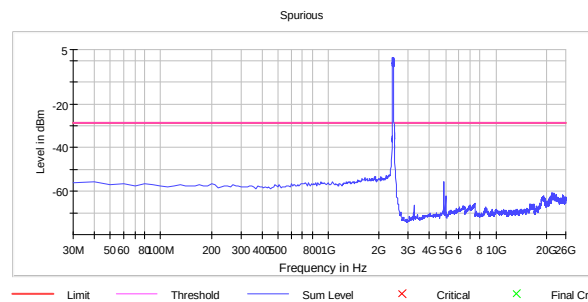
Band Edge Ch04 802.11n HT40 MCS8 MIMO



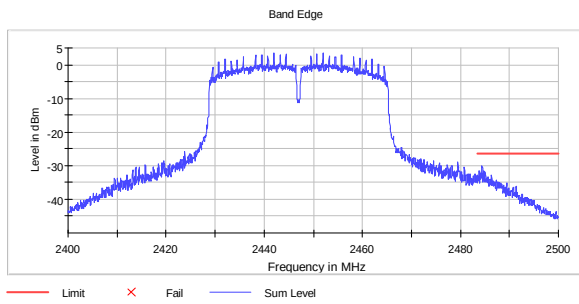
Band Edge Ch04 802.11n HT40 MCS15 MIMO



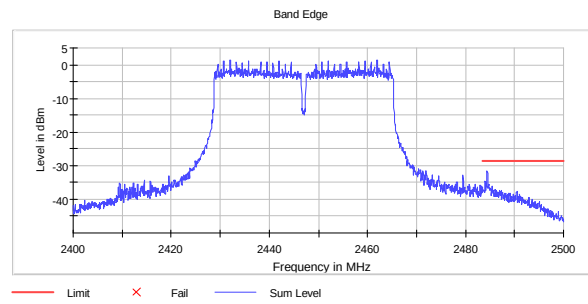
Conducted Emissions Ch06 802.11n HT40 MCS8 MIMO



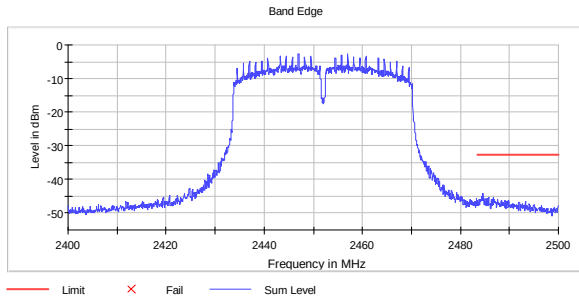
Conducted Emissions Ch06 802.11n HT40 MCS15 MIMO



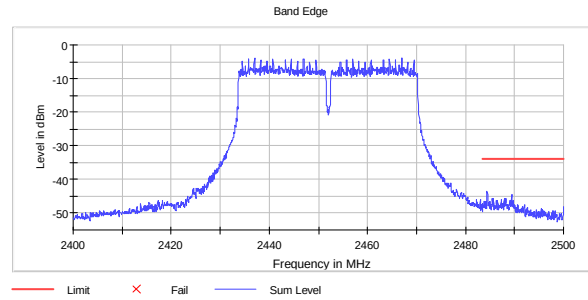
Band Edge Ch08 802.11n HT40 MCS8 MIMO



Band Edge Ch08 802.11n HT40 MCS15 MIMO



Band Edge Ch09 802.11n HT40 MCS8 MIMO



Band Edge Ch09 802.11n HT40 MCS15 MIMO

3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISSED are defined in FCC Part 15.205 and ISSED Canada RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		0.96-1.24 1.3-1.427	0.96-1.427
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	2.4835-2.5	
6.215-6.218		2.69-2.9	2.655-2.9
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		3.6-4.4	3.5-4.4
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 123-138	108-138	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISSED, all other frequencies are common.

3.6 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

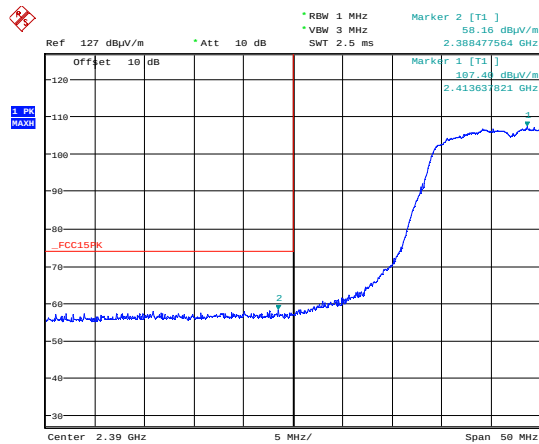
Combi Antenna, Peak Detector					
Modulation and Bitrate	Measured field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
802.11g, 6 Mbps	58.2	62.1	74	15.8	11.9
802.11n, SISO MCS0	59.6	64.2	74	14.4	9.8
802.11n, MIMO MCS0	59.2	66.1	74	14.8	7.9
802.11n, HT40 SISO MCS0	66.5	66.1	74	7.5	7.9
802.11n, HT40 MIMO MCS0	73.4	68.8	74	0.6	5.2
Combi Antenna, Average Detector					
Modulation and Bitrate	Measured field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
802.11g, 6 Mbps	46.0	49.8	54	8.0	4.2
802.11n, SISO MCS0	47.7	50.6	54	6.3	3.4
802.11n, MIMO MCS0	47.0	52.6	54	7.0	1.4
802.11n, HT40 SISO MCS0	52.3	52.1	54	1.7	1.9
802.11n, HT40 MIMO MCS0	53.6	53.8	54	0.4	0.2

Whip Antenna, Peak Detector					
Modulation and Bitrate	Measured field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
802.11b, 11 Mbps	57.9	58.2	74	16.1	15.8
802.11g, 6 Mbps	57.8	63.4	74	16.2	10.6
802.11n, SISO MCS0	57.8	62.3	74	16.2	11.7
802.11n, MIMO MCS0	63.4	63.9	74	10.6	10.1
Whip Antenna, Average Detector					
Modulation and Bitrate	Measured field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
802.11b, 11 Mbps	45.6	45.7	54	8.4	8.3
802.11g, 6 Mbps	44.9	48.7	54	9.1	5.3
802.11n, SISO MCS0	44.8	51.4	54	9.2	2.6
802.11n, MIMO MCS0	50.0	51.0	54	4.0	3.0

Average values were measured using trace averaging as described in ANSI C63.10-2013 clause 11.12.2.5.1 (Duty Cycle is 100%).

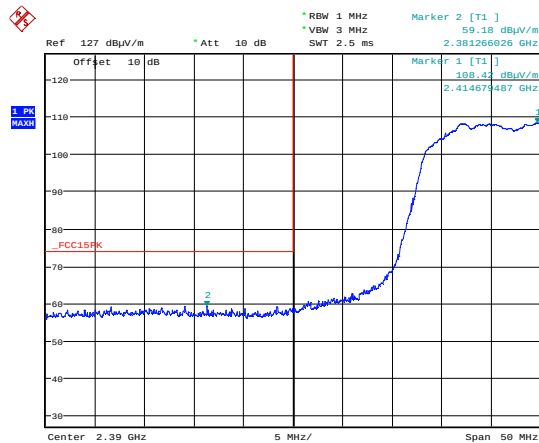
See attached plots.

Combi Antenna



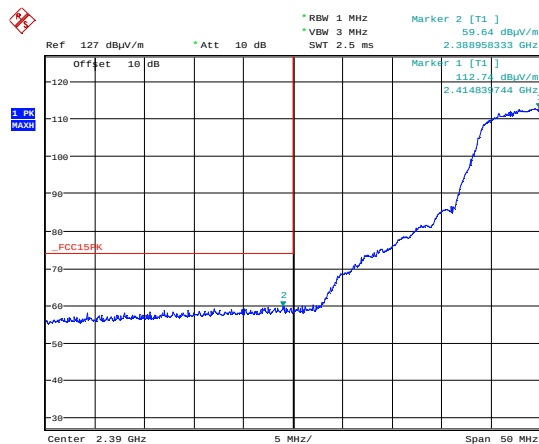
Date: 28. FEB. 2023 09:26:36

Band Edge, 2412 MHz, 802.11g 6M, Ant 0, Peak



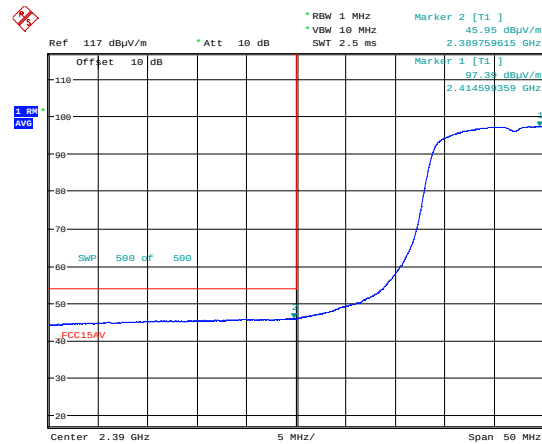
Date: 27. FEB. 2023 16:26:10

Band Edge, 2412 MHz, 802.11n MCS0, MIMO, Peak



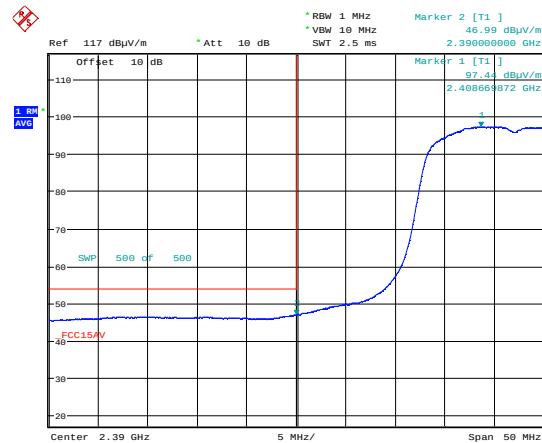
Date: 28. FEB. 2023 09:33:39

Band Edge, 2417 MHz, 802.11n MCS0, Ant 0, Peak



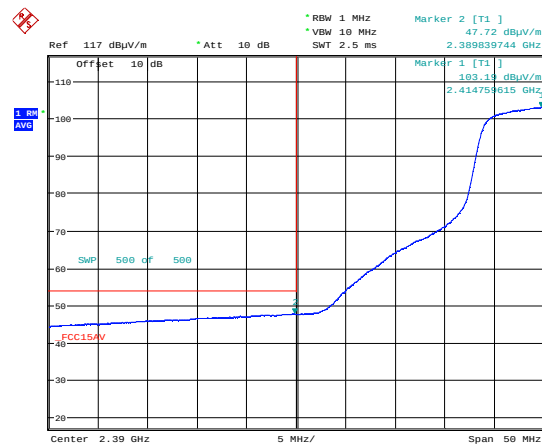
Date: 28. FEB. 2023 09:27:05

Average



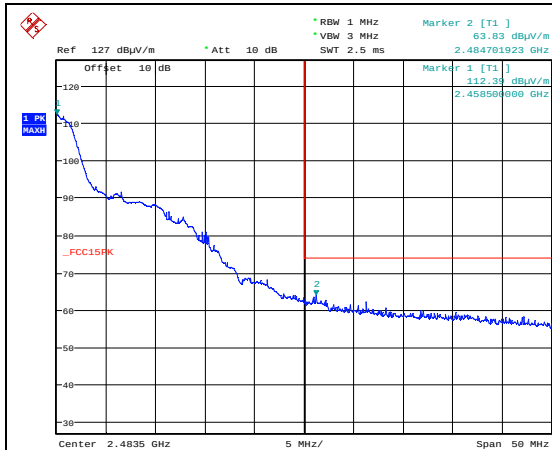
Date: 27. FEB. 2023 16:23:59

Average



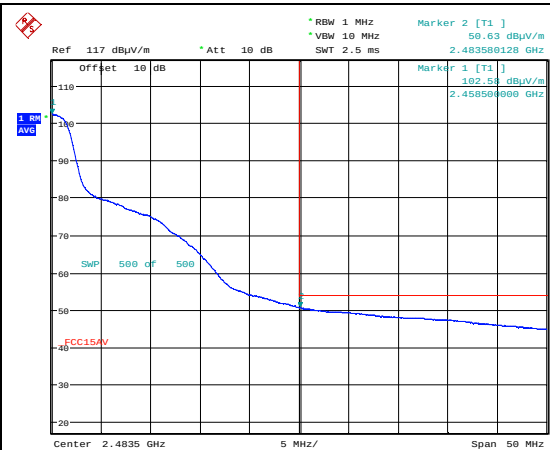
Date: 28. FEB. 2023 09:34:08

Average



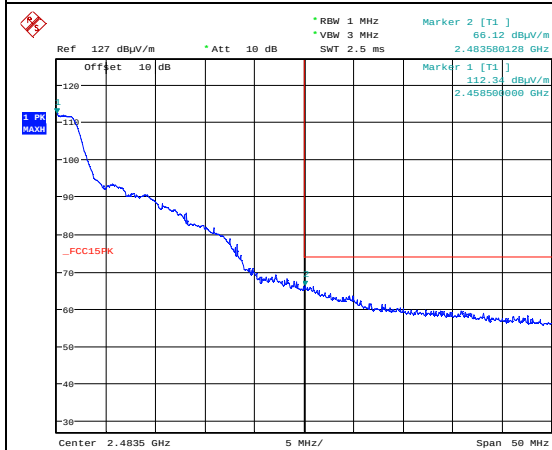
Date: 28.FEB.2023 10:15:01

Band Edge, 2452 MHz, 802.11n MCS0, Ant 0, Peak



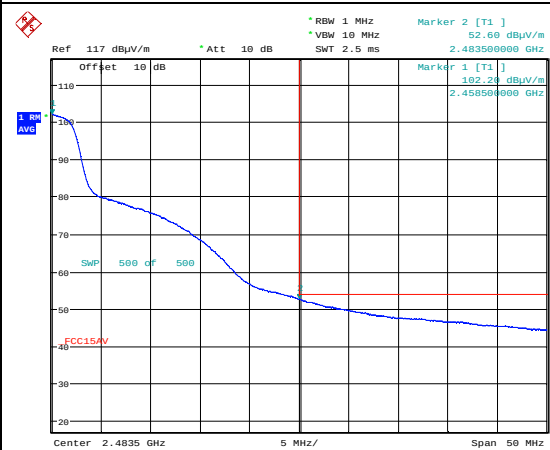
Date: 28.FEB.2023 10:14:11

Average



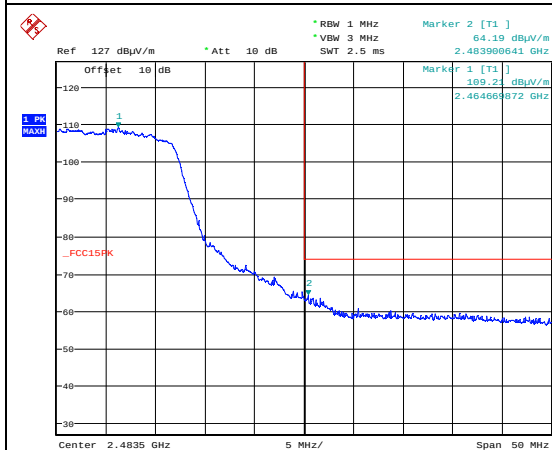
Date: 28.FEB.2023 10:30:32

Band Edge, 2452 MHz, 802.11n MCS0, MIMO, Peak



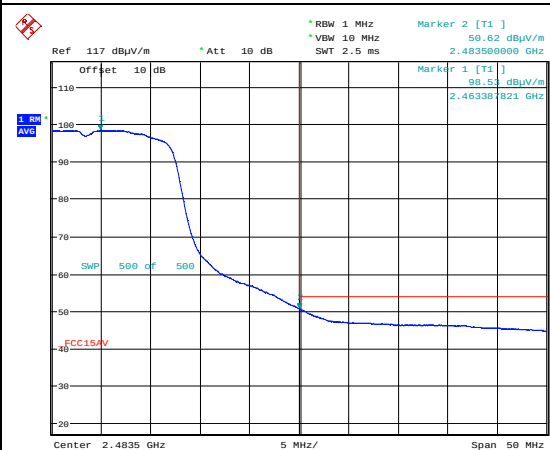
Date: 28.FEB.2023 10:31:00

Average



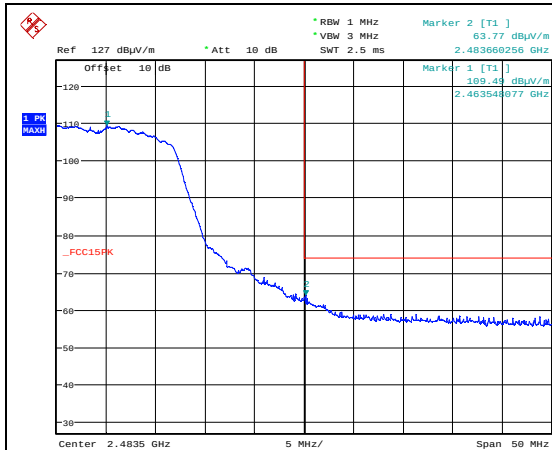
Date: 28.FEB.2023 10:33:29

Band Edge, 2462 MHz, 802.11n MCS0, Ant 0, Peak



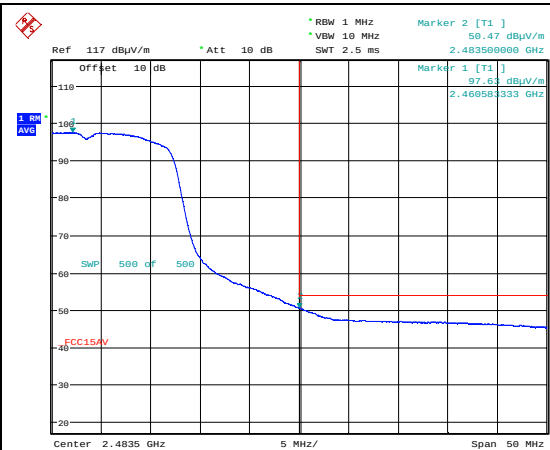
Date: 28.FEB.2023 10:33:57

Average



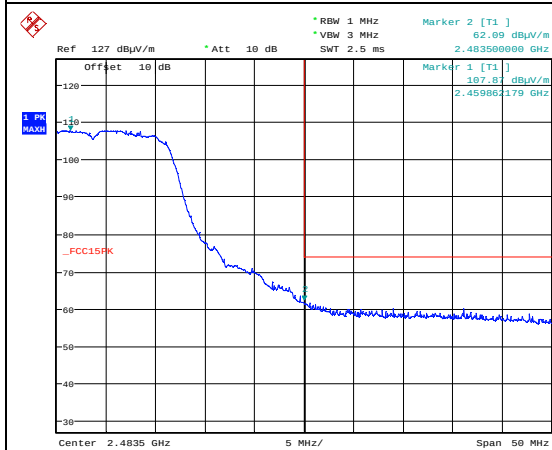
Date: 27.FEB.2023 16:30:24

Band Edge, 2462 MHz, 802.11n MCS0, MIMO, Peak



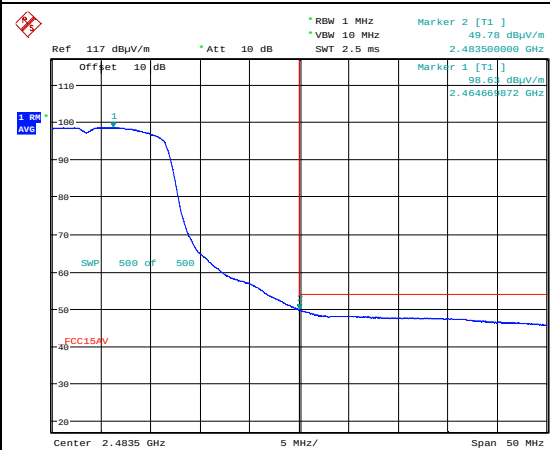
Date: 27.FEB.2023 16:30:52

Average



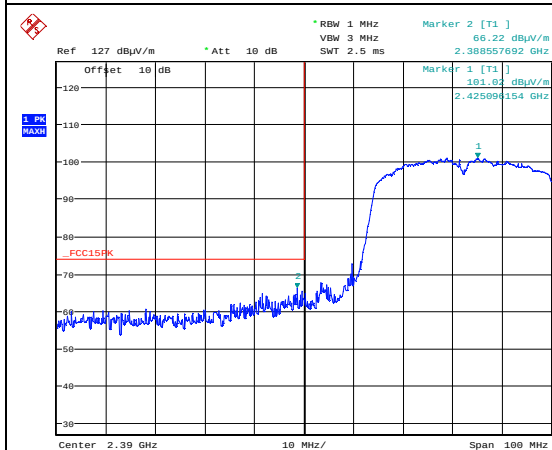
Date: 28.FEB.2023 09:42:30

Band Edge, 2462 MHz, 802.11g 6M, Ant 0, Peak



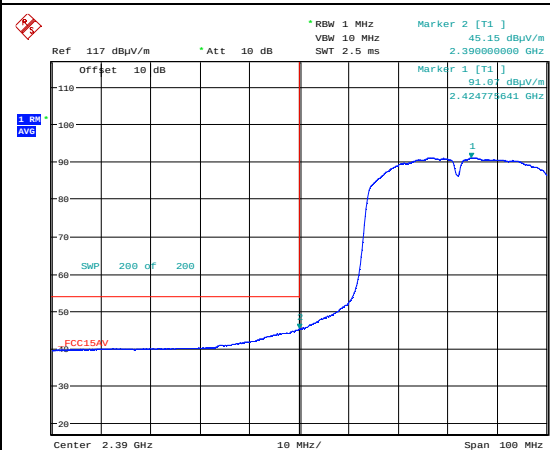
Date: 28.FEB.2023 09:43:12

Average



Date: 6.JUN.2023 15:50:46

Band Edge, 2422 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak

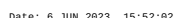


Date: 6.JUN.2023 15:51:09

Average



Band Edge, 2427 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak PL14



Average



Band Edge, 2432 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak PL16



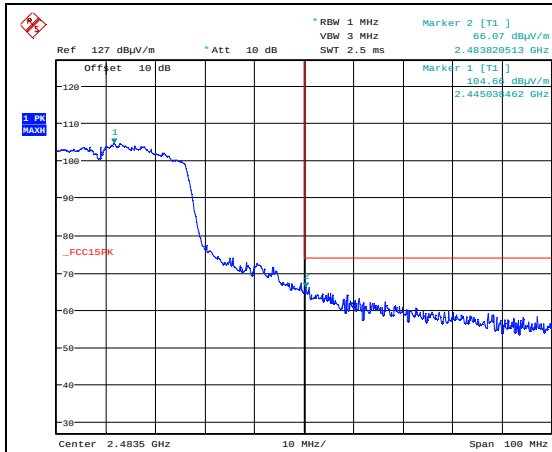
Average



Band Edge, 2437 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak PL16

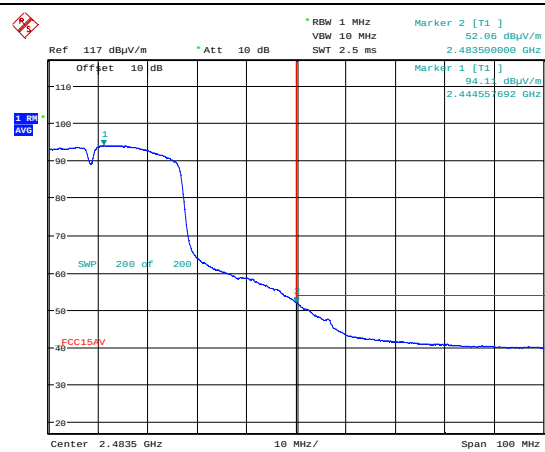


Average



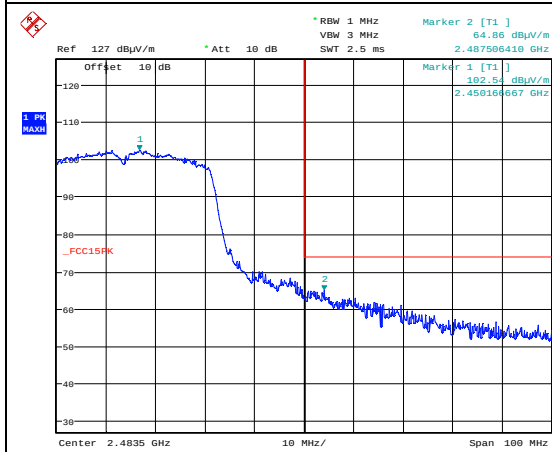
Date: 6 JUN. 2023 15:44:28

Band Edge, 2442 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak PL14



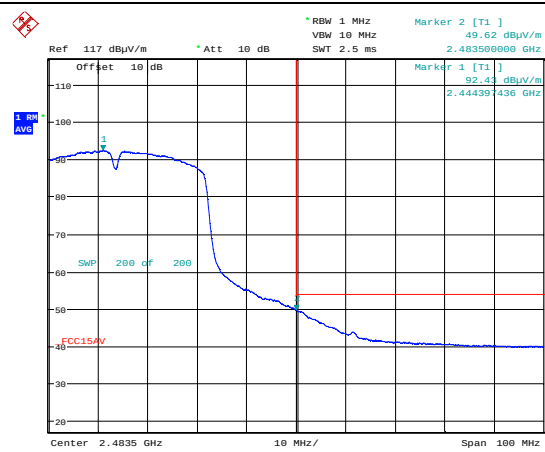
Date: 6 JUN. 2023 15:42:44

Average



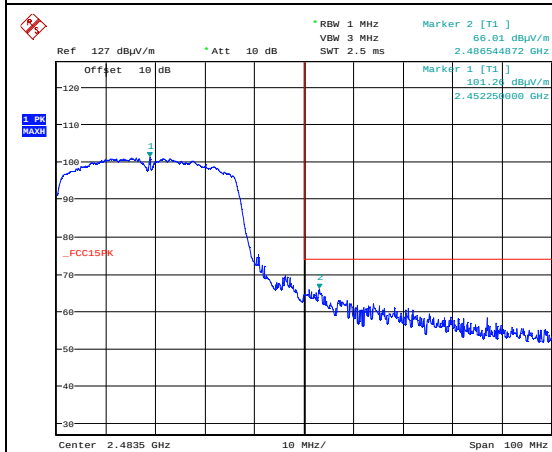
Date: 6 JUN. 2023 15:41:26

Band Edge, 2447 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak PL12



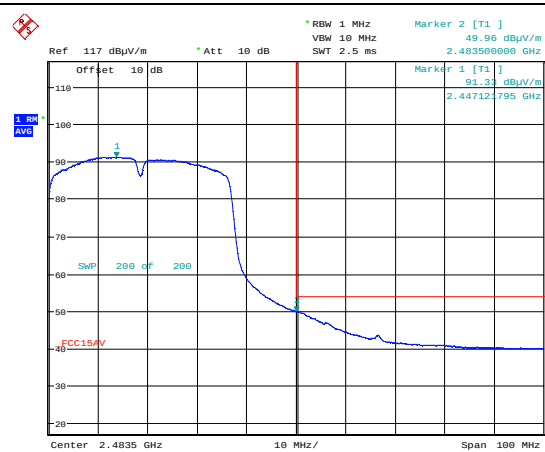
Date: 6 JUN. 2023 15:38:48

Average



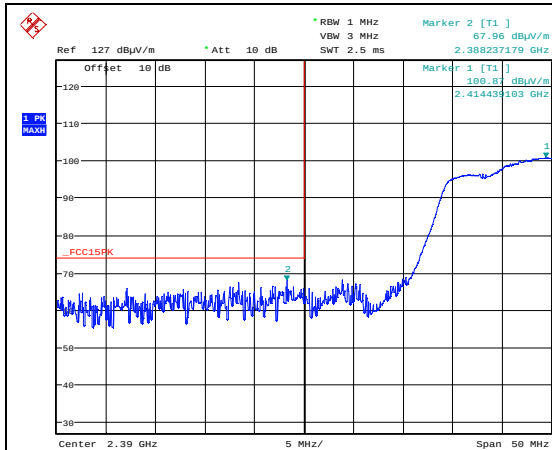
Date: 6 JUN. 2023 15:35:26

Band Edge, 2452 MHz, 802.11n HT40 MCS0, Max: Ant 0, Peak



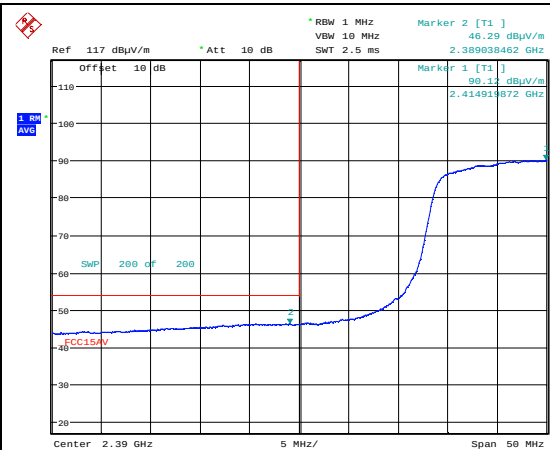
Date: 6 JUN. 2023 15:34:37

Average



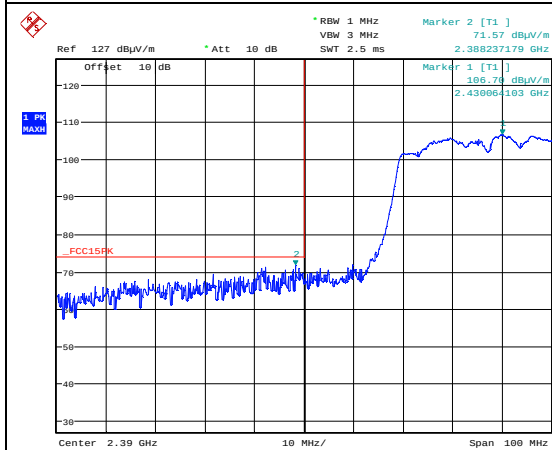
Date: 6 JUN. 2023 15:01:20

Band Edge, 2422 MHz, 802.11n HT40 MCS0, MIMO, Peak



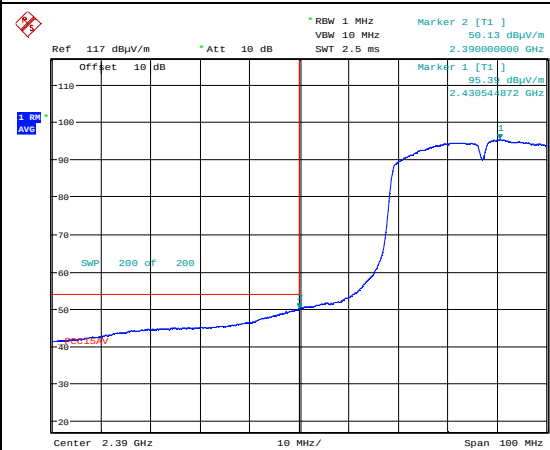
Date: 6 JUN. 2023 14:57:16

Average



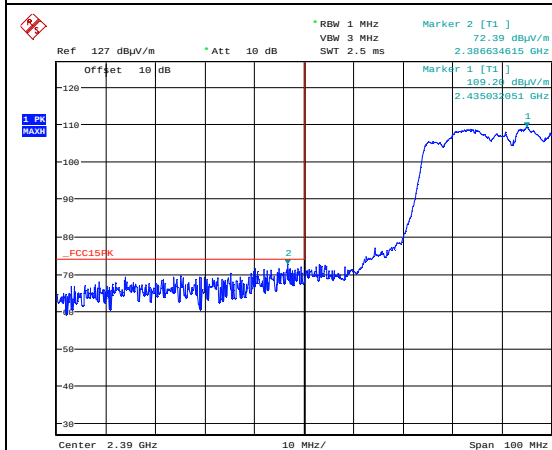
Date: 6 JUN. 2023 15:03:42

Band Edge, 2427 MHz, 802.11n HT40 MCS0, MIMO, Peak PL12



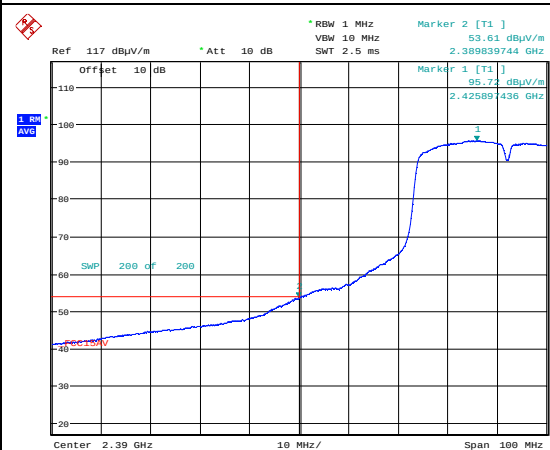
Date: 6 JUN. 2023 15:02:55

Average



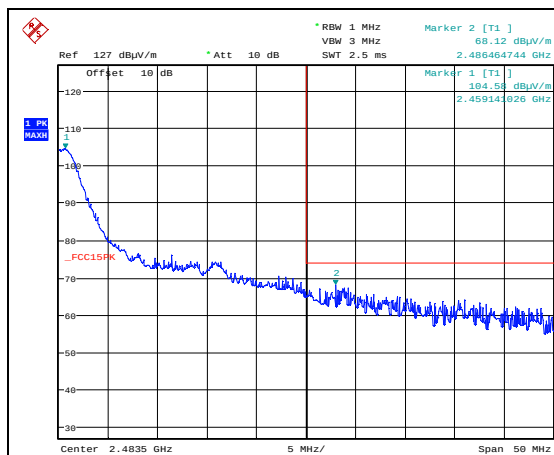
Date: 6 JUN. 2023 15:06:32

Band Edge, 2432 MHz, 802.11n HT40 MCS0, MIMO, Peak



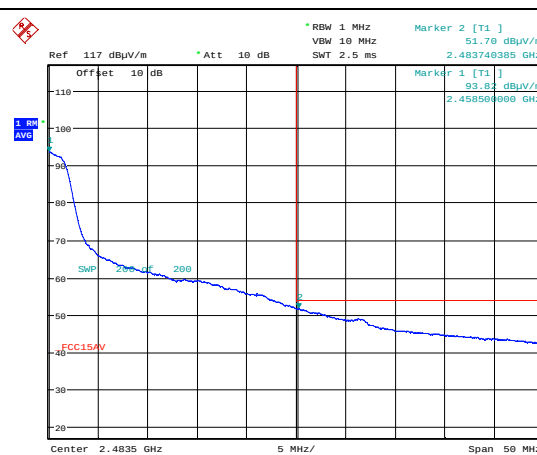
Date: 6 JUN. 2023 15:05:43

Average



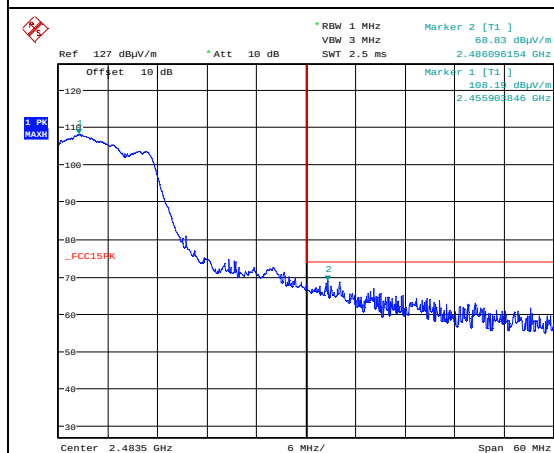
Date: 6 JUN. 2023 14:53:29

Band Edge, 2442 MHz, 802.11n HT40 MCS0, MIMO, Peak PL13



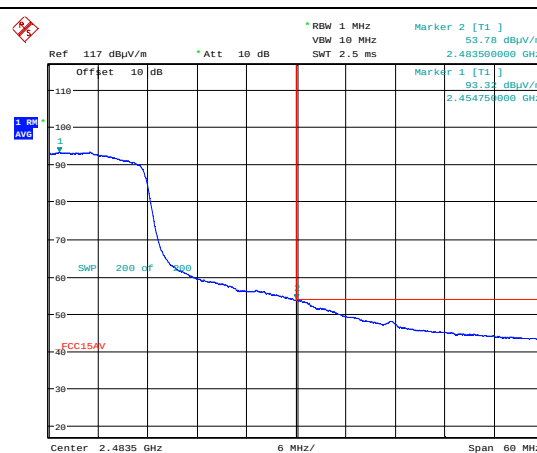
Date: 6 JUN. 2023 14:50:42

Average



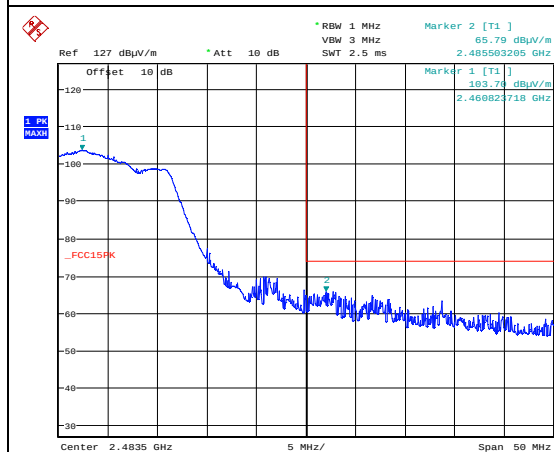
Date: 6 JUN. 2023 14:46:33

Band Edge, 2447 MHz, 802.11n HT40 MCS0, MIMO, Peak PL12



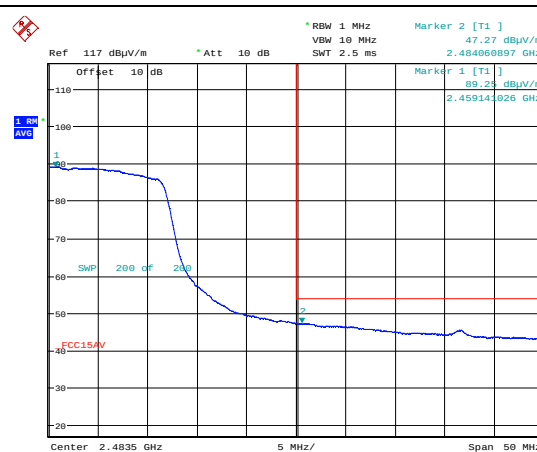
Date: 6 JUN. 2023 14:44:48

Average



Date: 6 JUN. 2023 14:56:10

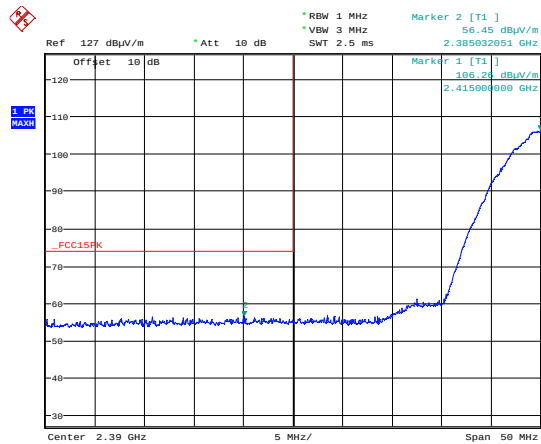
Band Edge, 2452 MHz, 802.11n HT40 MCS0, MIMO, Peak



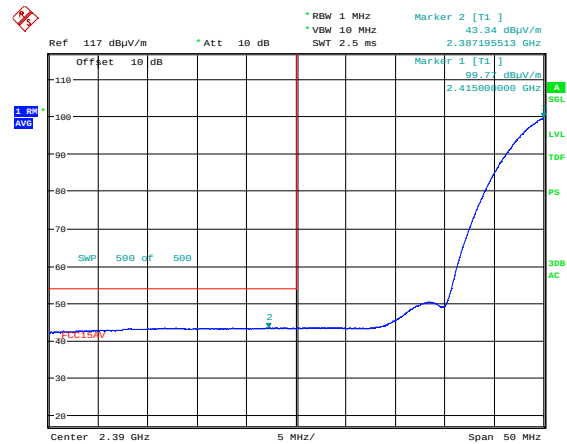
Date: 6 JUN. 2023 14:56:31

Average

Whip Antenna

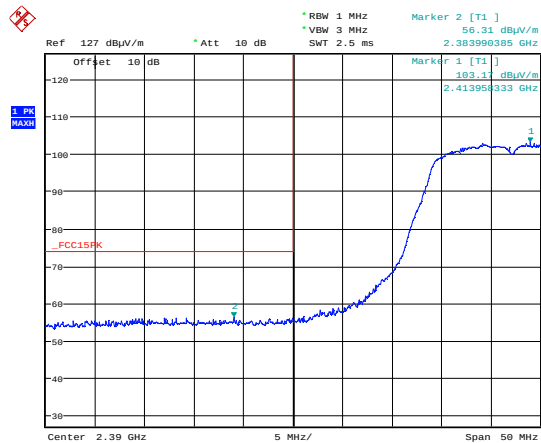


Date: 2.MAR.2023 12:23:36



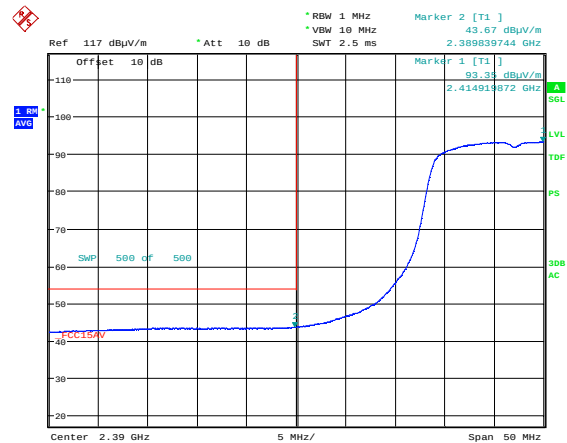
Date: 2.MAR.2023 12:24:05

Band Edge, 2412 MHz, 802.11b 11M, Peak



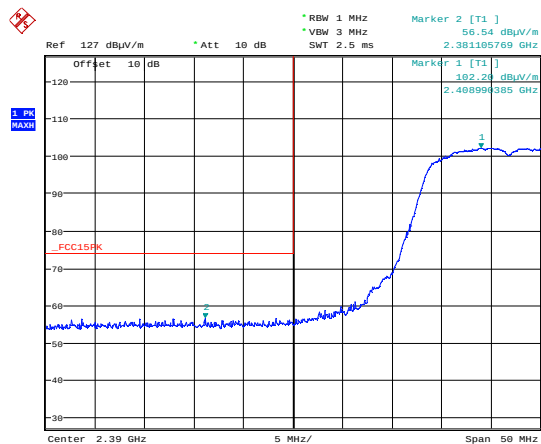
Date: 2.MAR.2023 12:27:15

Average



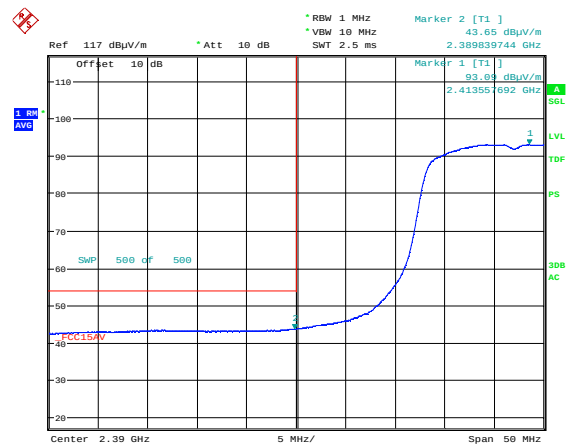
Date: 2.MAR.2023 12:27:44

Band Edge, 2412 MHz, 802.11g 6M, Peak



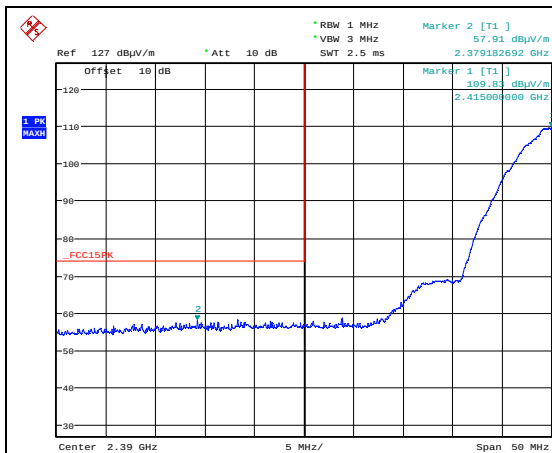
Date: 2.MAR.2023 12:30:20

Average



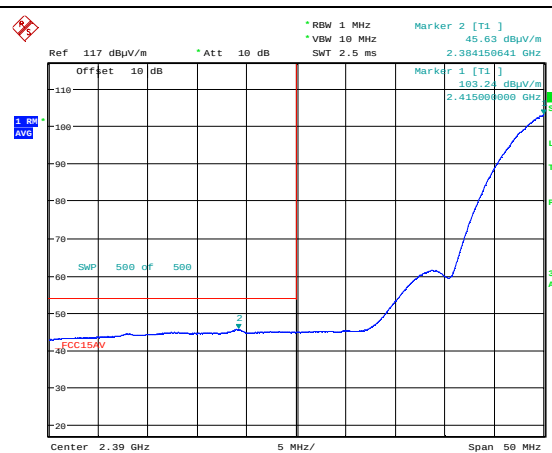
Date: 2.MAR.2023 12:30:49

Band Edge, 2412 MHz, 802.11n MCS0, Peak



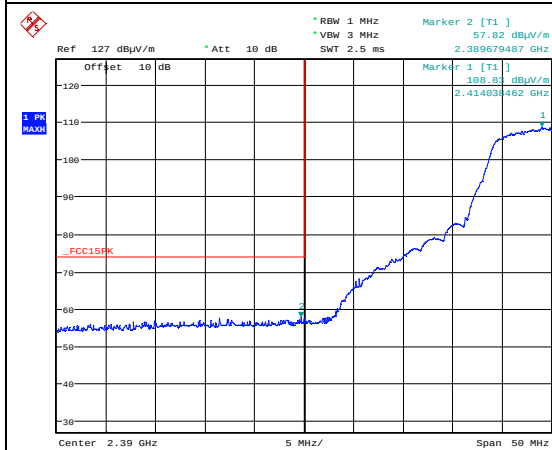
Date: 2.MAR.2023 12:11:21

Band Edge, 2417 MHz, 802.11b 11M, Peak



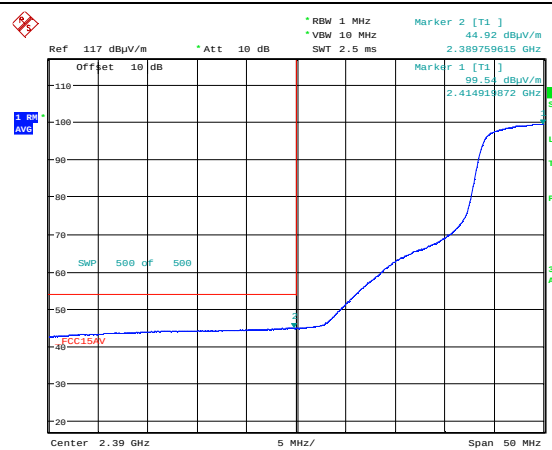
Date: 2.MAR.2023 12:11:50

Average



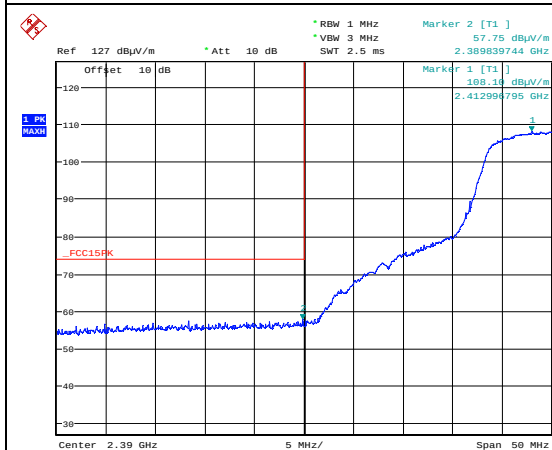
Date: 2.MAR.2023 12:07:10

Band Edge, 2417 MHz, 802.11g 6M, Peak



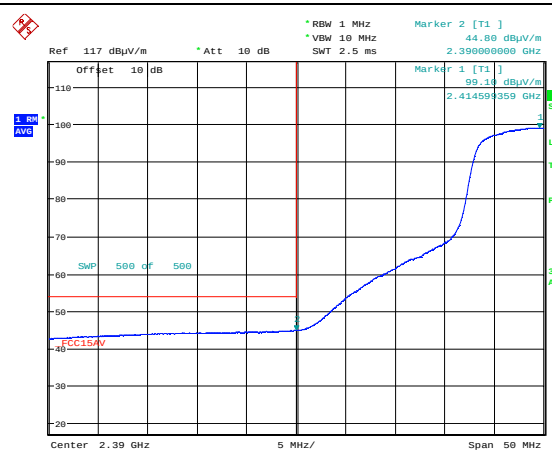
Date: 2.MAR.2023 12:07:39

Average



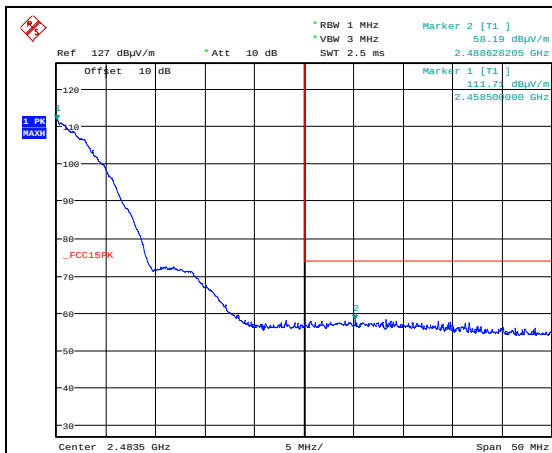
Date: 2.MAR.2023 12:02:03

Band Edge, 2417 MHz, 802.11n MCS0, Peak



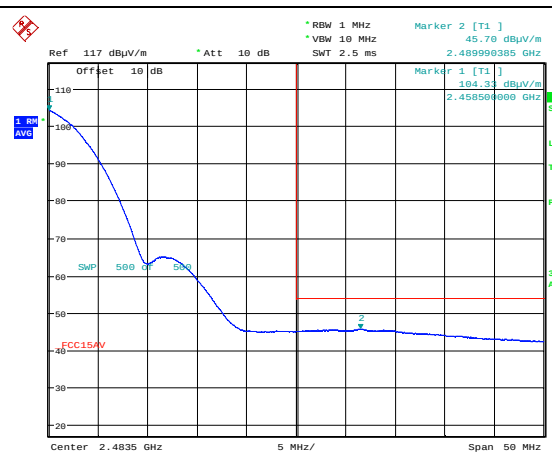
Date: 2.MAR.2023 12:02:32

Average



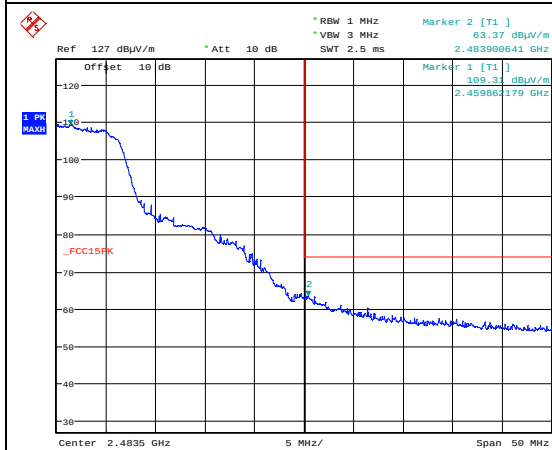
Date: 2.MAR.2023 10:48:35

Band Edge, 2457 MHz, 802.11b 11M, Peak



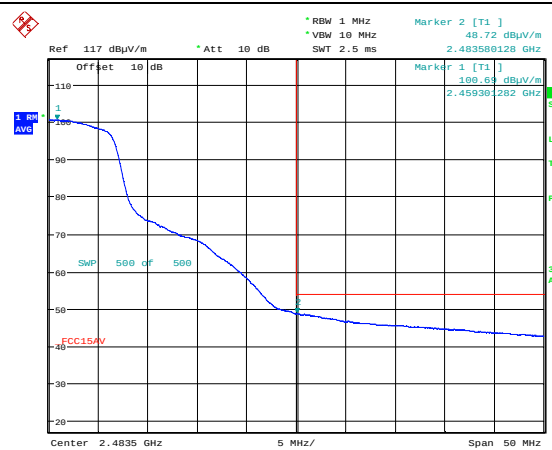
Date: 2.MAR.2023 10:49:03

Average PL18



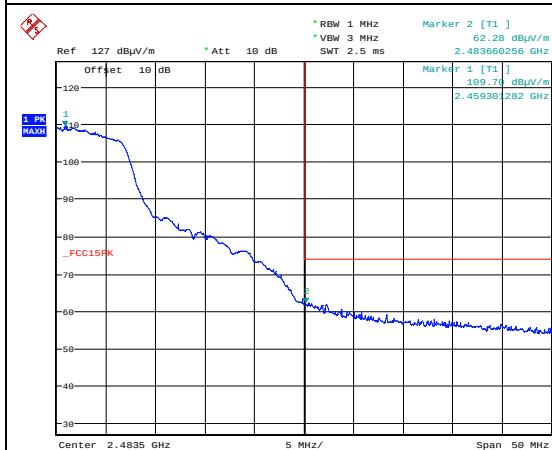
Date: 2.MAR.2023 10:44:40

Band Edge, 2457 MHz, 802.11g 6M, Peak



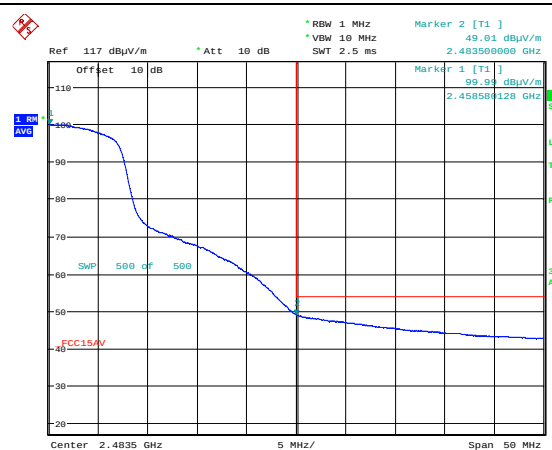
Date: 2.MAR.2023 10:45:13

Average PL17



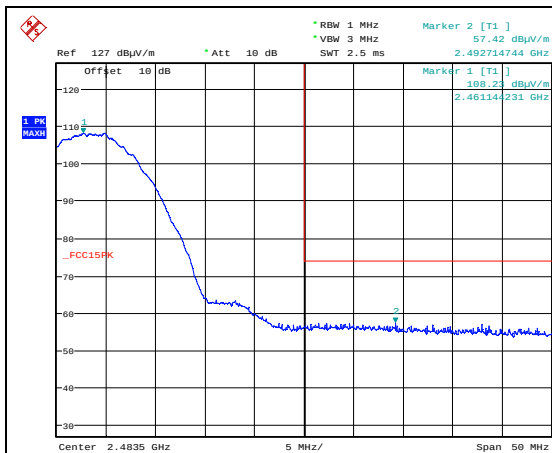
Date: 2.MAR.2023 11:01:50

Band Edge, 2457 MHz, 802.11n MCS0, Peak



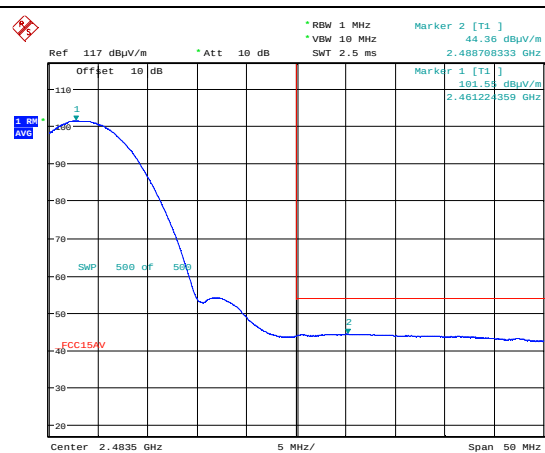
Date: 2.MAR.2023 11:02:17

Average PL17



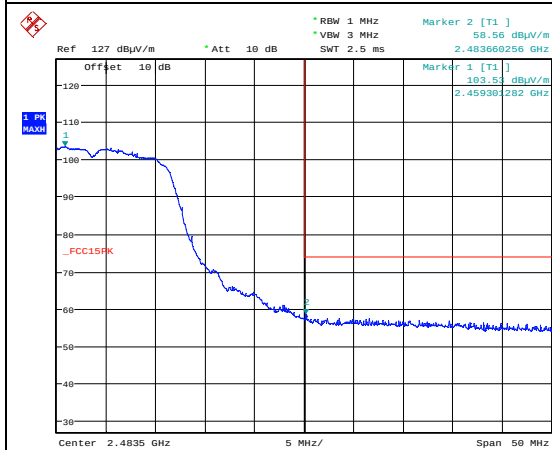
Date: 2.MAR.2023 10:52:45

Band Edge, 2462 MHz, 802.11b 11M, Peak



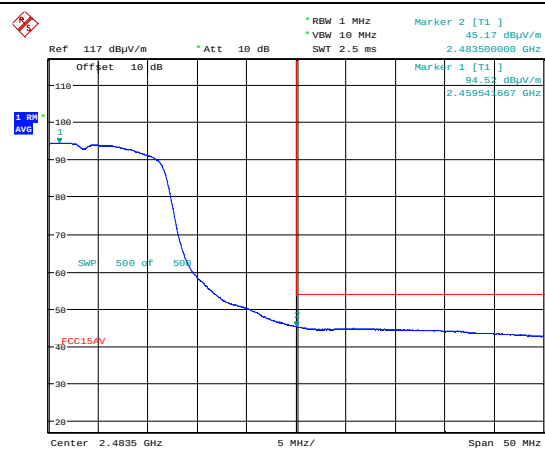
Date: 2.MAR.2023 10:53:13

Average PL15



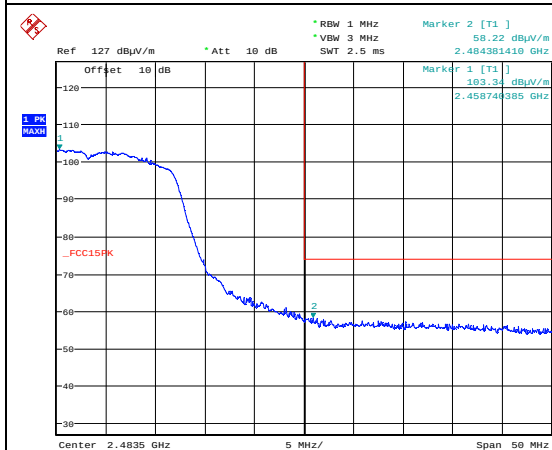
Date: 2.MAR.2023 10:42:43

Band Edge, 2462 MHz, 802.11g 6M, Peak



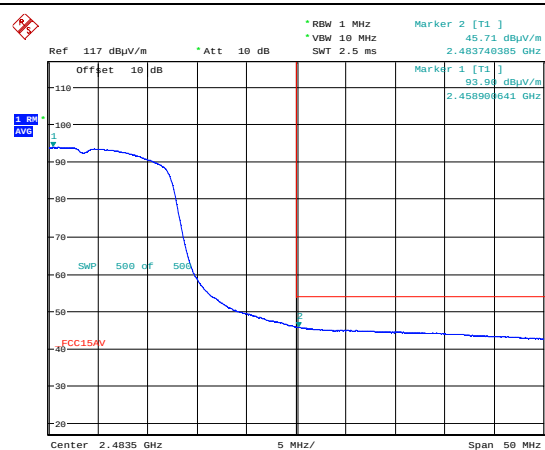
Date: 2.MAR.2023 10:43:13

Average



Date: 2.MAR.2023 10:58:23

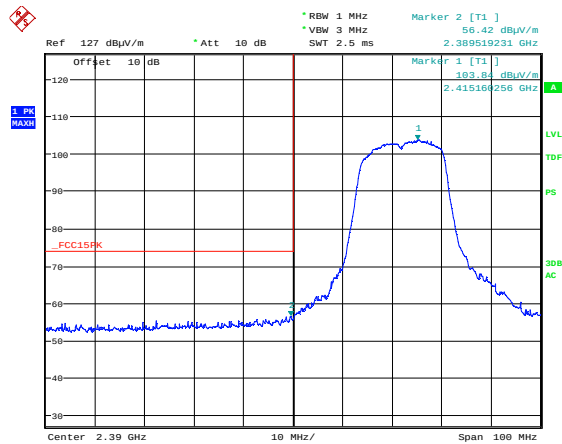
Band Edge, 2462 MHz, 802.11n MCS0, Peak



Date: 2.MAR.2023 10:58:51

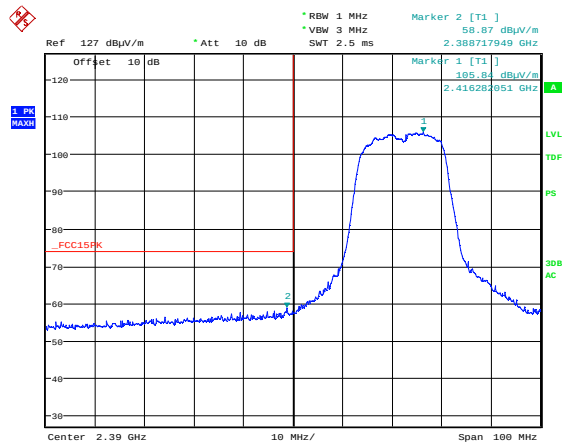
Average PL11

Whip Antenna +Patch Antenna for Ant 1 and MIMO



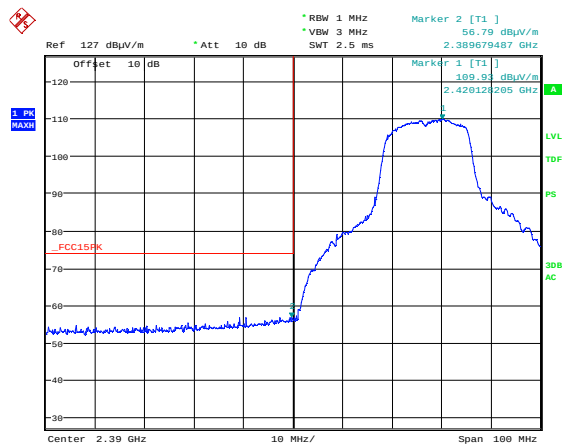
Date: 6.MAR.2023 13:09:33

Band Edge, 2412 MHz, 802.11n MCS0, SISO, Peak



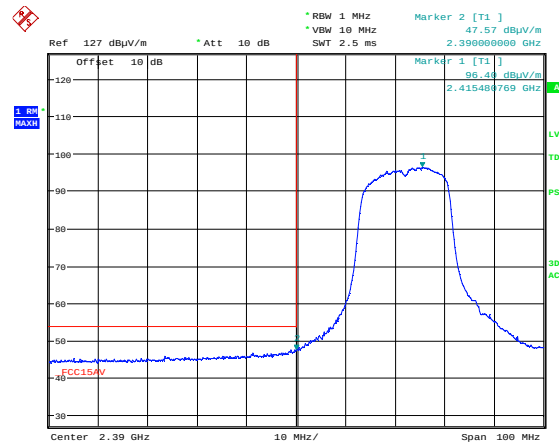
Date: 6.MAR.2023 13:45:42

Band Edge, 2412 MHz, 802.11n MCS8, MIMO, Peak



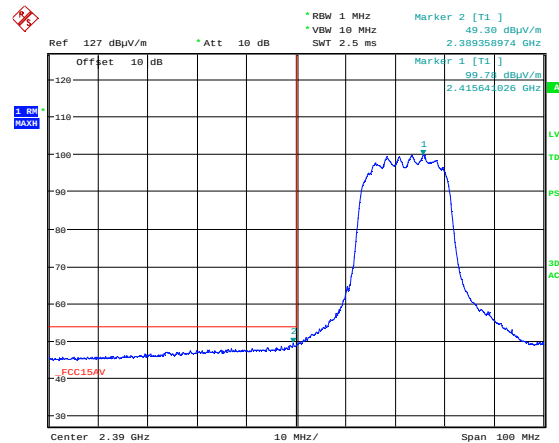
Date: 6.MAR.2023 13:03:04

Band Edge, 2417 MHz, 802.11n MCS0, SISO, Peak



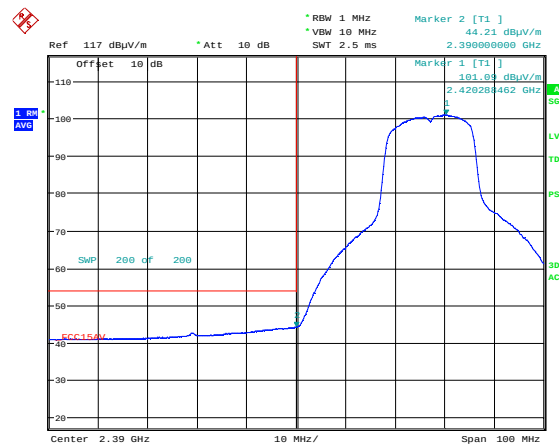
Date: 6.MAR.2023 13:10:19

Average



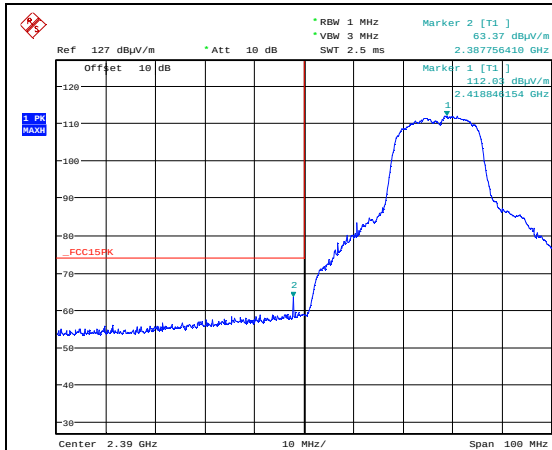
Date: 6.MAR.2023 13:46:28

Average



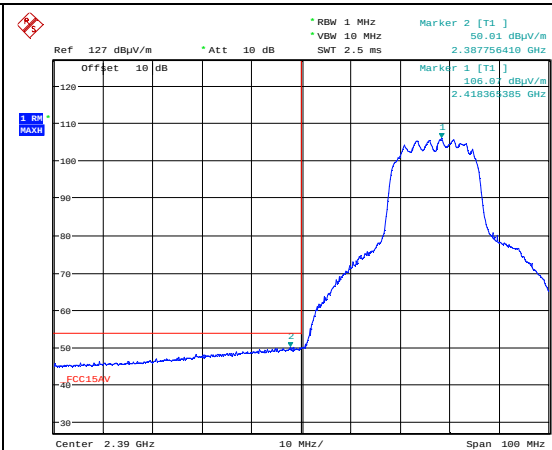
Date: 6.MAR.2023 13:05:40

Average



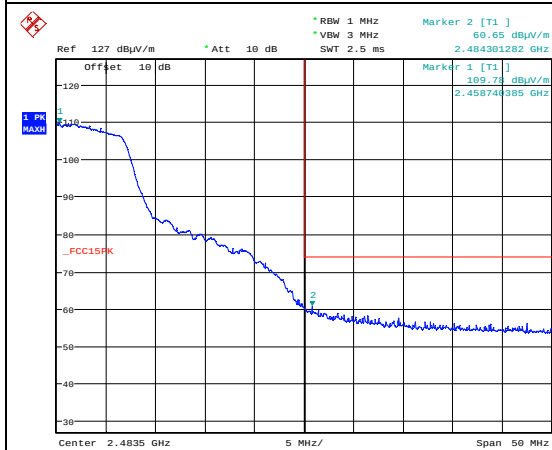
Date: 6.MAR.2023 13:42:21

Band Edge, 2417 MHz, 802.11n MCS8, MIMO, Peak



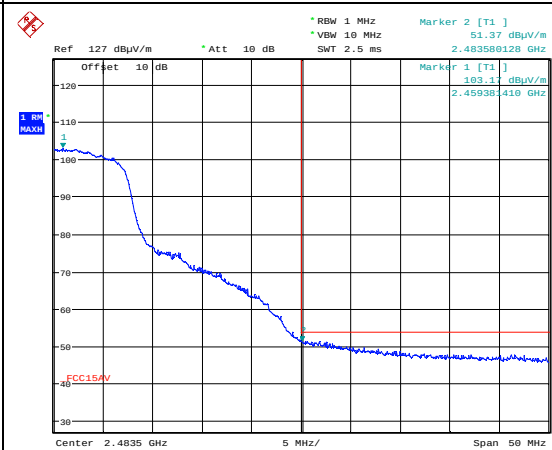
Date: 6.MAR.2023 13:43:08

Average



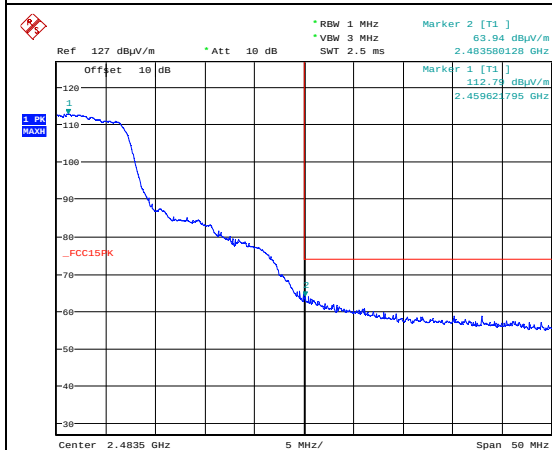
Date: 6.MAR.2023 12:53:36

Band Edge, 2457 MHz, 802.11n MCS0, SISO, Peak



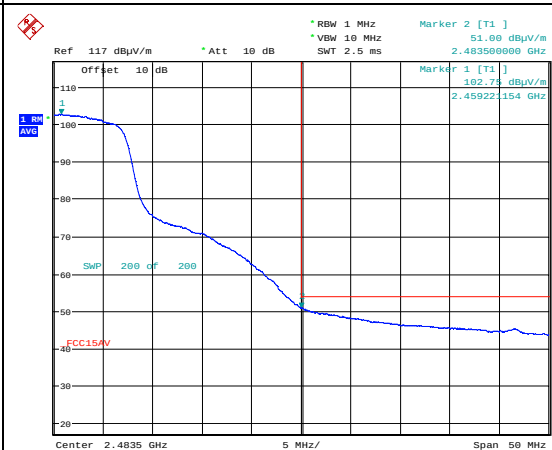
Date: 6.MAR.2023 12:55:02

Average



Date: 6.MAR.2023 13:56:35

Band Edge, 2457 MHz, 802.11n MCS8, MIMO, Peak



Date: 6.MAR.2023 13:58:59

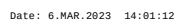
Average



Band Edge, 2462 MHz, 802.11n MCS0, SISO, Peak



Average



Band Edge, 2462 MHz, 802.11n MCS8, MIMO, Peak



Average

3.7 Radiated Emissions, 30 – 1000 MHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Detector: Quasi-Peak

Measuring distance 3 m

Tested in test mode with EUT transmitting on ch06.

Measured Frequency (MHz)	Carrier Frequency (MHz)	Modulation	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30 – 88	2440	GFSK	< 30	40.0	> 10
88 – 216	2440	GFSK	40.0	43.5	3.5
216 – 960	2440	GFSK	< 36	46.0	> 10
960 – 1000	2440	GFSK	< 35	54.0	> 19
120.010	2440	GFSK	40.0	43.5	3.5

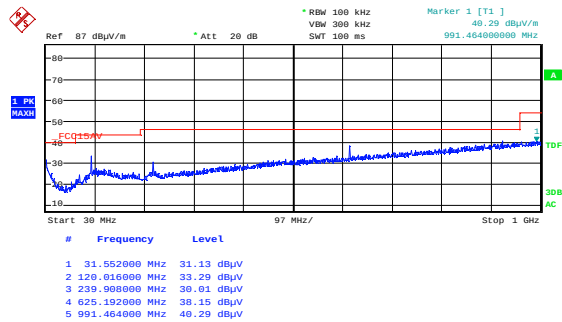
The spurious at 120.010 MHz is independent of RF signal or antenna type.

See attached plots.

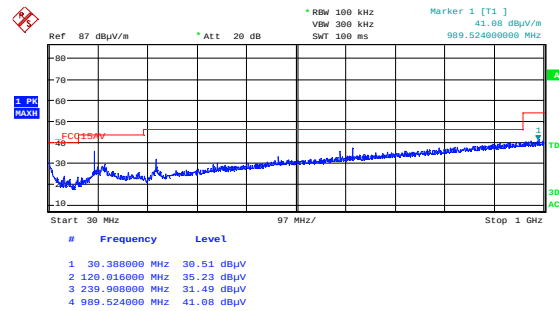
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 μV/m	40.0 dBμV/m
88 – 216 MHz	150 μV/m	43.5 dBμV/m
216 – 960 MHz	200 μV/m	46.0 dBμV/m
960 – 1000 MHz	500 μV/m	54.0 dBμV/m
Limits above are with Quasi Peak Detector		

Combi Antenna

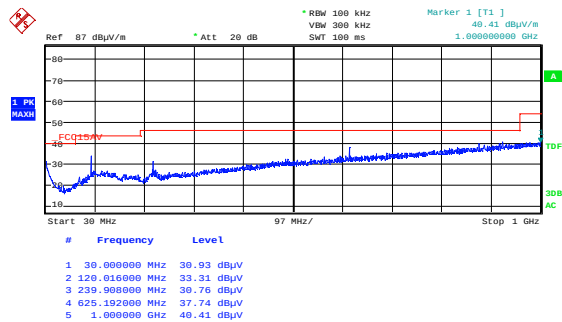


Date: 10.MAR.2023 13:30:29

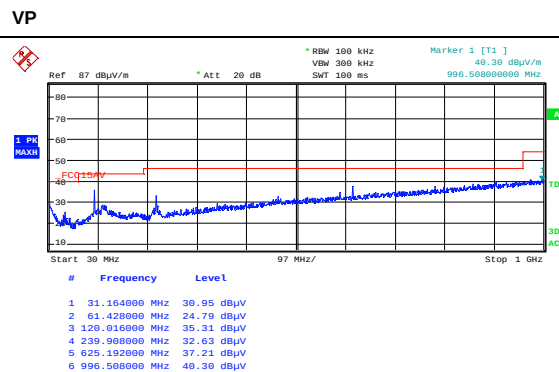


Date: 10.MAR.2023 13:28:33

Radiated Emissions 30 - 1000 MHz, 802.11b 11M, Ant 0, HP

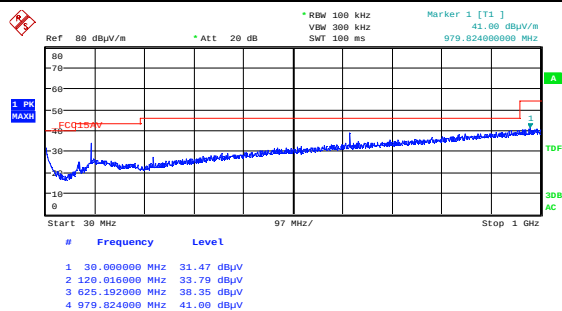


Date: 10.MAR.2023 13:21:50

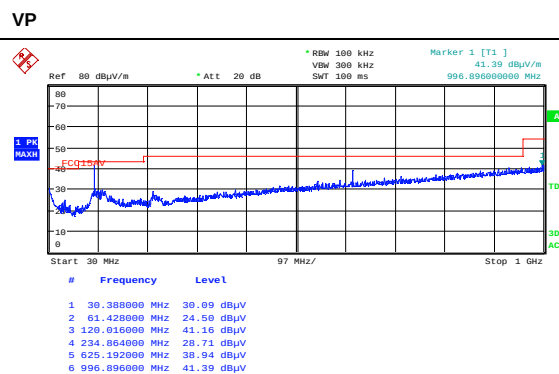


Date: 10.MAR.2023 13:19:54

Radiated Emissions 30 - 1000 MHz, 802.11g 6M, Ant 0, HP



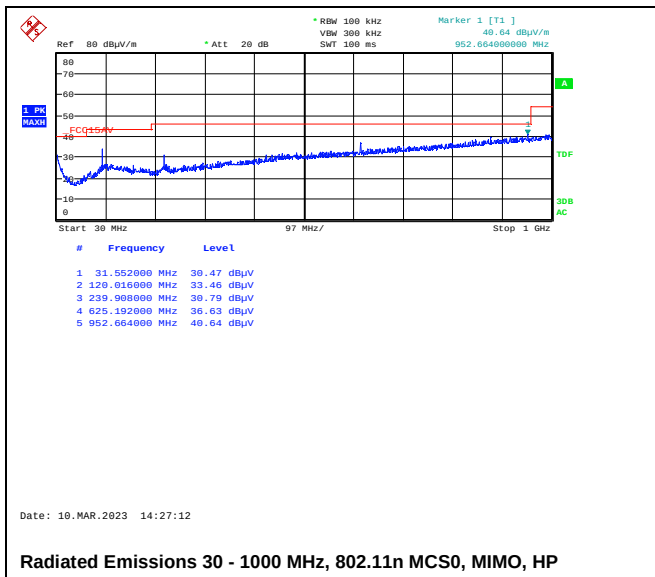
Date: 10.MAR.2023 14:37:09



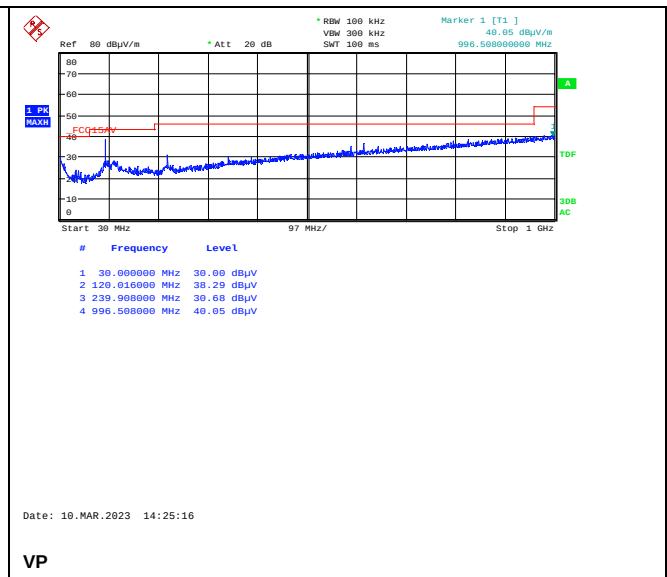
Date: 10.MAR.2023 14:34:47

Radiated Emissions 30 - 1000 MHz, 802.11n MCS0, Ant 1, HP

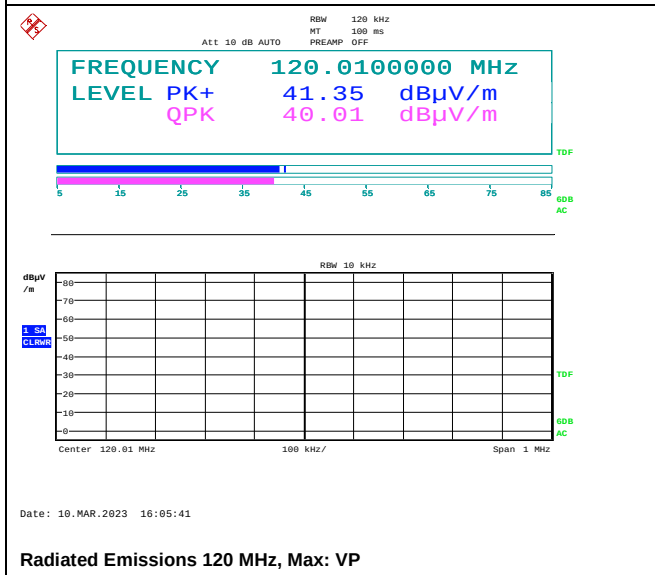
VP



Radiated Emissions 30 - 1000 MHz, 802.11n MCS0, MIMO, HP

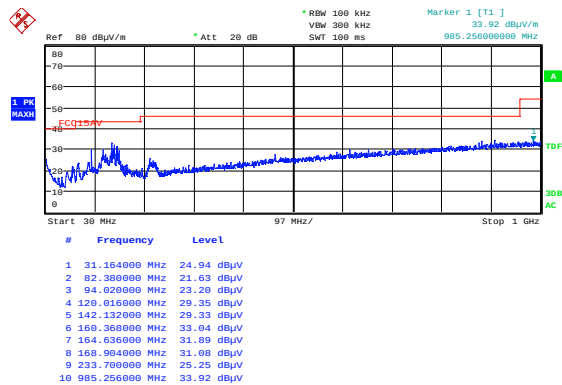


VP

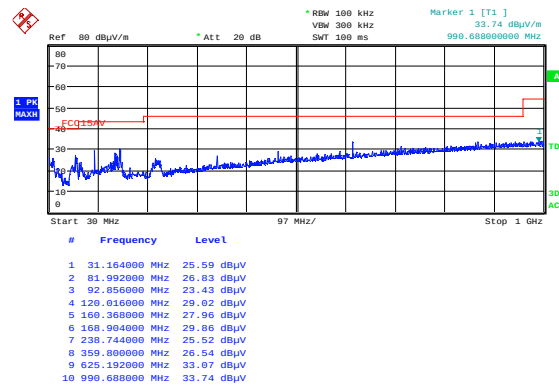


Radiated Emissions 120 MHz, Max: VP

Whip Antenna (+Patch Antenna for Ant 1 and MIMO)

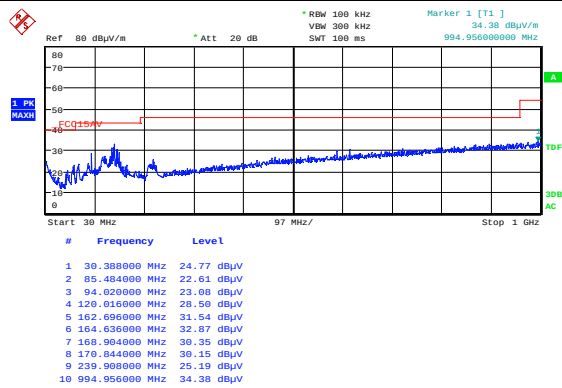


Date: 13.MAR.2023 10:41:29



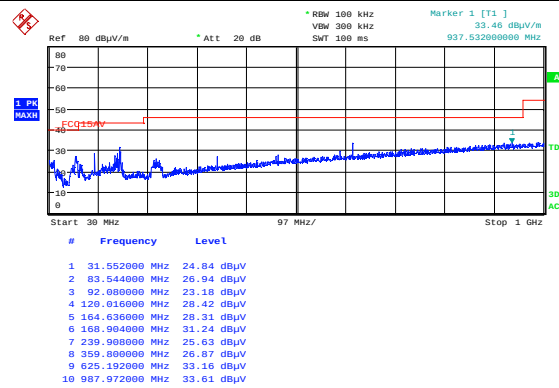
Date: 13.MAR.2023 10:39:32

Radiated Emissions 30 - 1000 MHz, 802.11g 6M, Ant 0, HP



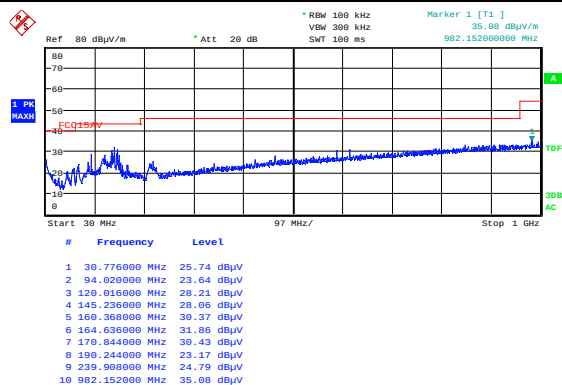
Date: 13.MAR.2023 10:51:26

VP



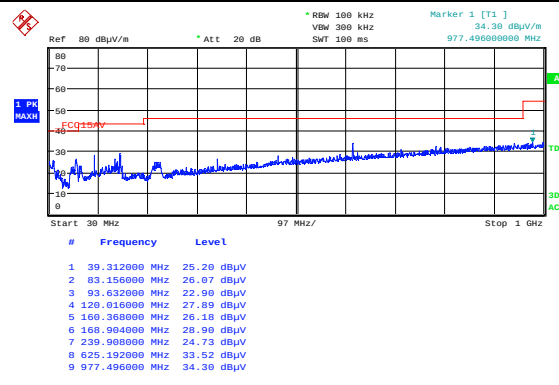
Date: 13.MAR.2023 10:49:29

Radiated Emissions 30 - 1000 MHz, 802.11g 6M, Ant 1, HP



Date: 13.MAR.2023 11:00:17

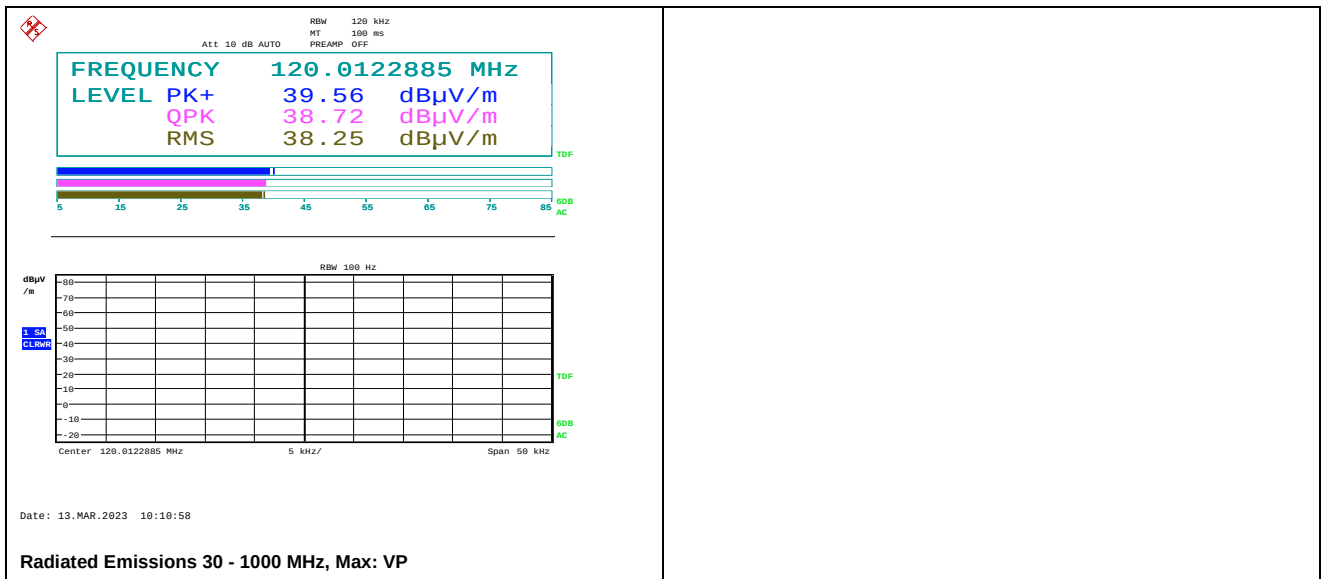
VP



Date: 13.MAR.2023 10:58:20

Radiated Emissions 30 - 1000 MHz, 802.11n MCS0, MIMO, HP

VP



3.8 Radiated Emissions, 1 – 26 GHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

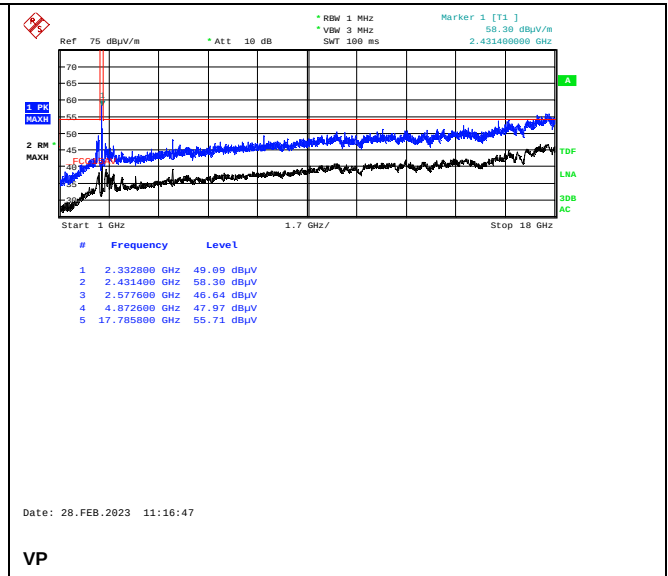
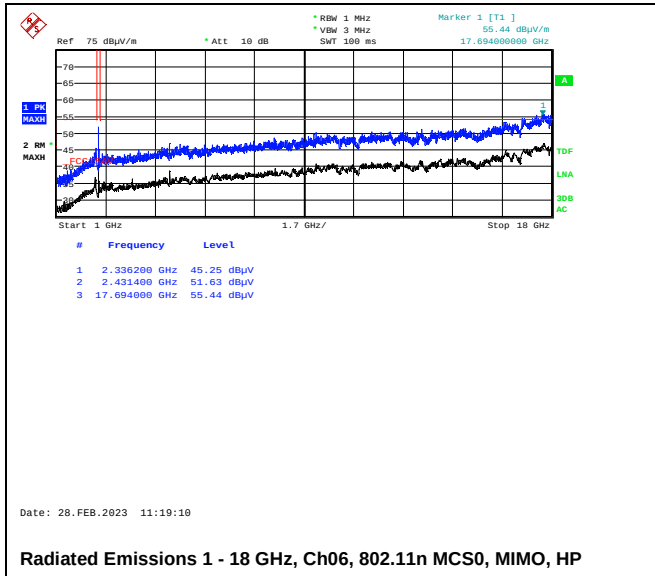
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

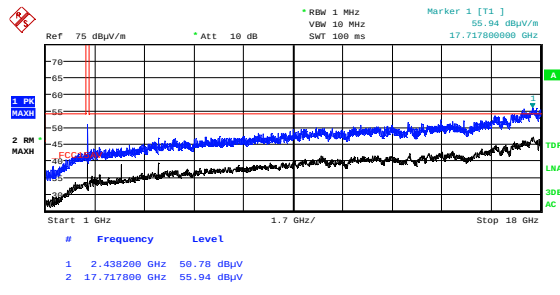
See plots.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector	Peak Detector
1 – 26 GHz	54.0 dBµV/m	74.0 dBµV/m

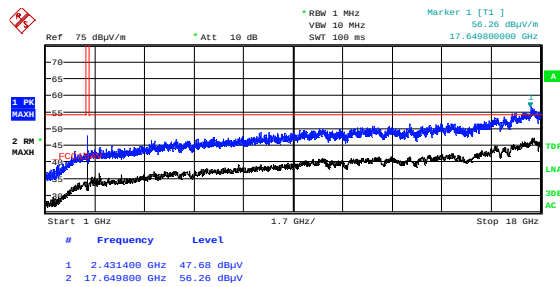


Patch Antenna



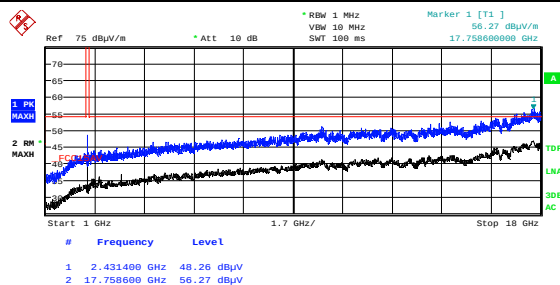
Date: 7.MAR.2023 15:57:08

Radiated Emissions 1 - 18 GHz, Ch06, 802.11b 11M, HP



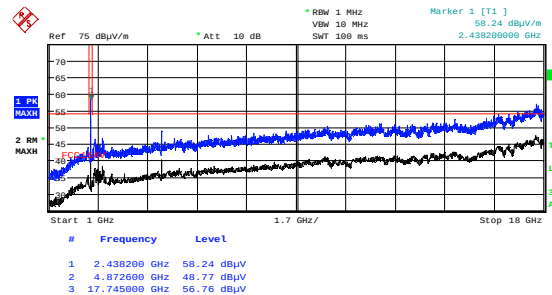
Date: 7.MAR.2023 15:42:26

Radiated Emissions 1 - 18 GHz, Ch06, 802.11g 6M, HP



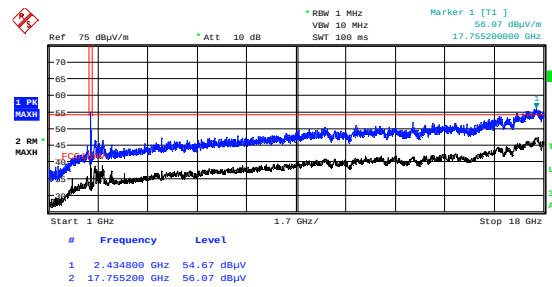
Date: 7.MAR.2023 15:49:25

Radiated Emissions 1 - 18 GHz, Ch06, 802.11n MCS0, HP



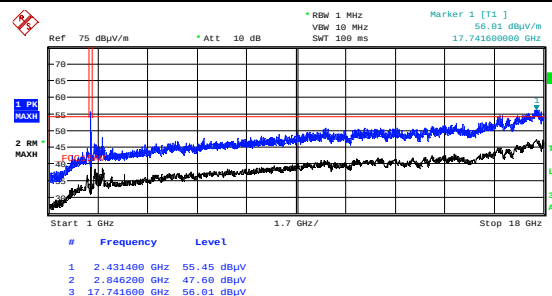
Date: 7.MAR.2023 15:55:10

VP



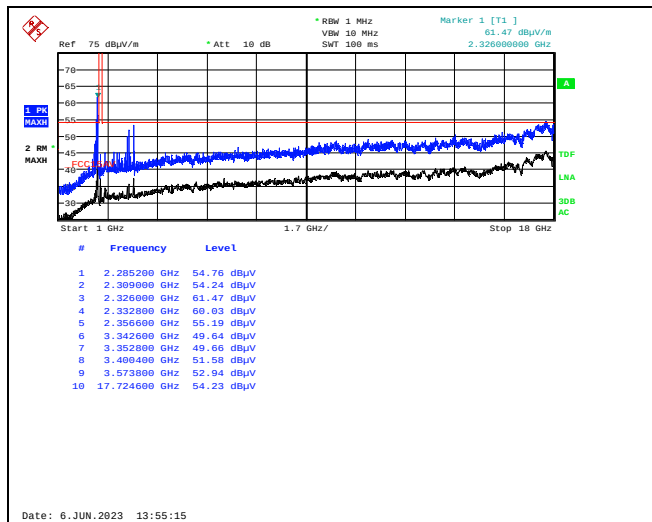
Date: 7.MAR.2023 15:40:27

VP

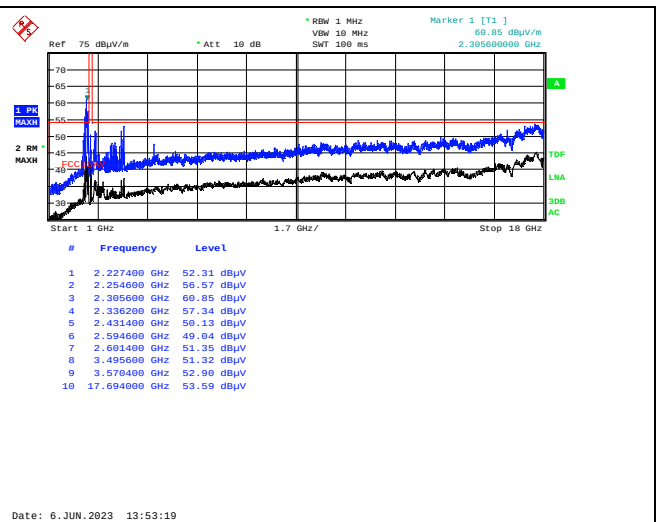


Date: 7.MAR.2023 15:47:28

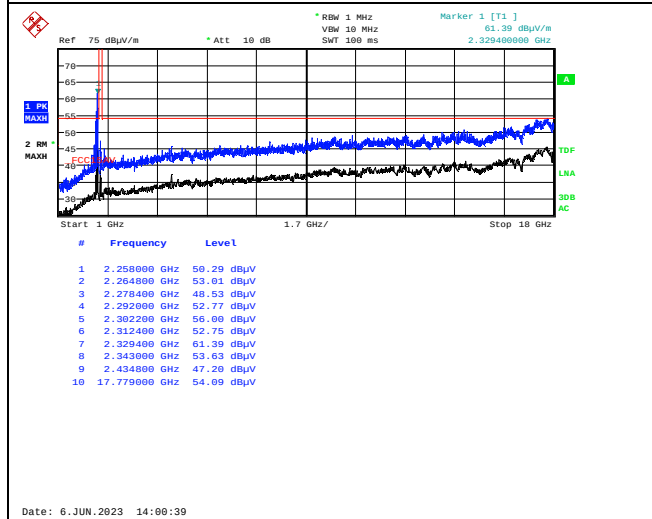
VP



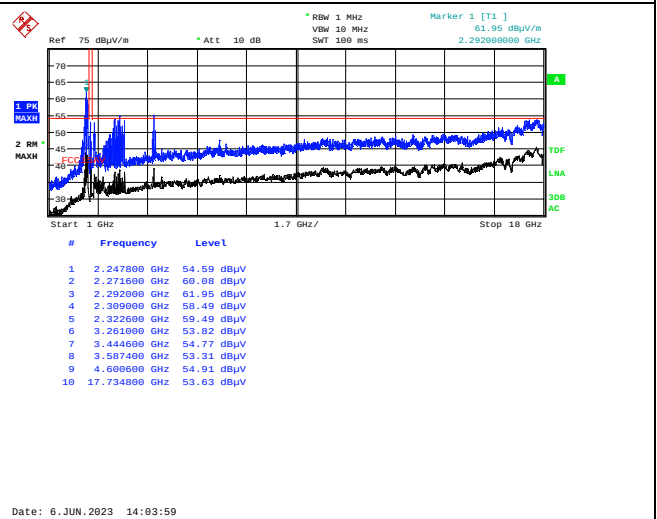
Radiated Emissions 1 - 18 GHz, Ch06, 802.11n HT40, Ant0, HP



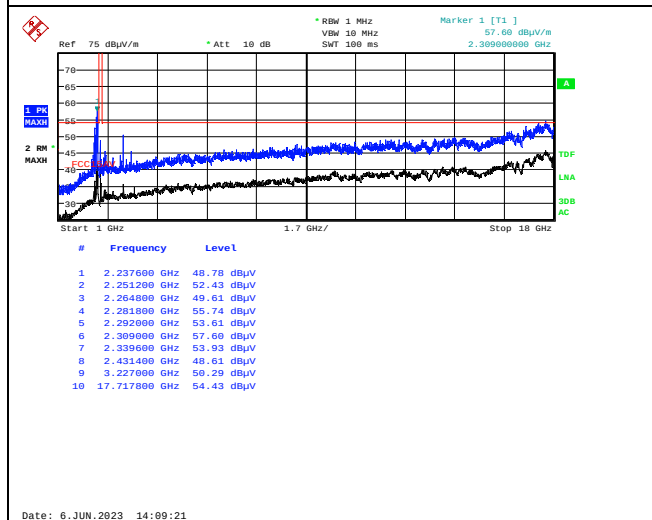
VP



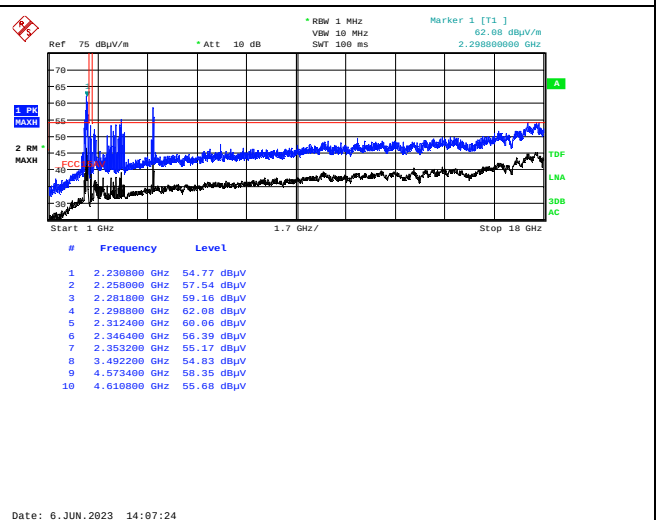
Radiated Emissions 1 - 18 GHz, Ch06, 802.11n HT40, Ant1, HP



VP

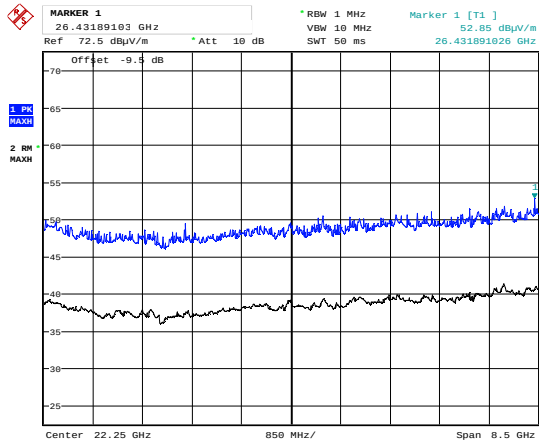


Radiated Emissions 1 - 18 GHz, Ch06, 802.11n HT40, MIMO, HP

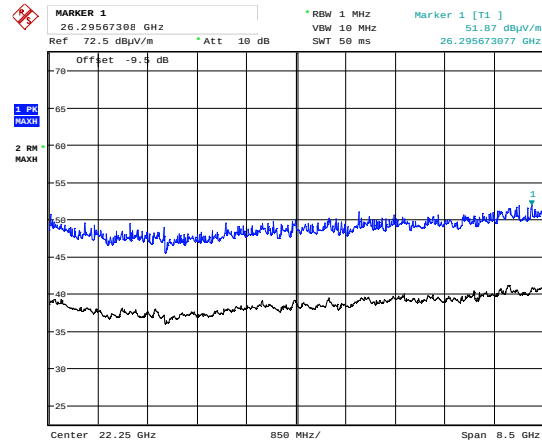


VP

COMBI Antenna

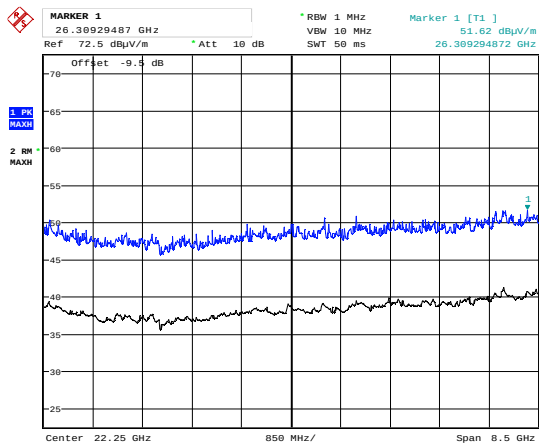


Date: 14.MAR.2023 11:10:42

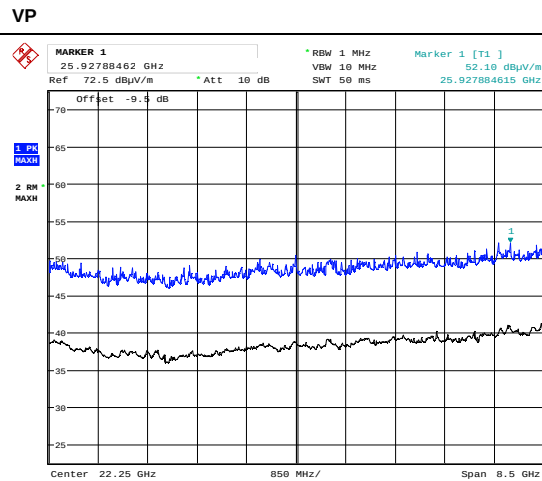


Date: 14.MAR.2023 11:13:36

Emissions 18 - 26 GHz, Ch06, 802.11b 11M Ant1, HP

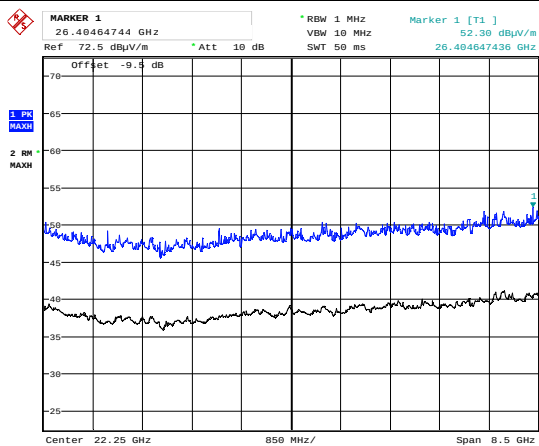


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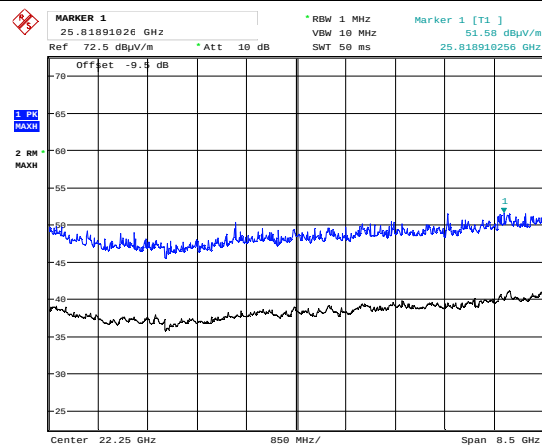


Date: 14.MAR.2023 11:52:41

Emissions 18 - 26 GHz, Ch06, 802.11g 6M Ant0, HP



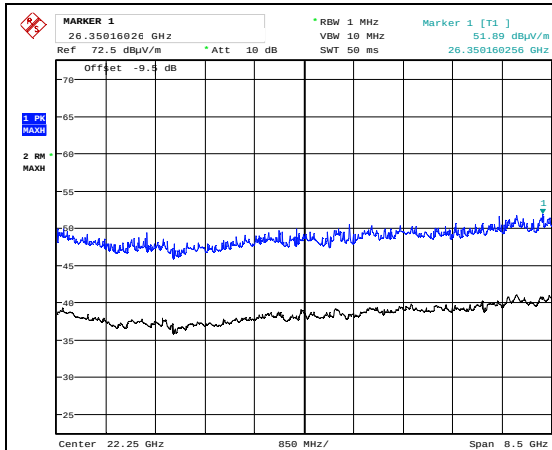
Date: 14.MAR.2023 11:58:45



Date: 14.MAR.2023 12:01:00

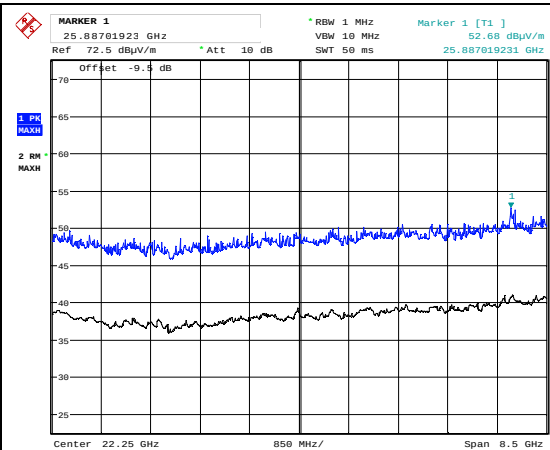
Emissions 18 - 26 GHz, Ch06, 802.11g 6M Ant1, HP

VP



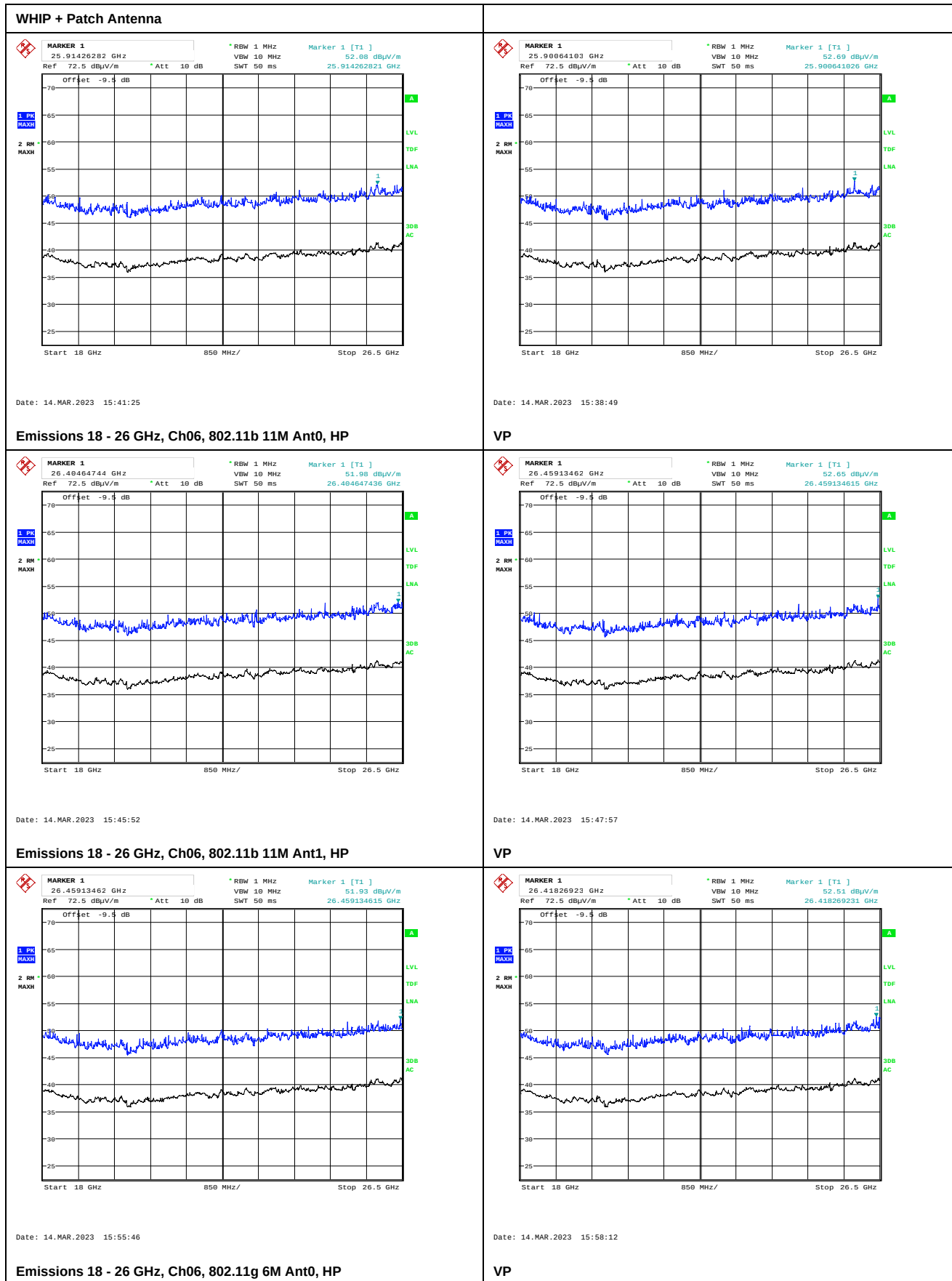
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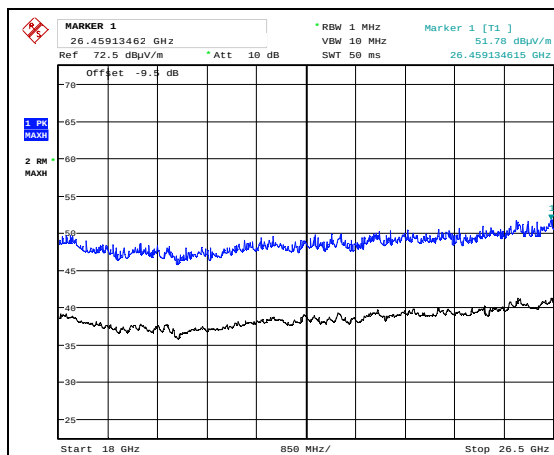
Emissions 18 - 26 GHz, Ch06, 802.11n MCS0 MIMO, HP



Date: 14.MAR.2023 12:04:41

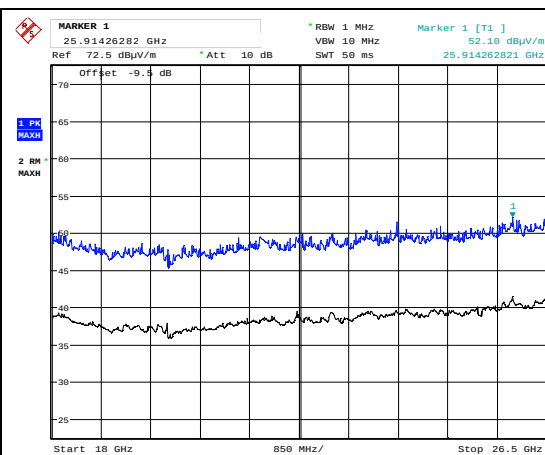
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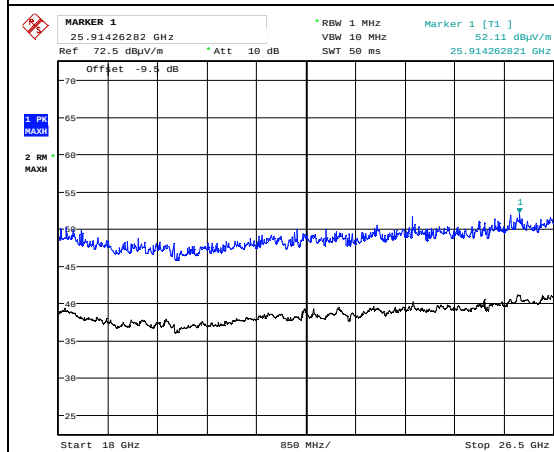
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Emissions 18 - 26 GHz, Ch06, 802.11g 6M Ant1, HP



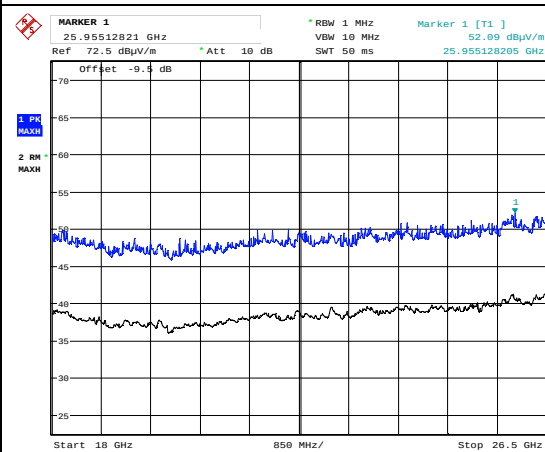
Date: 14.MAR.2023 16:01:28

VP



Date: 14.MAR.2023 15:53:08

Emissions 18 - 26 GHz, Ch06, 802.11m MCS0 MIMO, HP



Date: 14.MAR.2023 15:50:46

VP

3.9 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 3, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

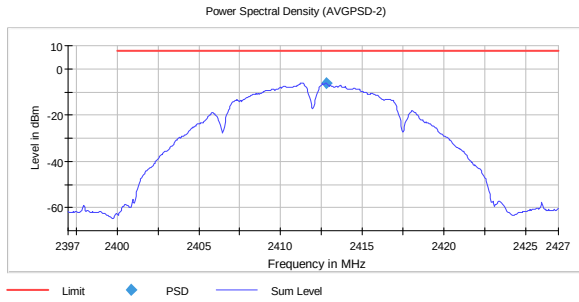
Measurement Data:

The measurement procedure AVG-PSD2 described in ANSI C63.10-2013 was used.

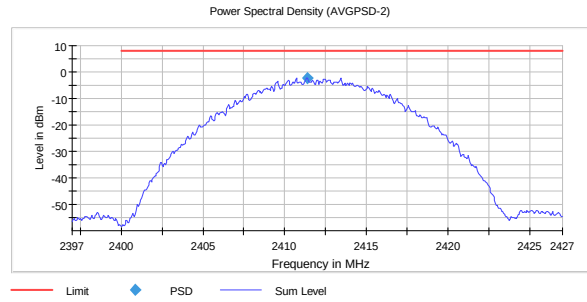
Modulation Type	Measured Power Spectral Density (dBm/3kHz)				
	2412 MHz	2417 MHz	2437 MHz	2457 MHz	2462 MHz
802.11b	-2.3	1.7	1.6	1.6	-1.5
802.11g	-9.3	-3.5	-3.0	-2.7	-7.8
802.11n SISO	-9.3	-3.6	-3.3	-2.7	-8.6
802.11n MIMO	-9.2	-3.5	-3.2	-3.3	-8.7
	2422 MHz	2427 MHz	2437 MHz	2447 MHz	2452 MHz
802.11n HT40 SISO	-11.4	-5.9	-5.6	-6.0	-11.5
802.11n HT40 MIMO	-11.5	-6.1	-5.9	-6.1	-11.5

Requirement for systems using Digital Modulation

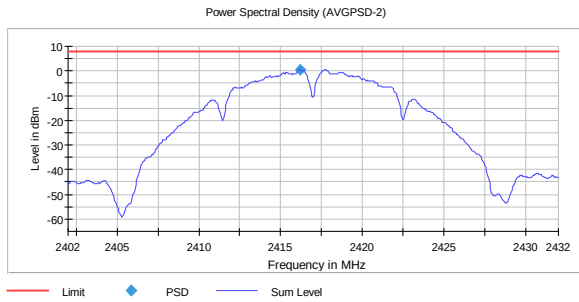
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.



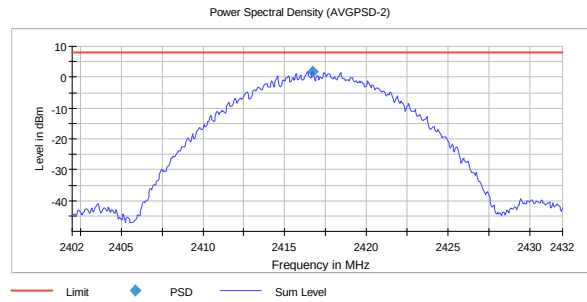
PSD, 2412 MHz, 802.11b 1M -6.20



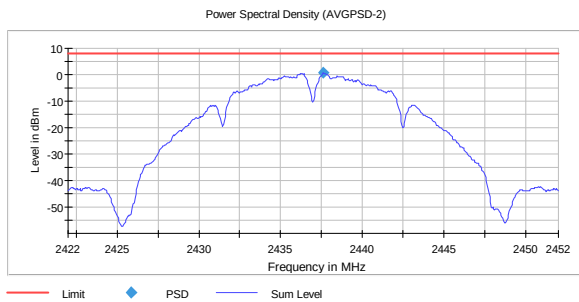
PSD, 2412 MHz, 802.11b 11M -2.27



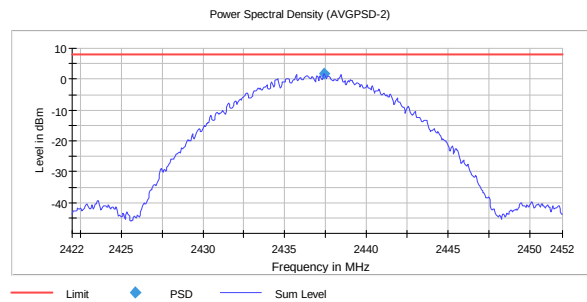
PSD, 2417 MHz, 802.11b 1M 0.45



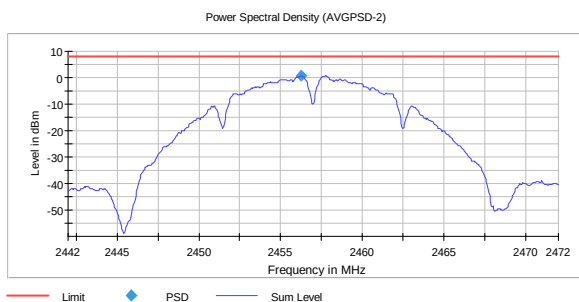
PSD, 2417 MHz, 802.11b 11M 1.73



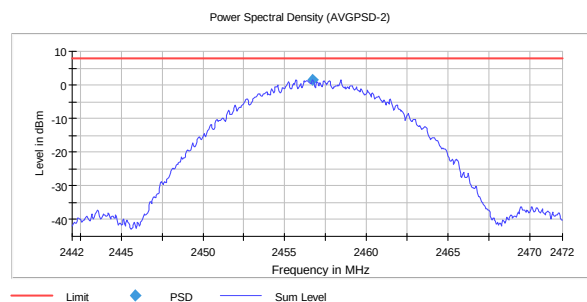
PSD, 2437 MHz, 802.11b 1M 0.64



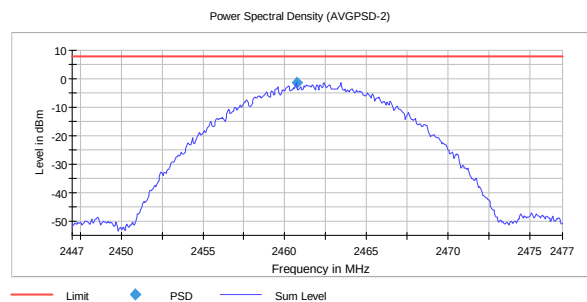
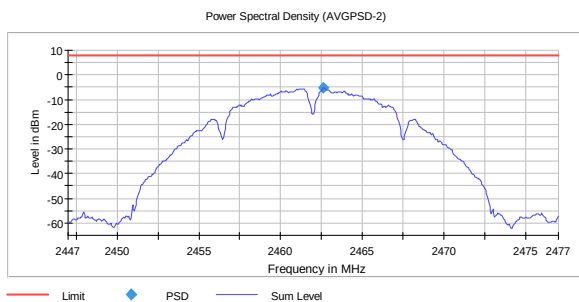
PSD, 2437 MHz, 802.11b 11M 1.63

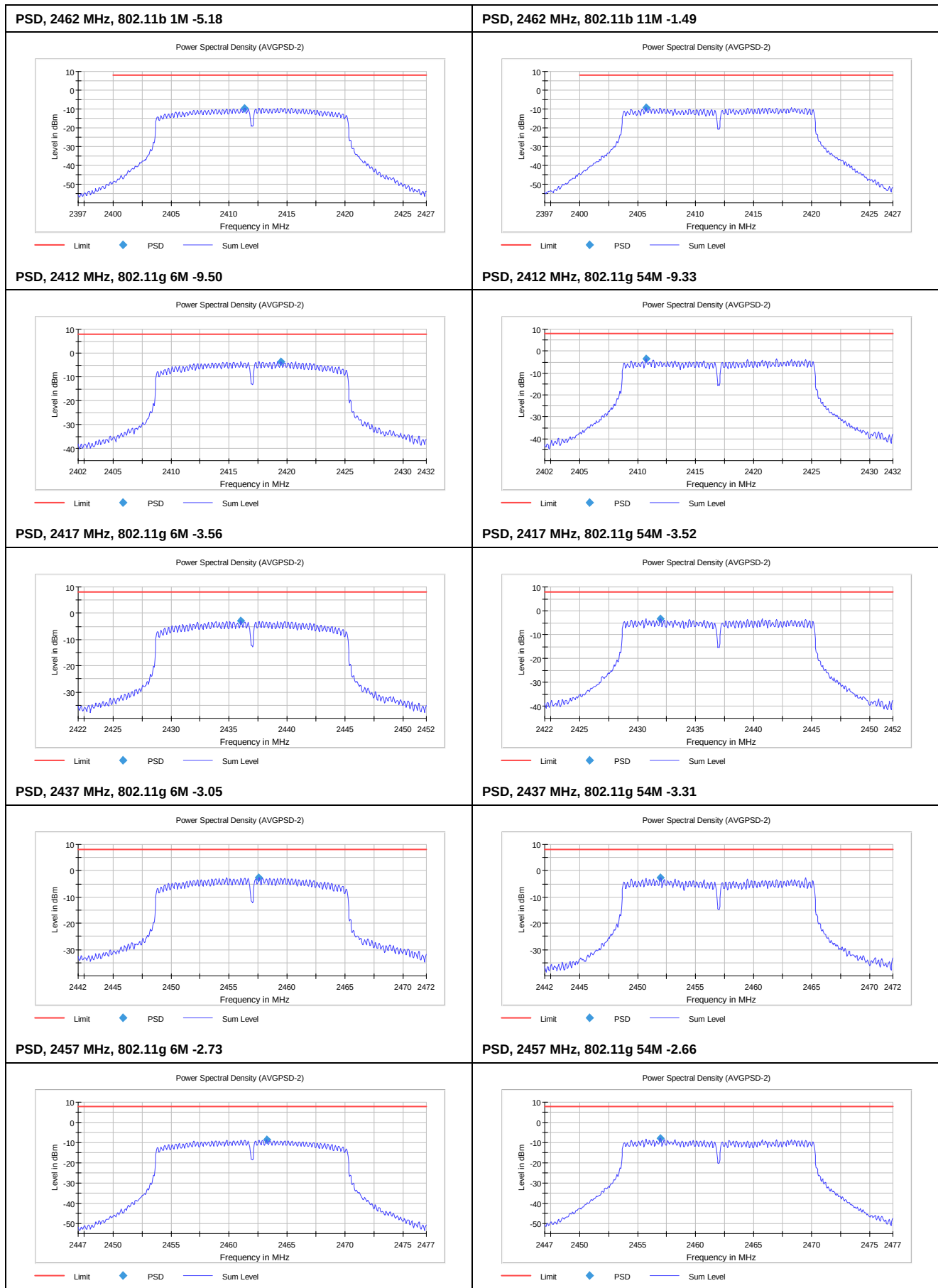


PSD, 2457 MHz, 802.11b 1M 0.66

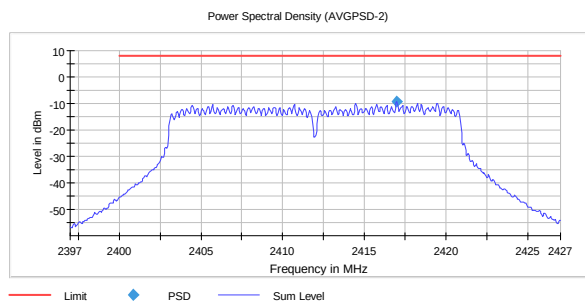


PSD, 2457 MHz, 802.11b 11M 1.58

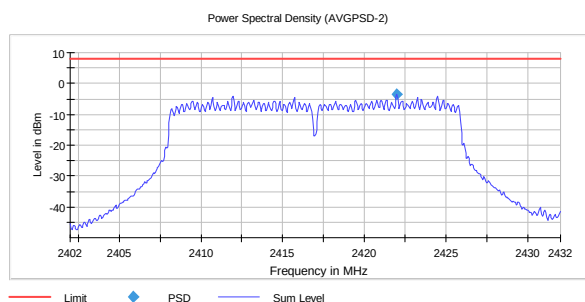




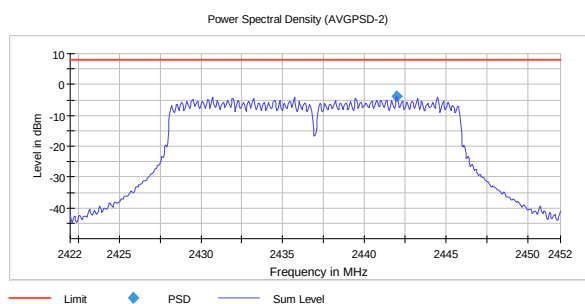
PSD, 2462 MHz, 802.11g 54M -7.83



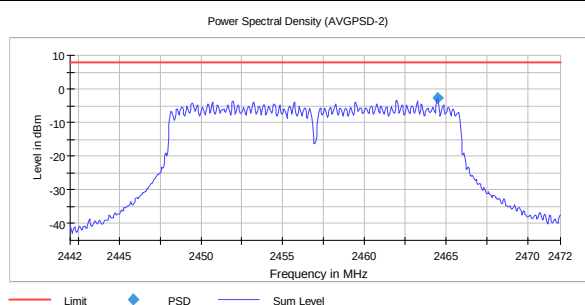
PSD, 2412 MHz, 802.11n SISO MCS7 -9.3



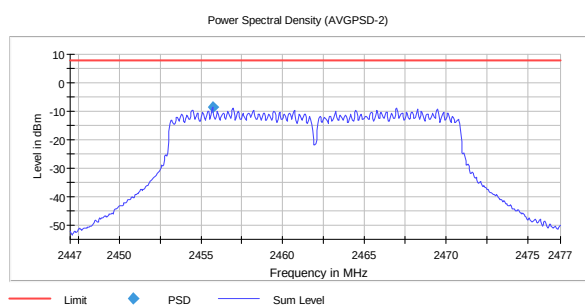
PSD, 2417 MHz, 802.11n SISO MCS7 -3.64

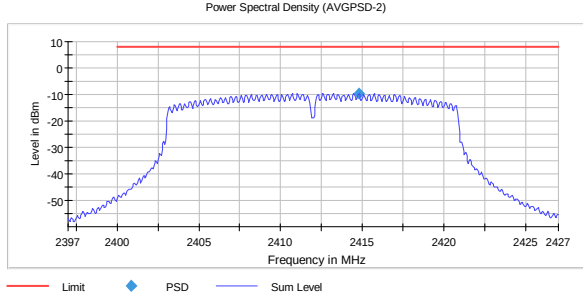
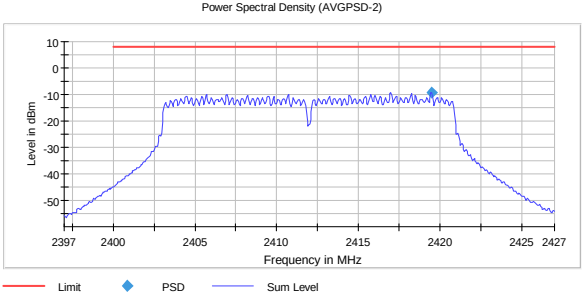
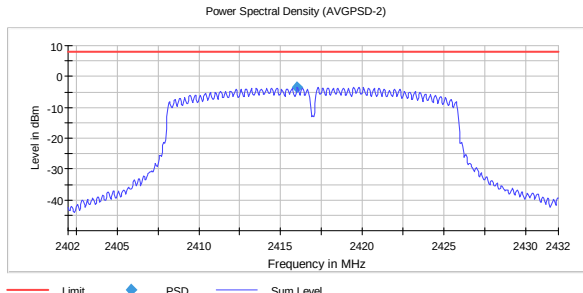
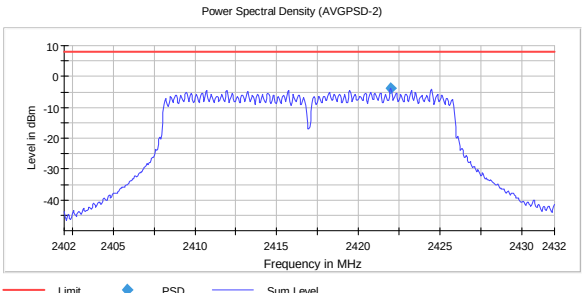
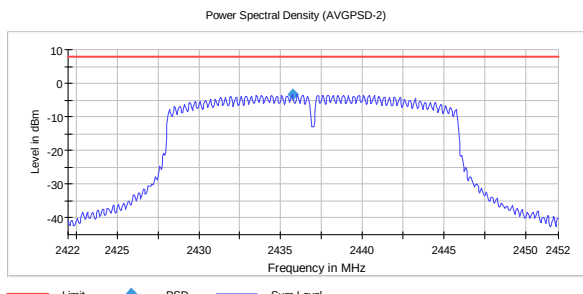
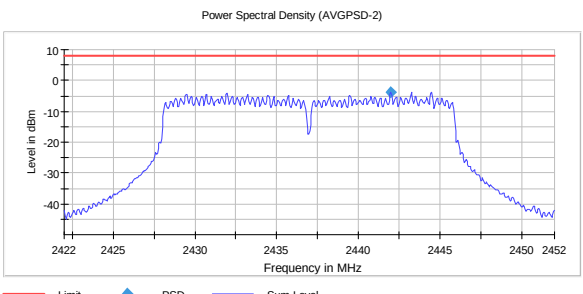
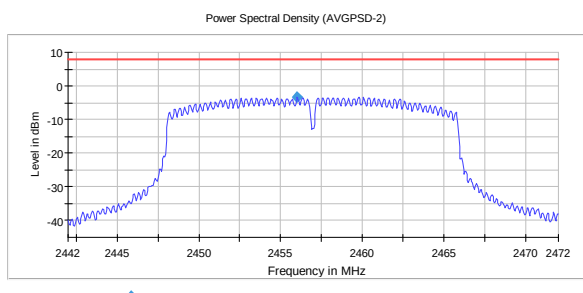
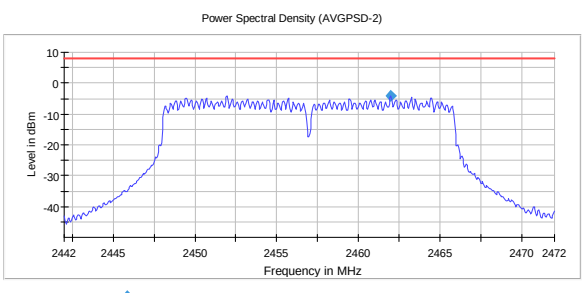
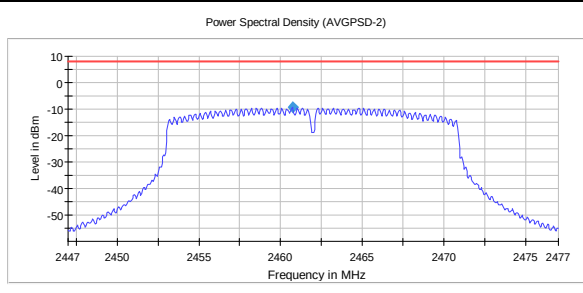
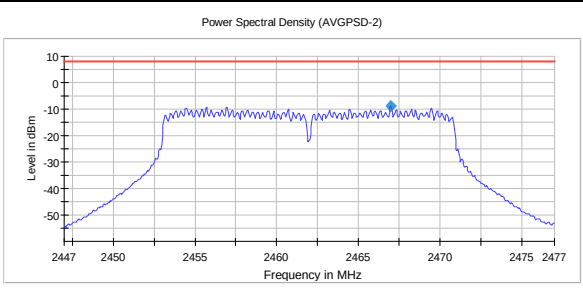


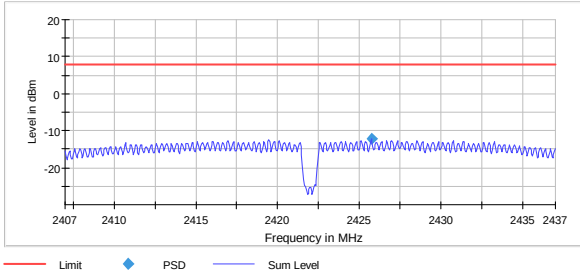
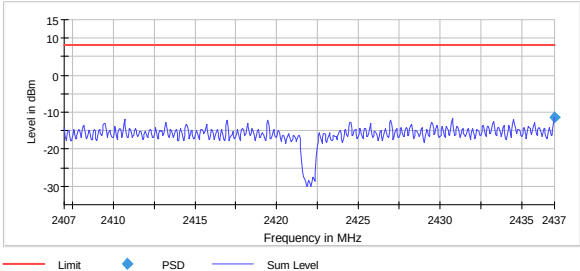
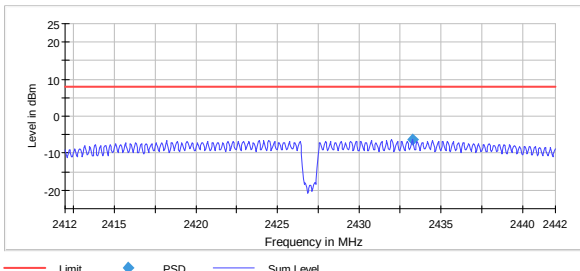
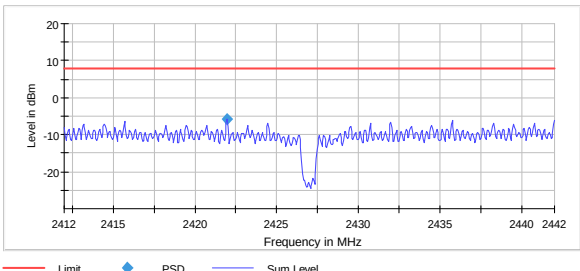
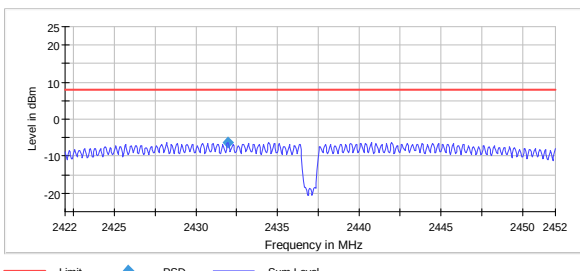
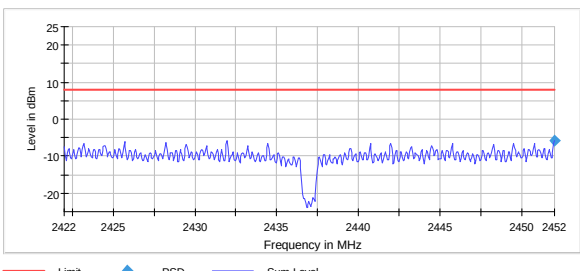
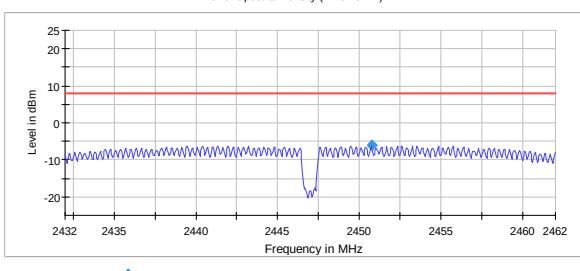
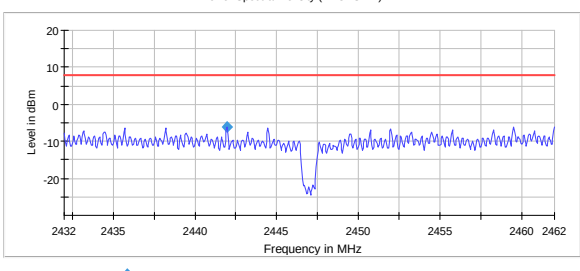
PSD, 2437 MHz, 802.11n SISO MCS7 -3.77

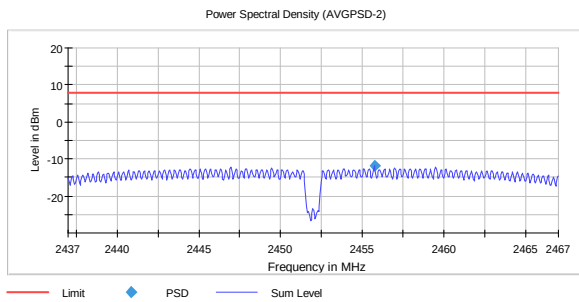


PSD, 2457 MHz, 802.11n SISO MCS7 -2.72

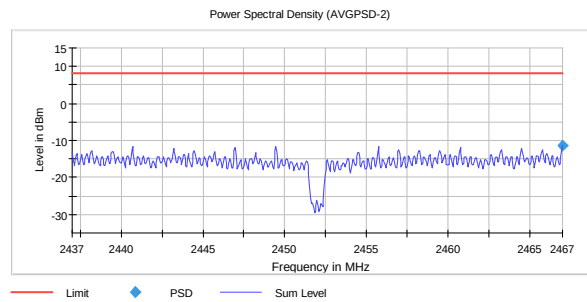


PSD, 2462 MHz, 802.11n SISO MCS0 -9.345  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level	PSD, 2462 MHz, 802.11n SISO MCS7 -8.62  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level
PSD, 2412 MHz, 802.11n MIMO MCS8 -9.63  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level	PSD, 2412 MHz, 802.11n MIMO MCS15 -9.17  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level
PSD, 2417 MHz, 802.11n MIMO MCS8 -3.55  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level	PSD, 2417 MHz, 802.11n MIMO MCS15 -3.78  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level
PSD, 2437 MHz, 802.11n MIMO MCS8 -3.24  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level	PSD, 2437 MHz, 802.11n MIMO MCS15 -3.69  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level
PSD, 2457 MHz, 802.11n MIMO MCS8 -3.29  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level	PSD, 2457 MHz, 802.11n MIMO MCS15 -4.13  Power Spectral Density (AVG) Level in dBm Frequency in MHz Limit PSD Sum Level

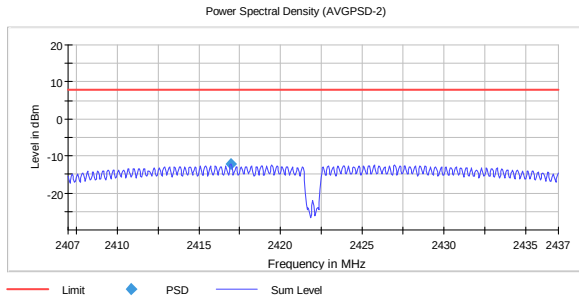
PSD, 2462 MHz, 802.11n MIMO MCS8 -9.38  Limit PSD Sum Level	PSD, 2462 MHz, 802.11n MIMO MCS15 -8.74  Limit PSD Sum Level
PSD, 2422 MHz, 802.11n HT40 SISO MCS0 -12.2  Limit PSD Sum Level	PSD, 2422 MHz, 802.11n HT40 SISO MCS7 -11.4  Limit PSD Sum Level
PSD, 2427 MHz, 802.11n HT40 SISO MCS0 -6.3  Limit PSD Sum Level	PSD, 2427 MHz, 802.11n HT40 SISO MCS7 -5.9  Limit PSD Sum Level
PSD, 2437 MHz, 802.11n HT40 SISO MCS0 -6.2  Limit PSD Sum Level	PSD, 2437 MHz, 802.11n HT40 SISO MCS7 -5.6  Limit PSD Sum Level
PSD, 2447 MHz, 802.11n HT40 SISO MCS0 -6.1  Limit PSD Sum Level	PSD, 2447 MHz, 802.11n HT40 SISO MCS7 -6.0  Limit PSD Sum Level



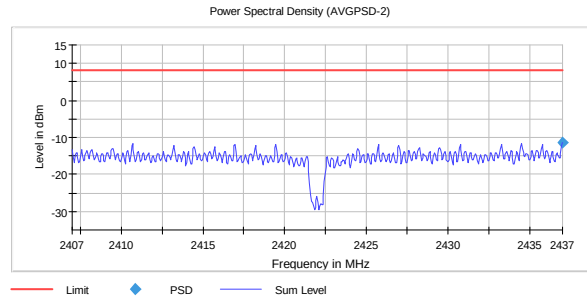
PSD, 2452 MHz, 802.11n HT40 SISO MCS0 -11.9



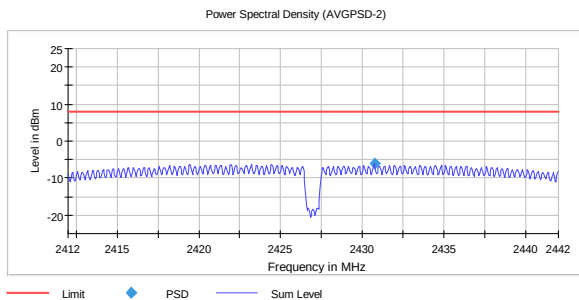
PSD, 2452 MHz, 802.11n HT40 SISO MCS7 -11.5



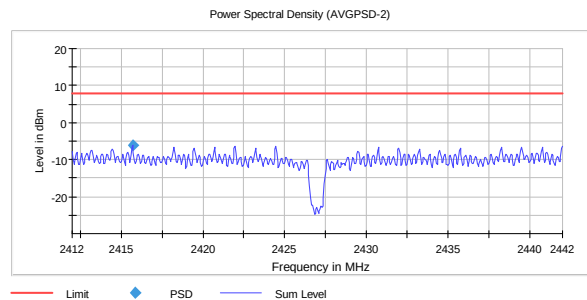
PSD, 2422 MHz, 802.11n HT40 MIMO MCS8 -12.1



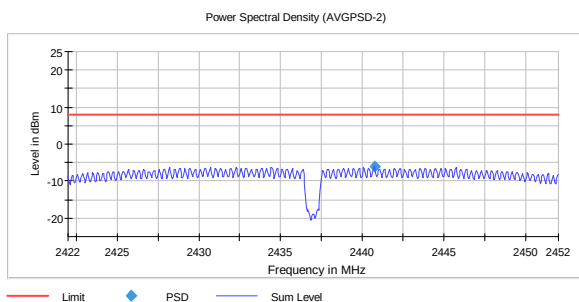
PSD, 2422 MHz, 802.11n HT40 MIMO MCS15 -11.5



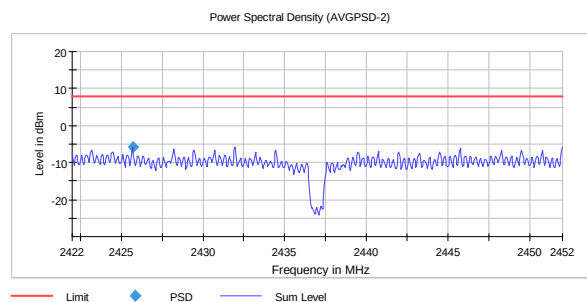
PSD, 2427 MHz, 802.11n HT40 MIMO MCS8 -6.1



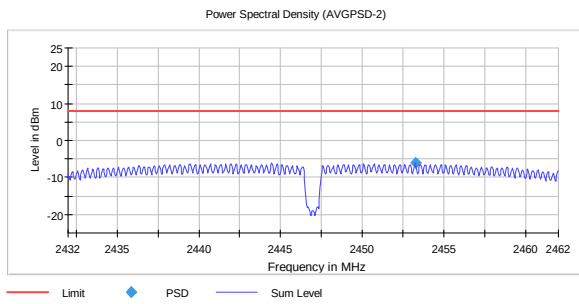
PSD, 2427 MHz, 802.11n HT40 MIMO MCS15 -6.1



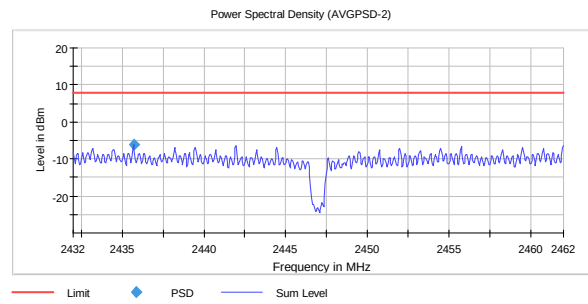
PSD, 2437 MHz, 802.11n HT40 MIMO MCS8 -6.1



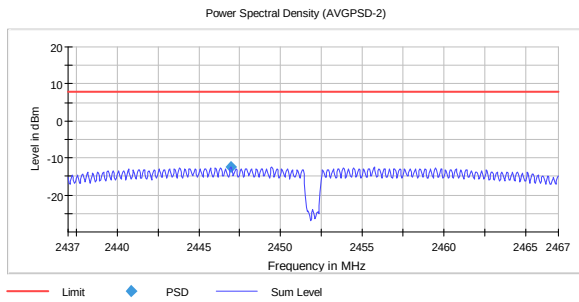
PSD, 2437 MHz, 802.11n HT40 MIMO MCS15 -5.9



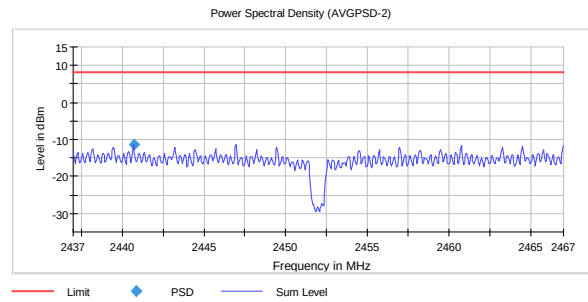
PSD, 2447 MHz, 802.11n HT40 MIMO MCS8 -6.1



PSD, 2447 MHz, 802.11n HT40 MIMO MCS15 -6.1



PSD, 2452 MHz, 802.11n HT40 MIMO MCS8 -12.4



PSD, 2452 MHz, 802.11n HT40 MIMO MCS15 -11.5

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2023-01	2024-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2023-01	2024-01
3	6810.17B	Attenuator	Suhner	LR 1669	2022-08	2023-08
4	NO324415	Band Reject Filter (2.4GHz)	Microwave Circuits	LR 1760	COU	
5	JB3	BiLog Antenna	Sunol	N-4525	2022-09	2025-09
6	317	Preamplifier	Sonoma Inst.	LR 1687	2022-08	2023-08
7	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2022-08	2023-08
8	3115	Horn Antenna	EMCO	LR 1226	2022-12	2027-12
9	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2022-08	2023-08
10	WLK5-1100-1485-7000-40SS	Low Pass Filter	Wainwright Inst.	LR 1761	COU	
11	638	Antenna Horn	Narda	LR 1480	N/A	
12	6032A	System Power Supply	Hewlett Packard	LR 1062	COU	
13	Model 87V	Multimeter	Fluke	LR 1600	2022-03	2024-03
14	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

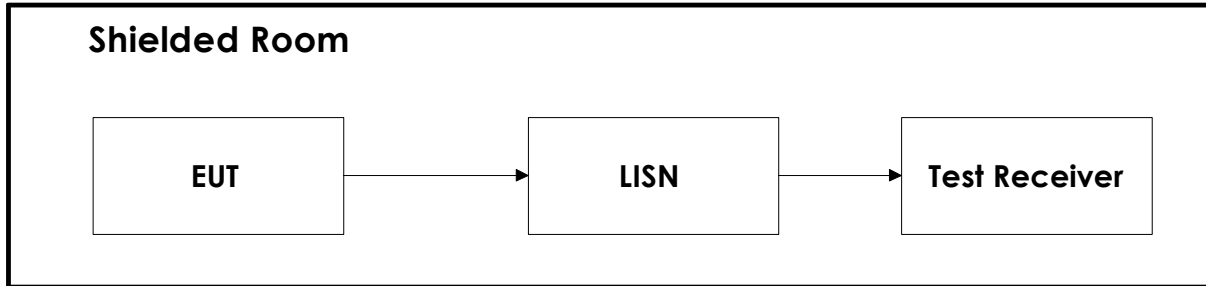
COU = Calibrate on Use

The software listed below has been used for one or more tests.

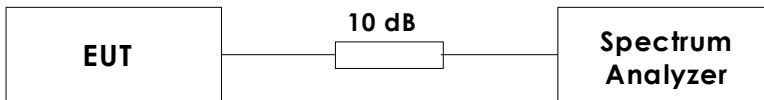
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	EMC test software
2	Rohde & Schwarz	GPIBShot	2.7	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission

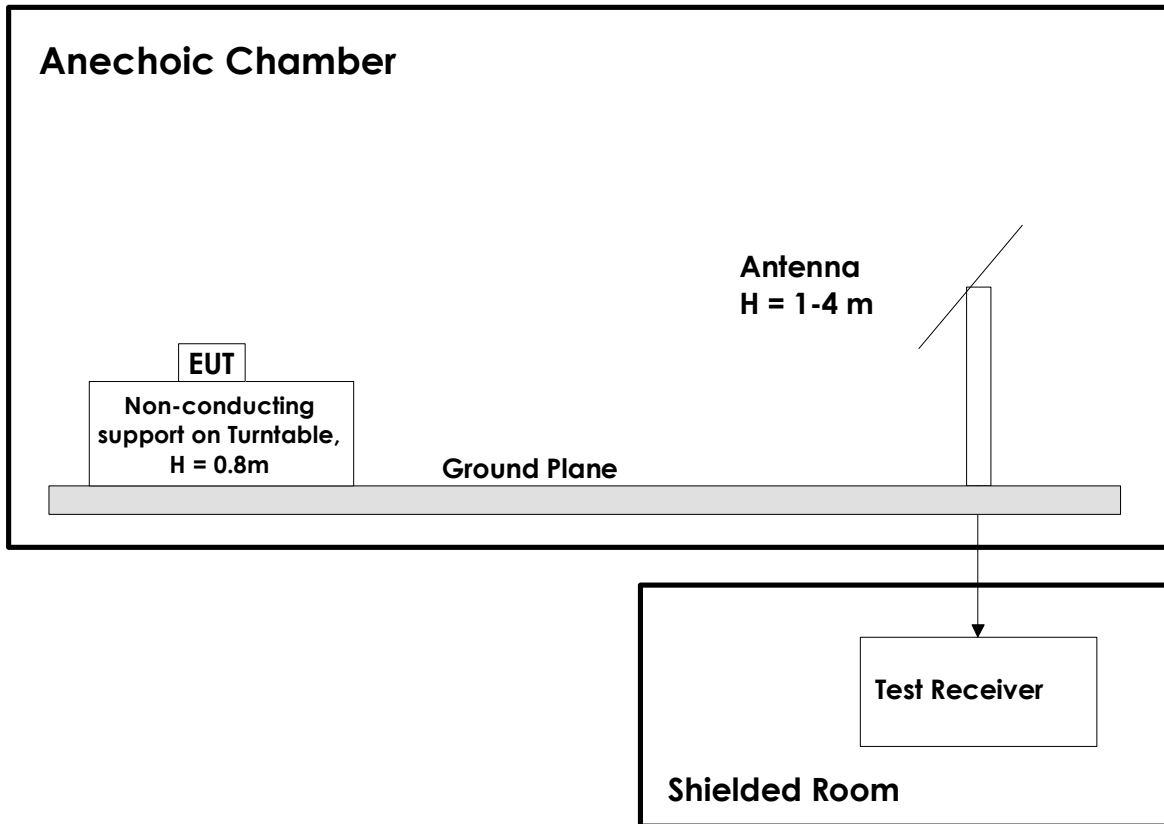


6.2 Conducted Tests



This test set-up is used for all Conducted tests.
For Frequency Stability test the EUT was placed in a climatic chamber.

6.3 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.