ENGINEERING TEST REPORT

VIP4Gb
Model: VIP4Gb
FCC ID: NS9VIP4GABGN20

Applicant:

Microhard Systems Inc.
150 Country Hills Landing NW
Calgary, Alberta
Canada T3K 5P3

In Accordance With

Federal Communications Commission (FCC) Part 15, Subpart E, Section 15.407
Unlicensed National Information Infrastructure (U-NII) Device
Operating in the 5.725-5.85 GHz Band

UltraTech's File No.: 16MCRS087_FCC15E407

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: July 13, 2016	
Report Prepared by: Dan Huynh Issued Date: July 13, 2016	Tested by: Hung Trinh Test Dates: April 20 – June 7, 2016

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*
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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart E, Section 15.407
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
Purpose of Test:	Certification to add Unlicensed National Information Infrastructure (U-NII) Device Operating in the 5.725-5.85 GHz Band and for Co-location RF Exposure Evaluation of WIFI Radio and Data Card Module (FCC ID: RI7LN930).
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC KDB Publication No. 789033 D02 General U-NII Test Procedures New Rules v01r02 ▪ FCC, KDB Publication No. 662911 D01 Multiple Transmitter Output v02r01
Environmental Classification:	[ ] Commercial, industrial or business environment [x] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2016	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC, KDB Publication No. 789033 D02 General U-NII Test Procedures New Rules v01r02	2016	GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E
FCC, KDB Publication No. 662911 D01 Multiple Transmitter Output v02r01	2013	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Microhard Systems Inc.
Address:	150 Country Hills Landing NW Calgary, Alberta Canada T3K 5P3
Contact Person:	Mr. Hany Shenouda Phone #: 403 248-0028 Fax #: 403 248 2762 Email Address: shenouda@microhardcorp.com

MANUFACTURER	
Name:	Microhard Systems Inc.
Address:	150 Country Hills Landing NW Calgary, Alberta Canada T3K 5P3
Contact Person:	Mr. Hany Shenouda Phone #: 403 248-0028 Fax #: 403 248-2762 Email Address: shenouda@microhardcorp.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Microhard Systems Inc.
Product Name:	VIP4Gb
Model Name or Number:	VIP4Gb
Serial Number:	Test Sample
Type of Equipment:	Unlicensed National Information Infrastructure TX
Input Power Supply Type:	120 VAC 60 Hz
Primary User Functions of EUT:	LTE Ethernet Bridge/Serial Gateway

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	• Mobile • Base Station (fixed use)
Intended Operating Environment:	Residential environment
Power Supply Requirement:	9-30VDC via MHS-supplied power adapter
RF Output Power Rating:	▪ 802.11a: 18.00 dBm (63.10 mW) ▪ 802.11an, HT20, MIMO: 15.31 dBm (33.98 mW) max. combined conducted output power ▪ 802.11an, HT40, MIMO: 14.92 dBm (31.04 mW) max. combined conducted output power
Operating Frequency Range:	5745 - 5825 MHz 5755 - 5795 MHz
RF Output Impedance:	50 Ω
Modulation Type:	DSSS, OFDM
Antenna Connector Types:	RPSMA

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Antenna Type	Maximum Gain (dBi)
Dipole Antenna	2

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	ANT1	1	RPSMA	Direct connection (no cable)
2	ANT2	1	RPSMA	Direct connection (no cable)
3	DIV	1	SMA	Direct connection (no cable)
4	MAIN	1	SMA	Direct connection (no cable)
5	GPS	1	SMA	Direct connection (no cable)
6	Serial	1	DB9	Shielded cable
7	Power	1	4-Pin Molex	Non-shielded cable
8	RS485	1	6-Pin Molex	Non-shielded cable
9	IO/Console	1	10-Pin Molex	Non-shielded cable
10	Gigabit Ethernet	4	RJ-45	Non-shielded cable

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Laptop
Brand name:	IBM
Model Name or Number:	1161-260
Connected to EUT's Port:	DB9 Serial

Ancillary Equipment # 2	
Description:	MHS-supplied power adapter (Switching Power Supply)
Brand name:	BL
Model Name or Number:	BI30-120200-AdU
Connected to EUT's Port:	PWR

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 ^{o}C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	120 VAC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Special software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as non-integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	5745 - 5825 MHz 5755 - 5795 MHz
Frequency(ies) Tested:	5745 MHz, 5785 MHz, 5825 MHz 5755 MHz, 5795 MHz
RF Power Output: (measured maximum output power at antenna terminals)	▪ 802.11a: 18.00 dBm (63.10 mW) ▪ 802.11an, HT20, MIMO: 15.31 dBm (33.98 mW) max. combined conducted output power ▪ 802.11an, HT40, MIMO: 14.92 dBm (31.04 mW) max. combined conducted output power
Normal Test Modulation:	OFDM
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2017-04-02.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna Requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	See Note 1
15.407(a)	Output Power	Yes
15.407(a)	Power Spectral Density	See Note 1
15.407(b)	Undesirable Emission	Yes
15.407(c)	Transmission Requirements	Yes
15.407(e)	6 dB Bandwidth	See Note 1
15.407(f)	RF Exposure	Yes
15.407(g)	Frequency Stability	Yes
15.407(h)	Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS).	N/A
15.407(i)	Device Security	Yes

Note 1: Refer to the original filing DTS test report under FCC ID: NS9VIP4GABGN20, Report Number: 1212FR16.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

5.1. DUTY CYCLE [§ 15.35(c)]

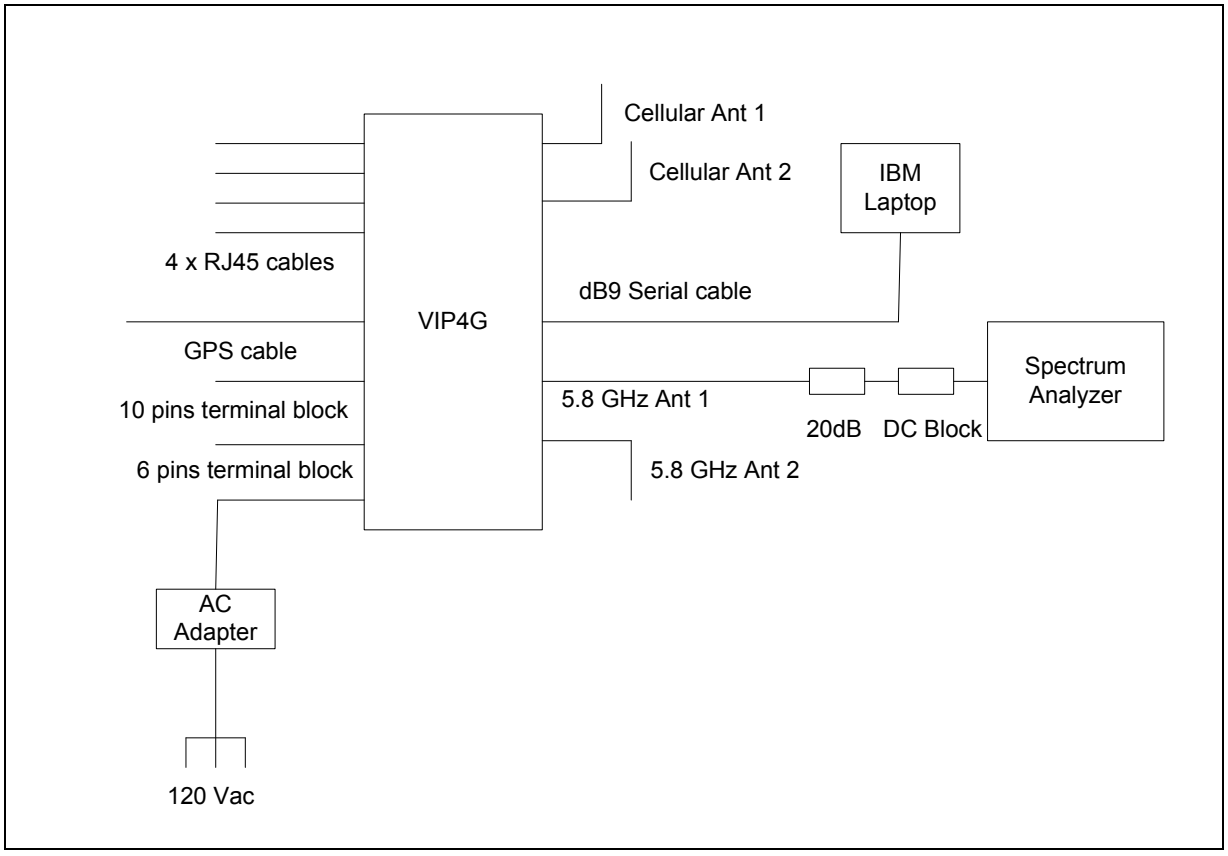
5.1.1. Requirements

§ 15.35(c) Unless otherwise specified, e.g., § 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

5.1.2. Method of Measurements

FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r02, Section II B.2.b

5.1.3. Test Arrangement

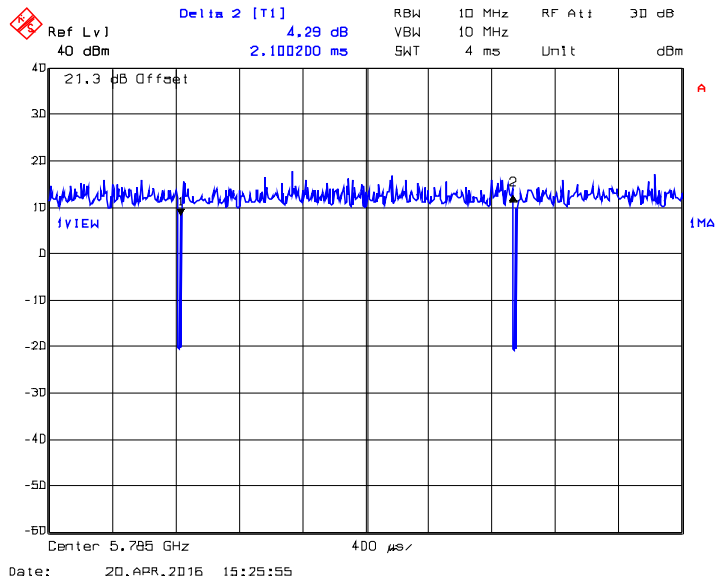


5.1.4. Test Data

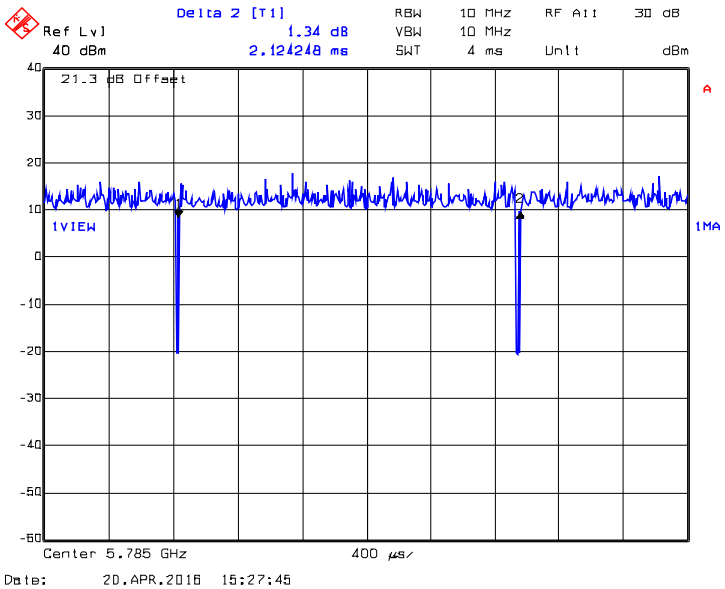
Operating Mode	Data Rate	Channel Number	Frequency (MHz)	Duty Cycle Correction Factor (dB)
802.11a	9	157	5785	0.0493
	18	157	5785	0.0652
	36	157	5785	0.1268
	54	157	5785	0.1620
802.11n HT20	6.5	157	5785	0.0269
	19.5	157	5785	0.0520
	39	157	5785	0.0998
	65	157	5785	0.1836
802.11n HT40	13.5	151	5755	0.0537
	40.5	151	5755	0.1199
	81	151	5755	0.2085
	135	151	5755	0.3415

Refer to the following plots for details.

Plot 5.1.4.1. Duty Cycle, 802.11a, 5785 GHz, Data Rate 9 Mbps, Pulse Width

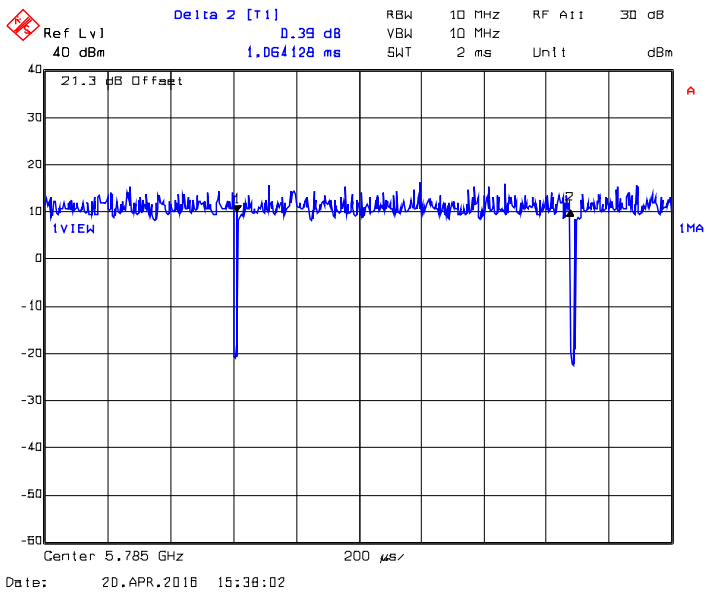


Plot 5.1.4.2. Duty Cycle, 802.11a, 5785 GHz, Data Rate 9 Mbps, Pulse Train

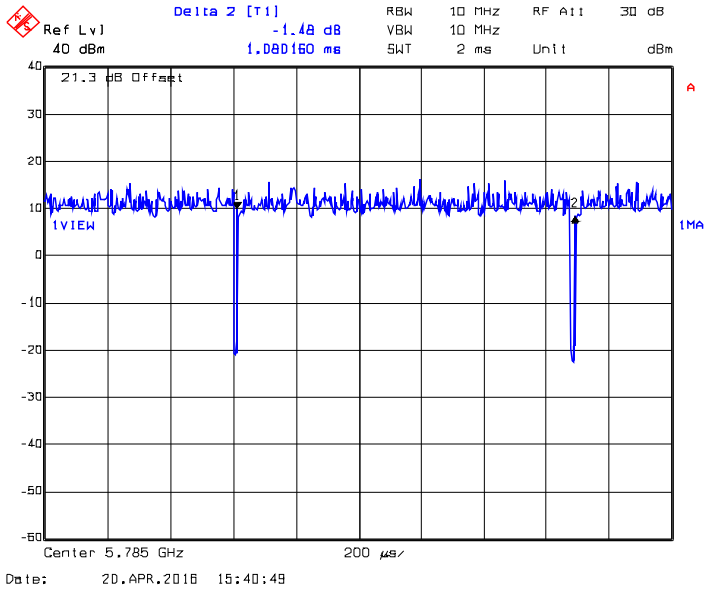


Duty Cycle Correction Factor = 10*log [1 / (2.1002 / 2.1242)] = 0.0493 dB

Plot 5.1.4.3. Duty Cycle, 802.11a, 5785 GHz, Data Rate 18 Mbps, Pulse Width

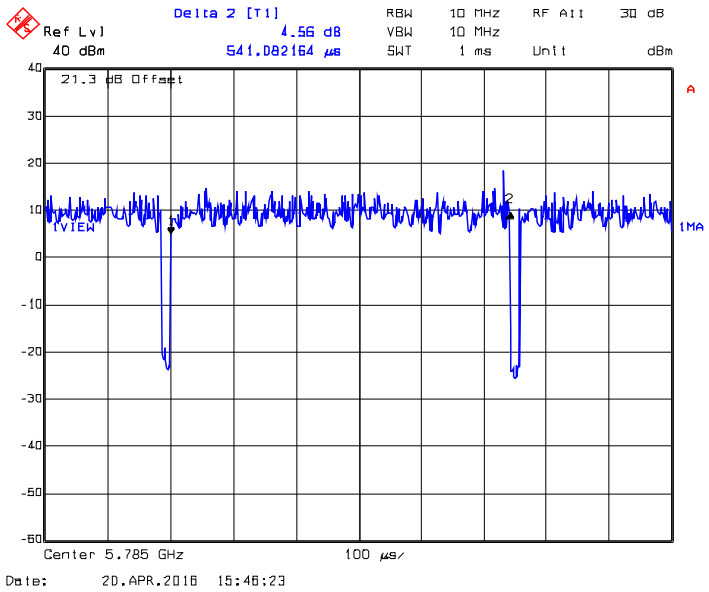


Plot 5.1.4.4. Duty Cycle, 802.11a, 5785 GHz, Data Rate 18 Mbps, Pulse Train

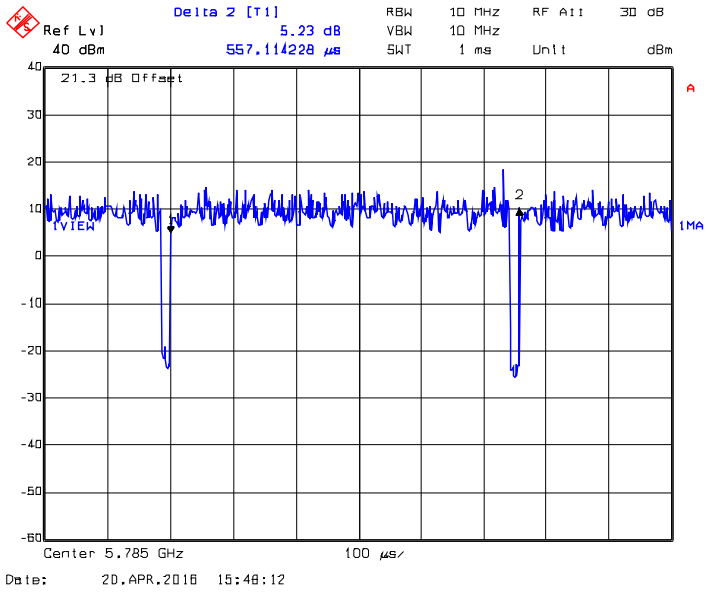


Duty Cycle Correction Factor = 10*log [1 / (1.0641 / 1.0802)] = 0.0652 dB

Plot 5.1.4.5. Duty Cycle, 802.11a, 5785 GHz, Data Rate 36 Mbps, Pulse Width

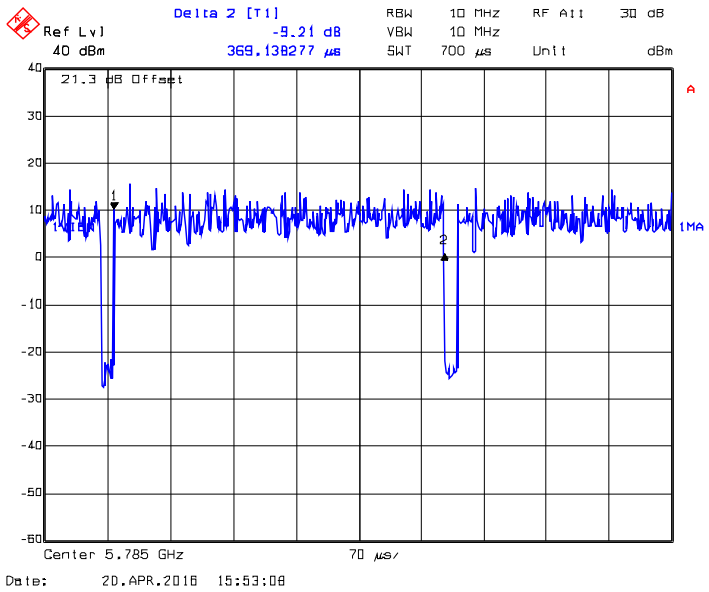


Plot 5.1.4.6. Duty Cycle, 802.11a, 5785 GHz, Data Rate 36 Mbps, Pulse Train

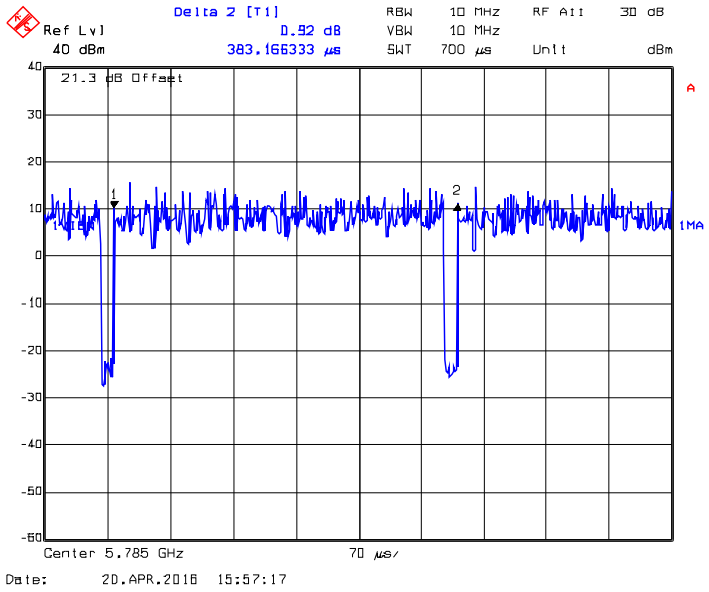


Duty Cycle Correction Factor = 10*log [1 / (541.0822 / 557.1142)] = 0.1268 dB

Plot 5.1.4.7. Duty Cycle, 802.11a, 5785 GHz, Data Rate 54 Mbps, Pulse Width

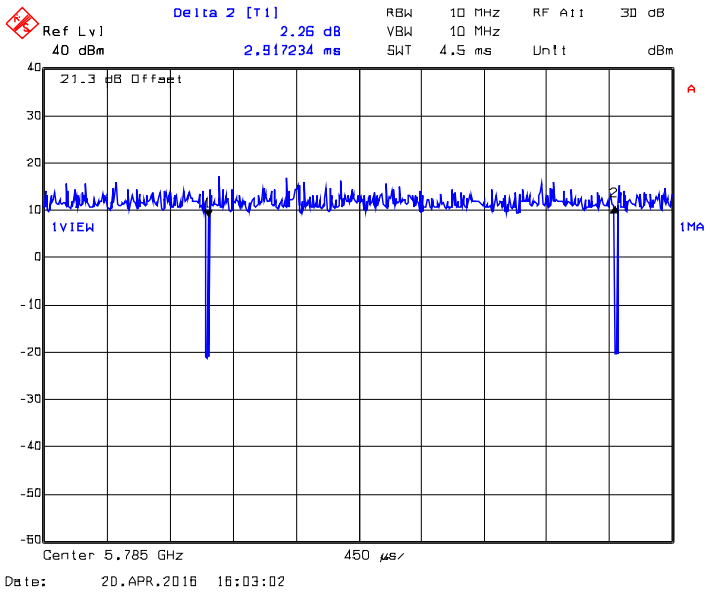


Plot 5.1.4.8. Duty Cycle, 802.11a, 5785 GHz, Data Rate 54 Mbps, Pulse Train

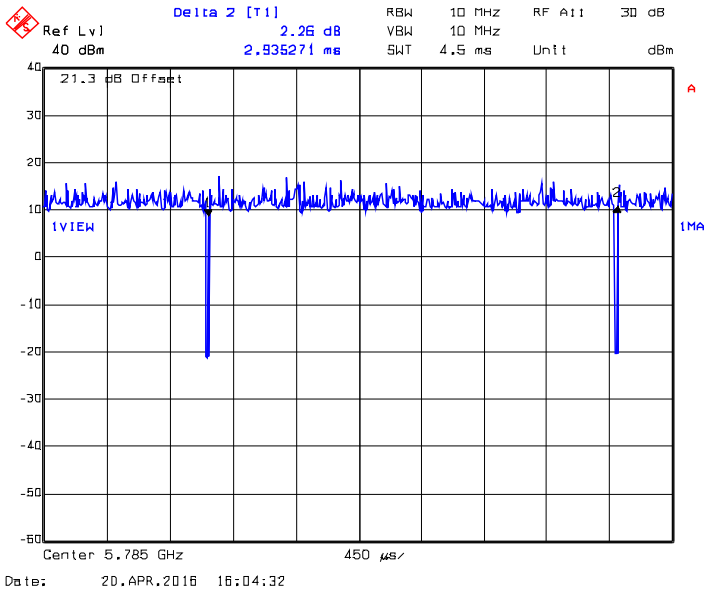


Duty Cycle Correction Factor = 10*log [1 / (369.1383 / 383.1663)] = 0.1620 dB

Plot 5.1.4.9. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 6.5 Mbps, Pulse Width

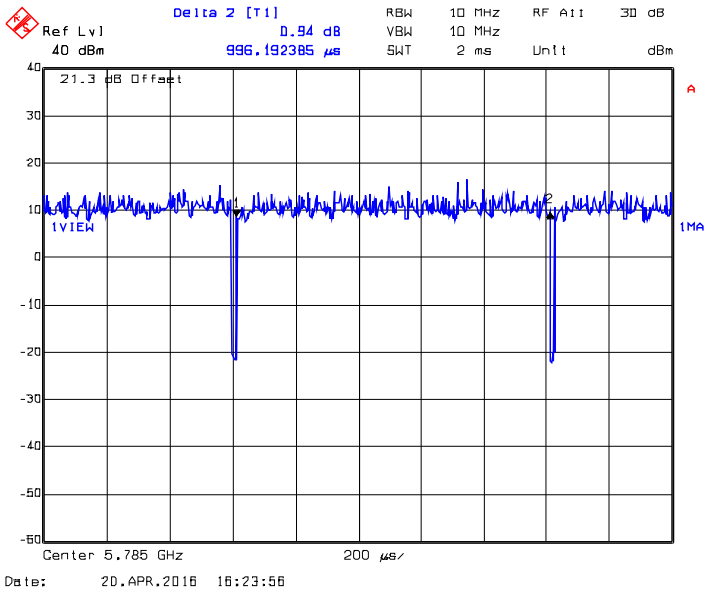


Plot 5.1.4.10. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 6.5 Mbps, Pulse Train

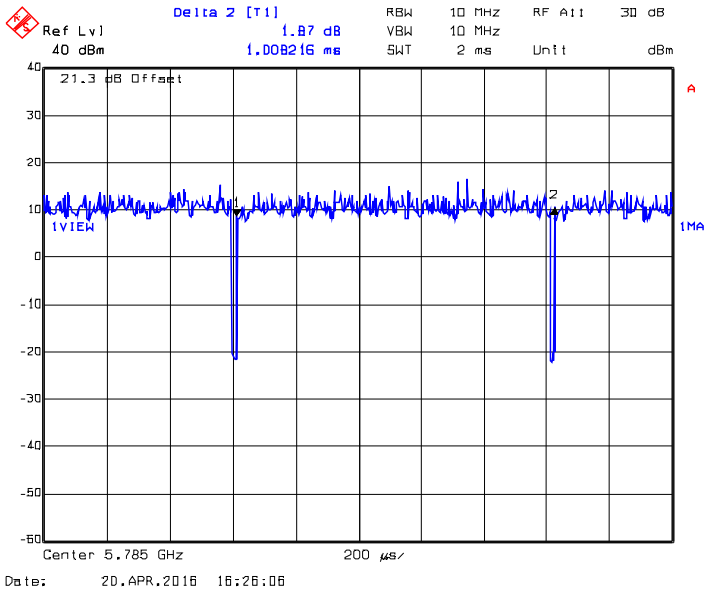


Duty Cycle Correction Factor = 10*log [1 / (2.9172 / 2.9353)] = 0.0269 dB

Plot 5.1.4.11. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 19.5 Mbps, Pulse Width

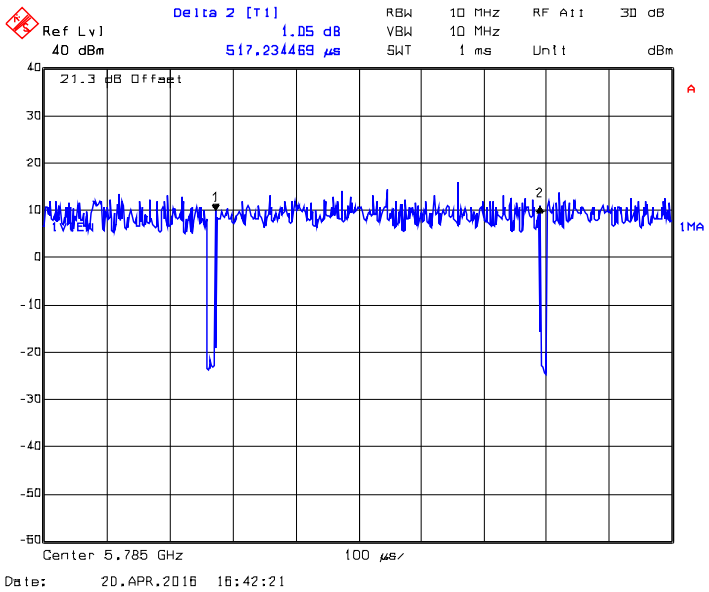


Plot 5.1.4.12. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 19.5 Mbps, Pulse Train

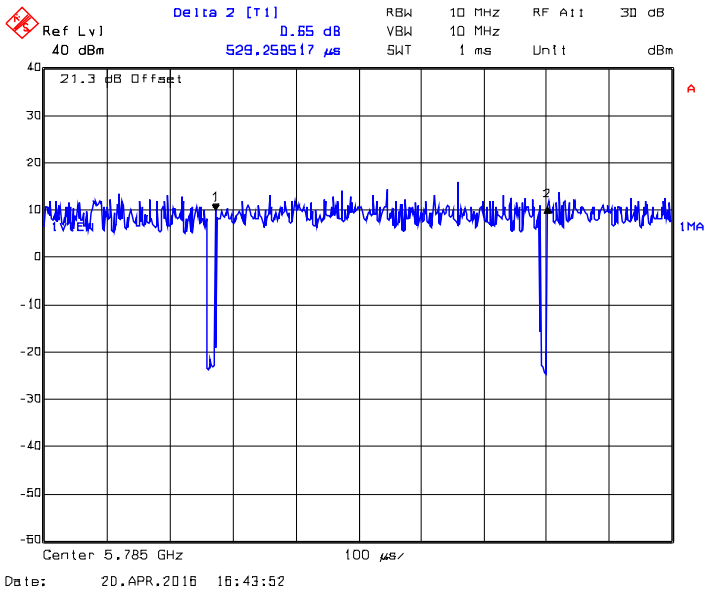


Duty Cycle Correction Factor = 10*log [1 / (0.9961924 / 1.0082)] = 0.0520 dB

Plot 5.1.4.13. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 39 Mbps, Pulse Width

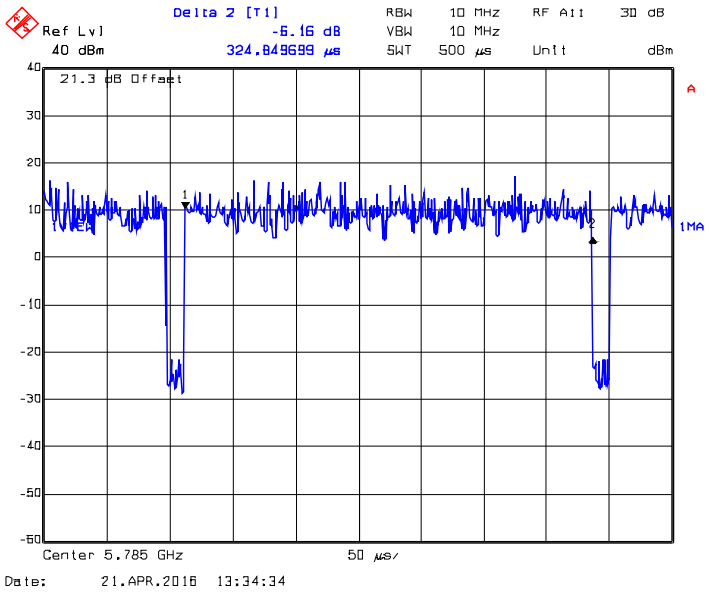


Plot 5.1.4.14. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 39 Mbps, Pulse Train

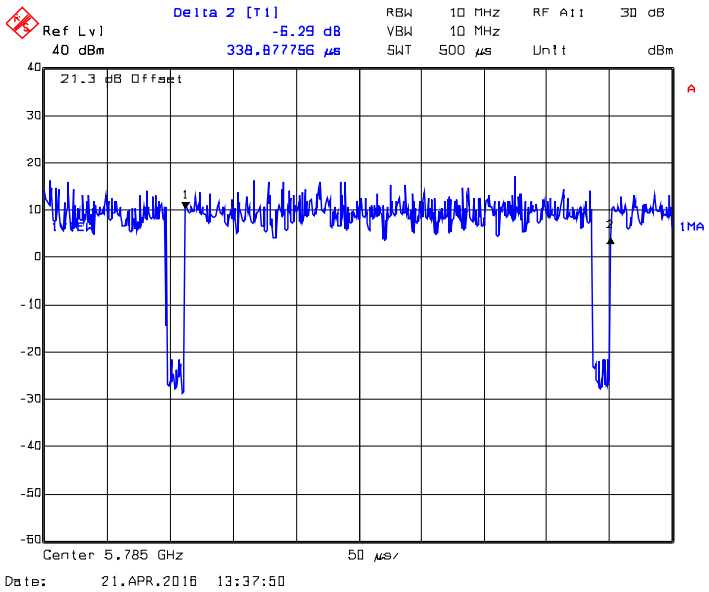


Duty Cycle Correction Factor = 10*log [1 / (517.2345 / 529.2585)] = 0.0998 dB

Plot 5.1.4.15. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 65 Mbps, Pulse Width

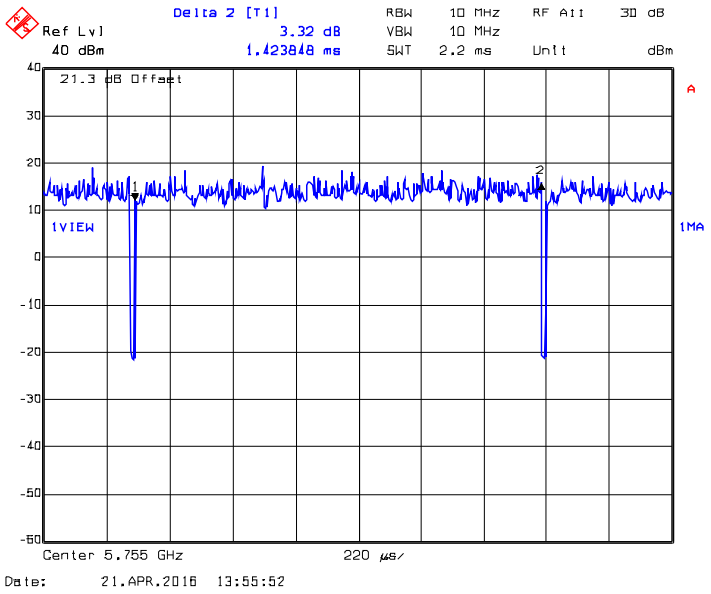


Plot 5.1.4.16. Duty Cycle, 802.11an HT20, 5785 GHz, Data Rate 65 Mbps, Pulse Train

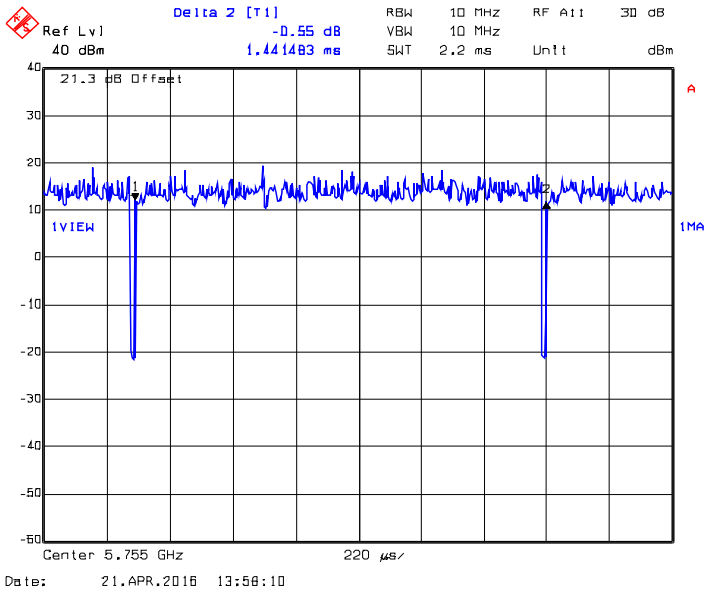


Duty Cycle Correction Factor = 10*log [1 / (324.8497 / 338.8778)] = 0.1836 dB

Plot 5.1.4.17. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 13.5 Mbps, Pulse Width

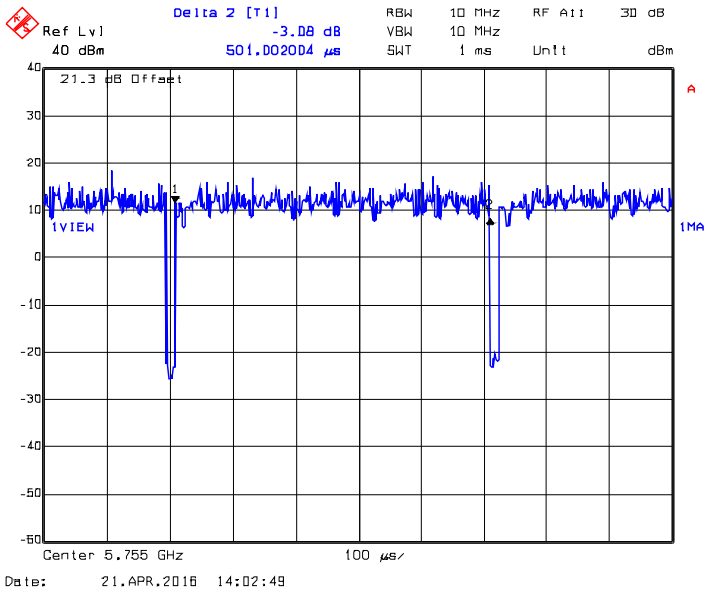


Plot 5.1.4.18. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 13.5 Mbps, Pulse Train

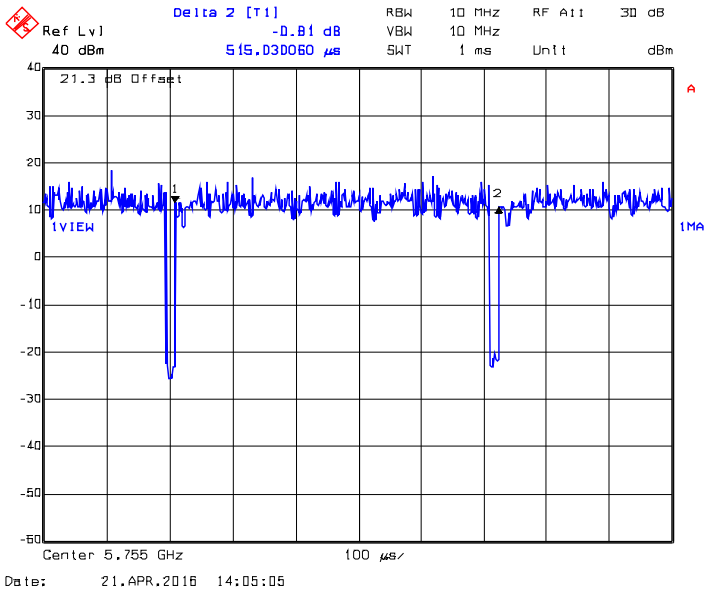


Duty Cycle Correction Factor = 10*log [1 / (1.4238 / 1.4415)] = 0.0537 dB

Plot 5.1.4.19. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 40.5 Mbps, Pulse Width

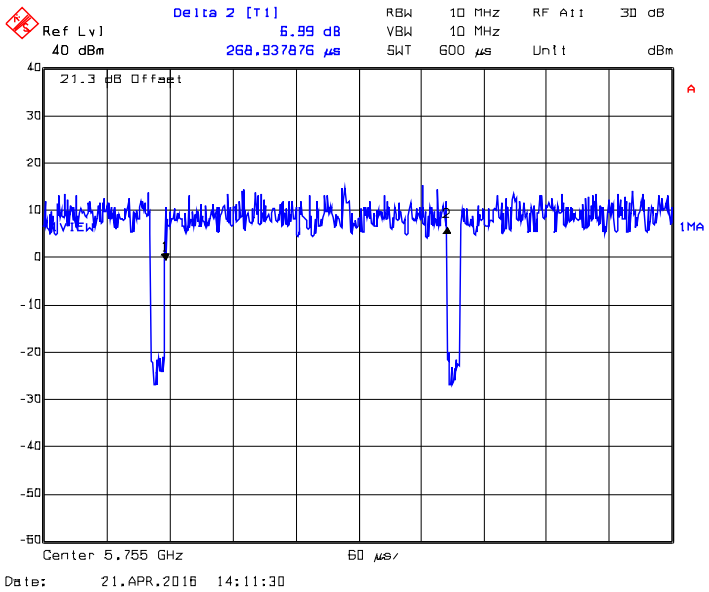


Plot 5.1.4.20. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 40.5 Mbps, Pulse Train

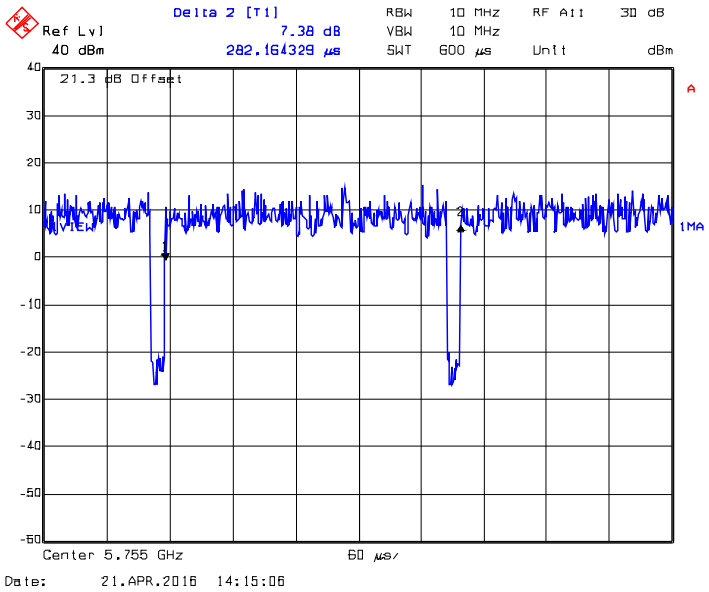


Duty Cycle Correction Factor = 10*log [1 / (501.0020 / 515.0301)] = 0.1199 dB

Plot 5.1.4.21. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 81 Mbps, Pulse Width

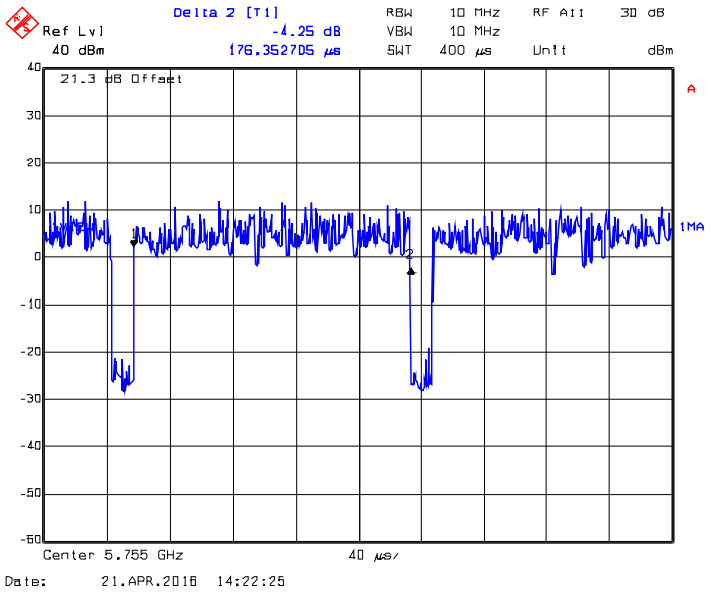


Plot 5.1.4.22. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 81 Mbps, Pulse Train

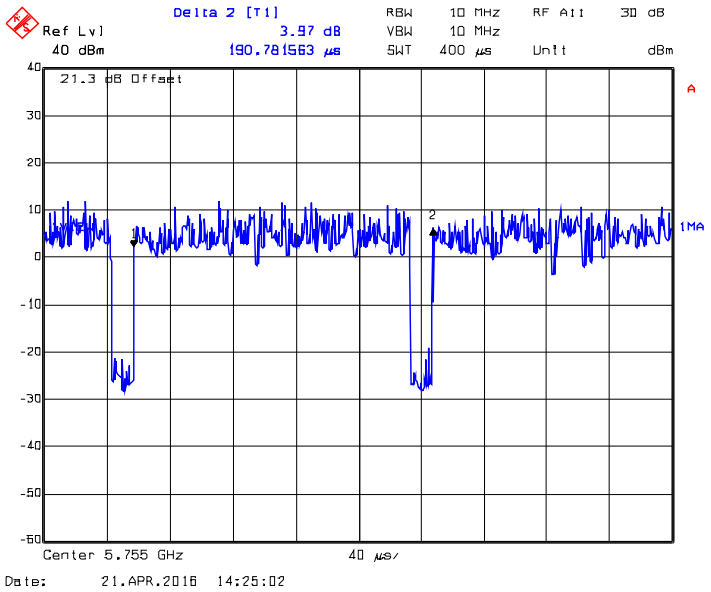


Duty Cycle Correction Factor = 10*log [1 / (268.9379 / 282.1643)] = 0.2085 dB

Plot 5.1.4.23. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 135 Mbps, Pulse Width



Plot 5.1.4.24. Duty Cycle, 802.11an HT40, 5755 GHz, Data Rate 135 Mbps, Pulse Train



Duty Cycle Correction Factor = 10*log [1 / (176.3527 / 190.7816)] = 0.3415 dB

5.2. MAXIMUM CONDUCTED OUTPUT POWER [§ 15.407(a)]

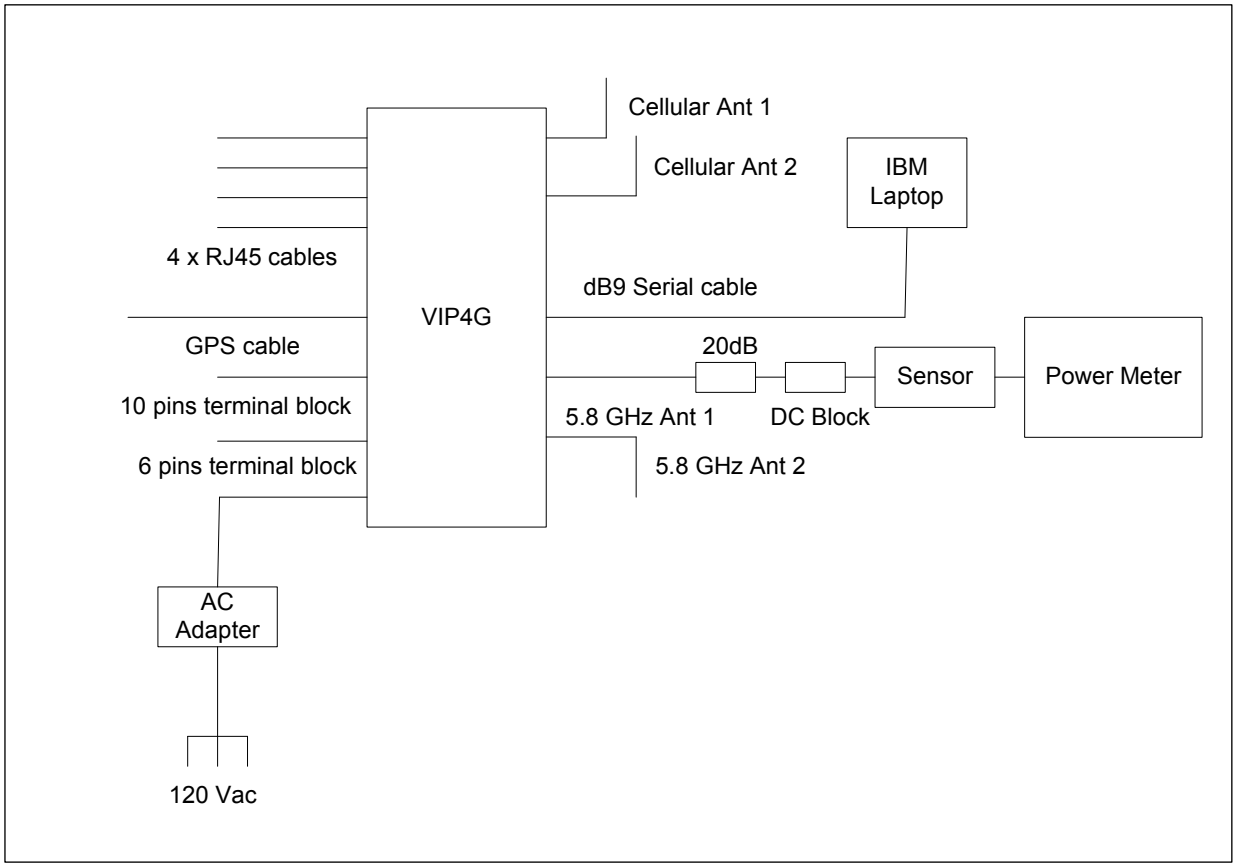
5.2.1. Limit(s)

§ 15.407(a)(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point UNII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the UNII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

5.2.2. Method of Measurements

FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r02, Section II.E.3.a
FCC KDB 662911 D01 Multiple Transmitter Output v02r01, Section E.1

5.2.3. Test Arrangement



5.2.4. Test Data

802.11a , Single Antenna Mode (no MIMO), ANT 1								
Modulation Type	Data Rate (Mbps)	Channel	Frequency (MHz)	[1]PCDAC Power	Average Power ANT 1 (dBm)	Duty Cycle Correction Factor, DCCF (dB)	Average Power w/ DCCF ANT 1 (dBm)	[2]EIRP (dBm)
BPSK	9	149	5745	30	10.21	0.0493	10.26	12.26
		157	5785	83	16.89	0.0493	16.94	18.94
		165	5825	40	12.92	0.0493	12.97	14.97
QPSK	18	149	5745	30	10.09	0.0652	10.16	12.16
		157	5785	83	16.75	0.0652	16.82	18.82
		165	5825	40	12.81	0.0652	12.88	14.88
16-QAM	36	149	5745	30	10.29	0.1268	10.42	12.42
		157	5785	83	16.84	0.1268	16.97	18.97
		165	5825	40	12.22	0.1268	12.35	14.35
64-QAM	54	149	5745	30	10.13	0.1620	10.29	12.29
		157	5785	83	16.68	0.1620	16.84	18.84
		165	5825	40	12.15	0.1620	12.31	14.31

[1]Test software power setting.
[2]EIRP = Average Power w/ DCCF (dBm) + Antenna Assembly Gain (2 dBi)

802.11a , Single Antenna Mode (no MIMO), ANT 2								
Modulation Type	Data Rate (Mbps)	Channel	Frequency (MHz)	[1]PCDAC Power	Average Power ANT 2 (dBm)	Duty Cycle Correction Factor, DCCF (dB)	Average Power w/ DCCF ANT 2 (dBm)	[2]EIRP (dBm)
BPSK	9	149	5745	30	10.34	0.0493	10.39	12.39
		157	5785	83	17.02	0.0493	17.07	19.07
		165	5825	40	12.61	0.0493	12.66	14.66
QPSK	18	149	5745	30	10.38	0.0652	10.45	12.45
		157	5785	83	17.30	0.0652	17.37	19.37
		165	5825	40	12.68	0.0652	12.75	14.75
16-QAM	36	149	5745	30	10.41	0.1268	10.54	12.54
		157	5785	83	17.87	0.1268	18.00	20.00
		165	5825	40	12.81	0.1268	12.94	14.94
64-QAM	54	149	5745	30	10.43	0.1620	10.59	12.59
		157	5785	83	16.81	0.1620	16.97	18.97
		165	5825	40	12.83	0.1620	12.99	14.99

[1]Test software power setting.
[2]EIRP = Average Power w/ DCCF (dBm) + Antenna Assembly Gain (2 dBi)

802.11an, HT20, MIMO											
MCS Index	Modulation Type	Data Rate (Mbps)	Ch	Frequency (MHz)	[1]PCDAC Power	Average Power (dBm)		Duty Cycle Correction Factor, DCCF (dB)	[2]Total Average Power w/ DCCF		[3]EIRP (dBm)
						ANT 1	ANT 2		(dBm)	(mW)	
0	BPSK1/2	6.5	149	5745	26	8.05	8.52	0.0269	11.33	13.58	13.33
		6.5	157	5785	40	12.10	12.28	0.0269	15.23	33.33	17.23
		6.5	165	5825	36	11.53	11.41	0.0269	14.51	28.23	16.51
2	QPSK3/4	19.5	149	5745	26	8.06	8.26	0.0520	11.22	13.25	13.22
		19.5	157	5785	40	11.91	12.08	0.0520	15.06	32.05	17.06
		19.5	165	5825	36	11.50	11.36	0.0520	14.49	28.14	16.49
4	16-QAM3/4	39	149	5745	26	8.00	8.23	0.0998	11.23	13.26	13.23
		39	157	5785	40	12.21	12.07	0.0998	15.25	33.50	17.25
		39	165	5825	36	11.49	11.33	0.0998	14.52	28.32	16.52
7	64-QAM5/6	65	149	5745	26	7.97	8.45	0.1836	11.41	13.84	13.41
		65	157	5785	40	11.84	12.38	0.1836	15.31	33.98	17.31
		65	165	5825	36	11.45	11.77	0.1836	14.81	30.25	16.81

[1]Test software power setting.
[2]Total Average Power = (Average Power of ANT 1 + Average Power of ANT 2) + Duty Cycle Correction Factor
[3]EIRP = Total Average Power (dBm) + Antenna Assembly Gain (2 dBi)

802.11an, HT40, MIMO											
MCS Index	Modulation Type	Data Rate (Mbps)	Ch	Frequency (MHz)	[1]PCDAC Power	Average Power (dBm)		Duty Cycle Correction Factor, DCCF (dB)	[2]Total Average Power w/ DCCF		[3]EIRP (dBm)
						ANT 1	ANT 2		(dBm)	(mW)	
0	BPSK1/2	13.5	151	5755	25	7.17	7.05	0.0537	10.17	10.41	12.17
		13.5	159	5795	36	11.67	11.59	0.0537	14.69	29.47	16.69
2	QPSK3/4	40.5	151	5755	25	6.78	7.01	0.1199	10.03	10.06	12.03
		40.5	159	5795	36	11.77	11.74	0.1199	14.89	30.80	16.89
4	16-QAM3/4	81	151	5755	25	6.82	6.75	0.2085	10.00	10.01	12.00
		81	159	5795	36	11.78	11.62	0.2085	14.92	31.04	16.92
7	64-QAM5/6	135	151	5755	25	6.75	7.06	0.3415	10.26	10.62	12.26
		135	159	5795	36	11.29	11.56	0.3415	14.78	30.05	16.78

[1]Test software power setting.
[2]Total Average Power = (Average Power of ANT 1 + Average Power of ANT 2) + Duty Cycle Correction Factor
[3]EIRP = Total Average Power (dBm) + Antenna Assembly Gain (2 dBi)

5.3. UNDESIRABLE EMISSIONS [§ 15.407(b)]

5.3.1. Limit(s)

§ 15.407(b) *Undesirable emission limits.* Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of −17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of −27 dBm/MHz.

(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

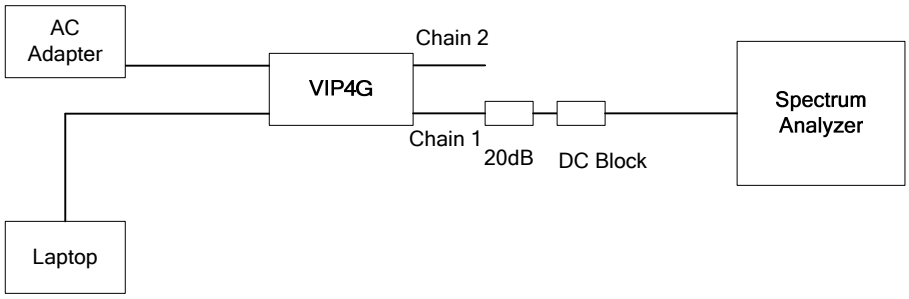
(7) The provisions of §15.205 apply to intentional radiators operating under this section.

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

5.3.2. Method of Measurements

FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r02, Section II.G.

5.3.3. Test Arrangement



5.3.4. Test Data

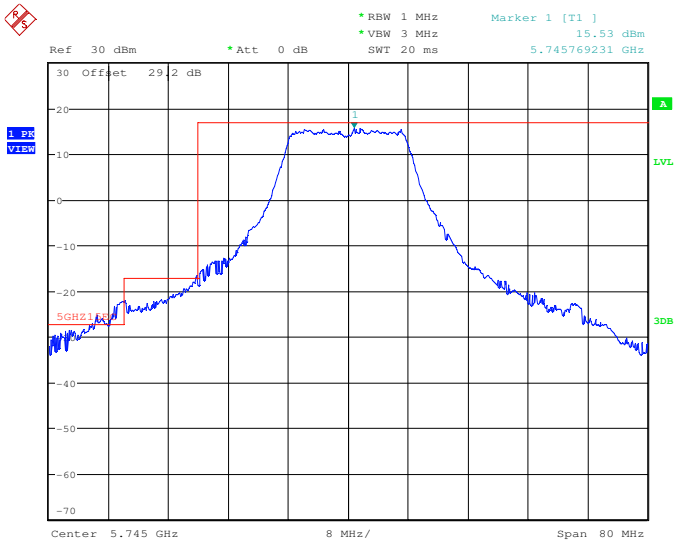
Remark(s): Exploratory tests performed to determined worst-case test configurations, the following test results represent the worst-case.

5.3.4.1. Band-Edge Conducted Emissions

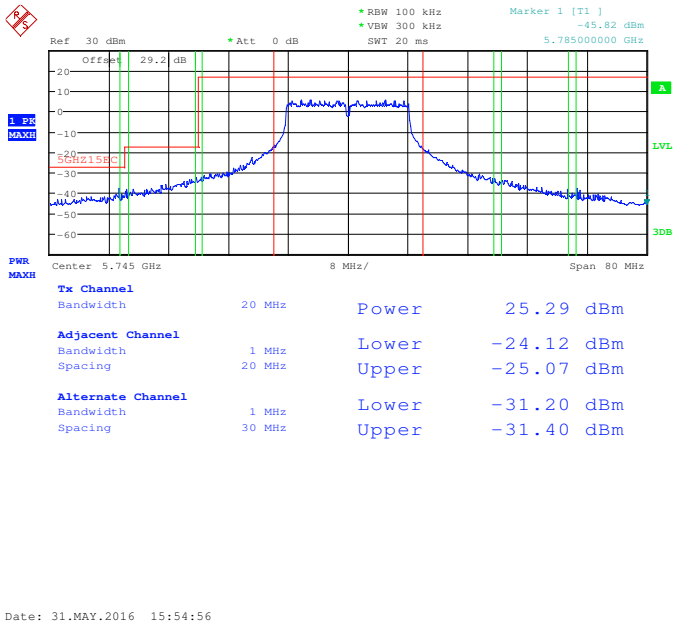
Test Configuration			
Operating Mode	**Data rate (Mbps)**	**Frequency (MHz)**	***PCDAC Setting**
802.11a	54	5745	45
		5765	83
		5805	83
		5825	83
802.11an HT20	65	5745	40
		5825	40
802.11an HT40	135	5755	40
		5795	40

* Test software power setting.

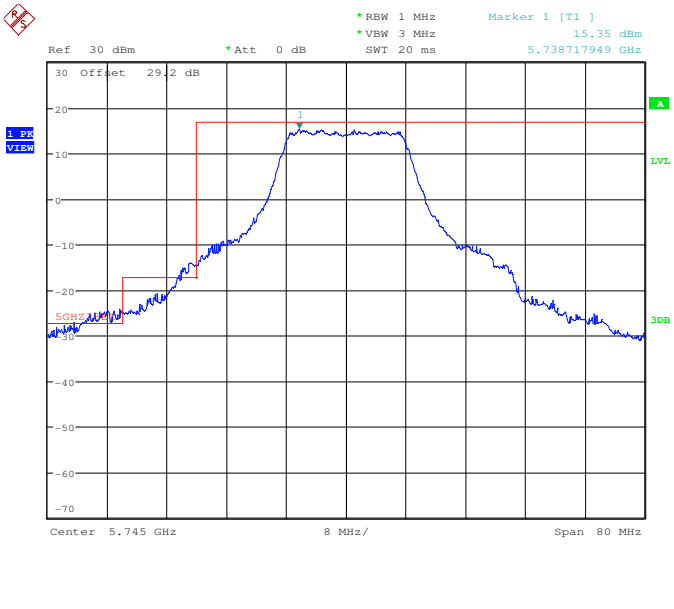
Plot 5.3.4.1.1. Band-Edge Conducted Emissions, 802.11a 54 Mbps, Ch 149, 5745 MHz, PCDAC Power 45, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



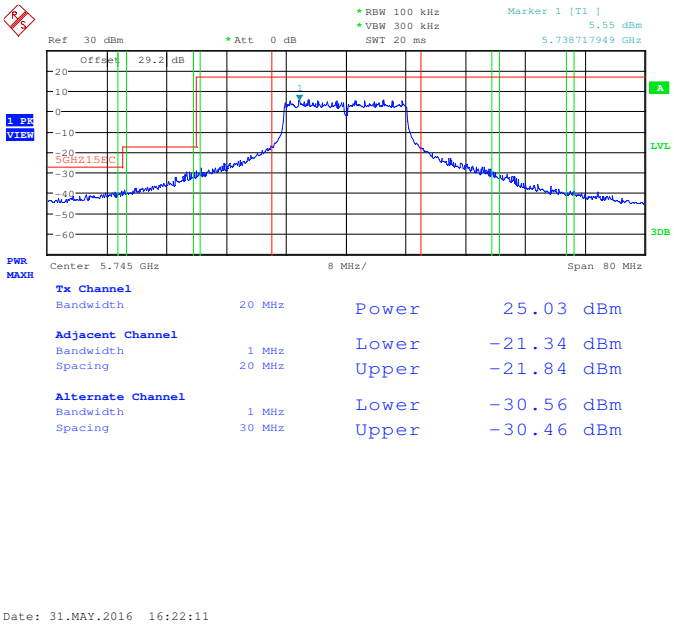
Plot 5.3.4.1.2. Band-Edge Conducted Emissions, 802.11a 54 Mbps, Ch 149, 5745 MHz, PCDAC Power 45, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain, Integration Method



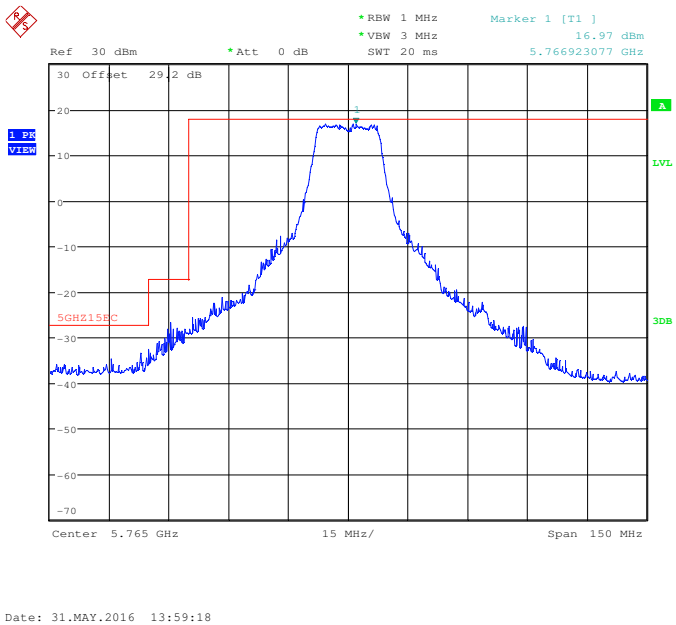
Plot 5.3.4.1.3. Band-Edge Conducted Emissions, 802.11a 54 Mbps, Ch 149, 5745 MHz, PCDAC Power 45, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



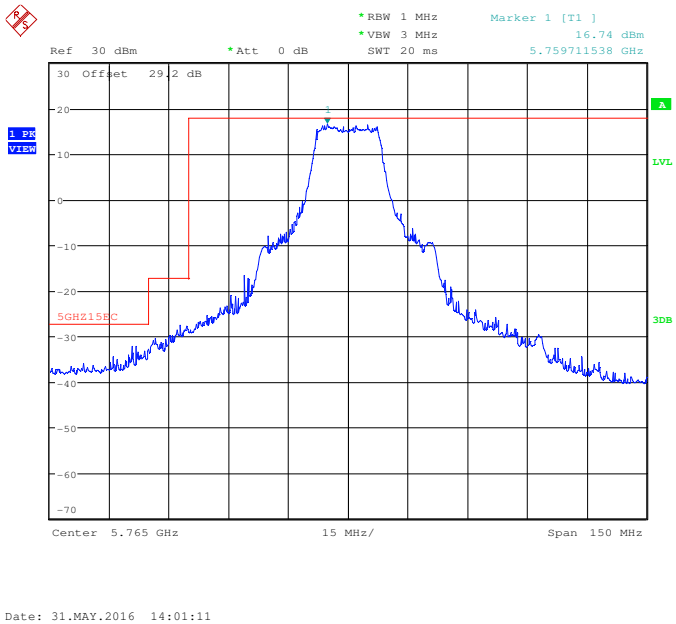
Plot 5.3.4.1.4. Band-Edge Conducted Emissions, 802.11a 54 Mbps, Ch 149, 5745 MHz, PCDAC Power 45, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain, Integration Method



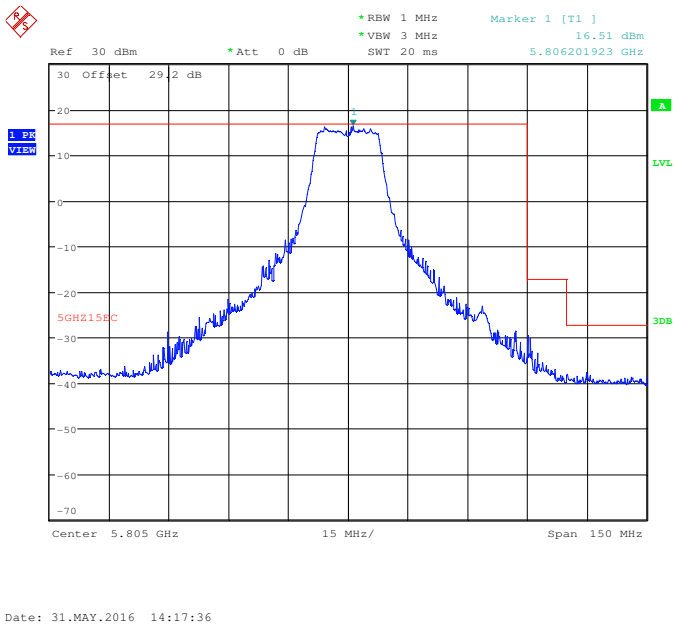
Plot 5.3.4.1.5. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 153, 5765 MHz, PCDAC Power 83, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



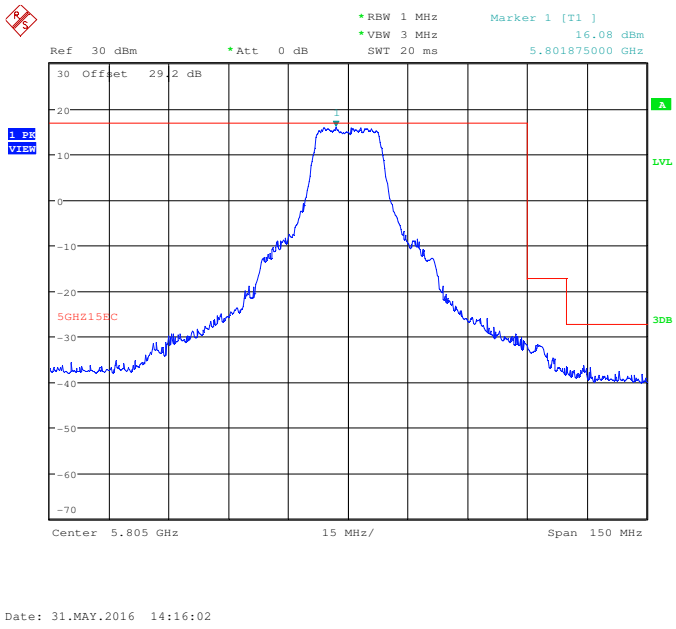
Plot 5.3.4.1.6. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 153, 5765 MHz, PCDAC Power 83, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



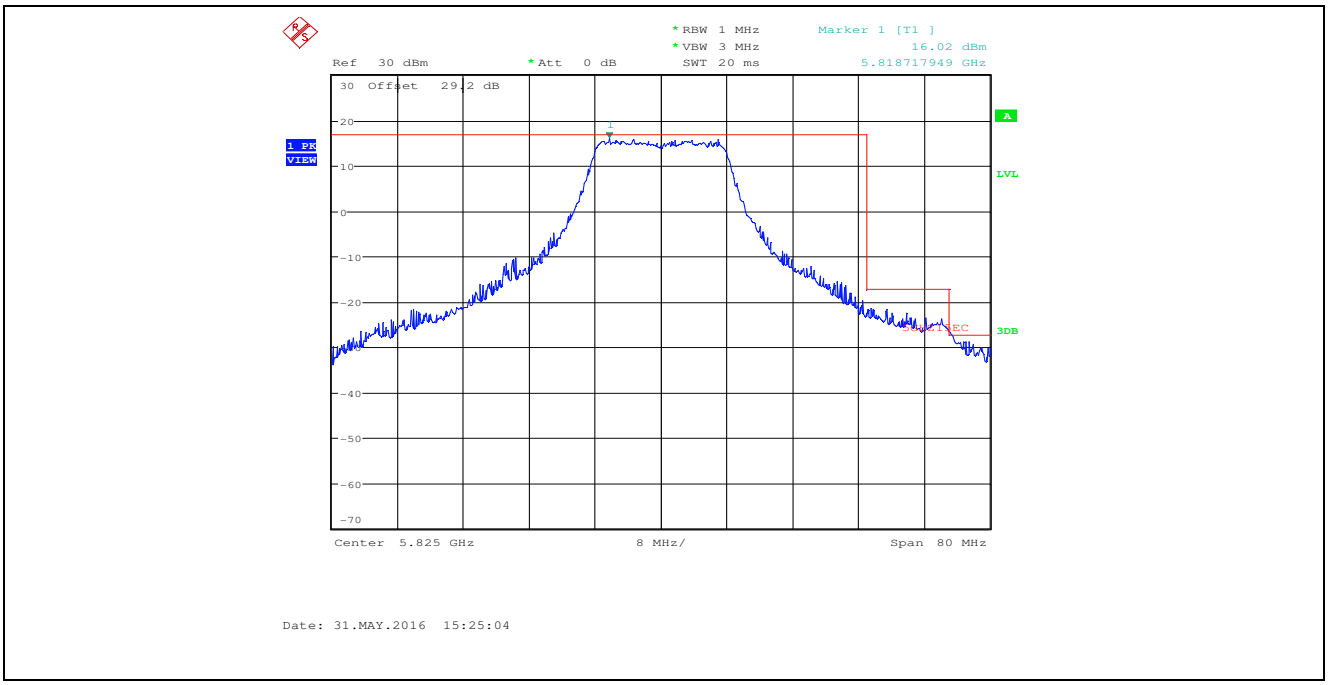
Plot 5.3.4.1.7. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 161, 5805 MHz, PCDAC Power 83, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



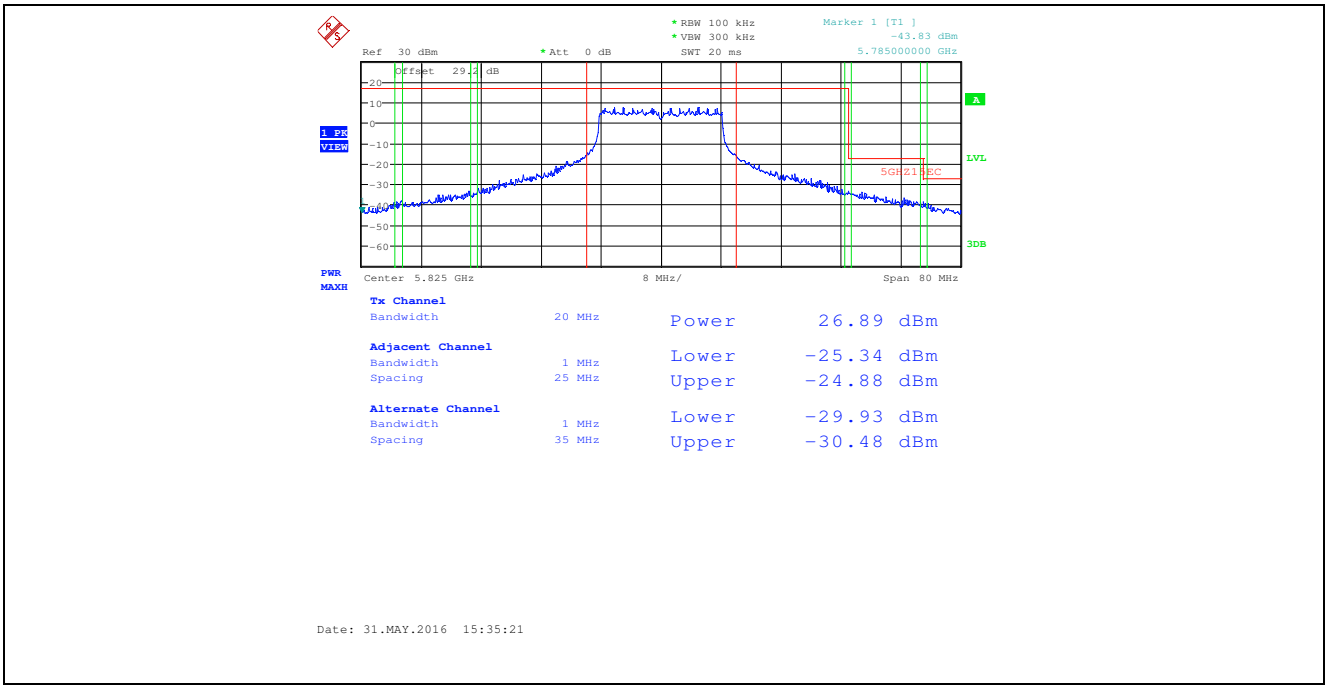
Plot 5.3.4.1.8. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 161, 5805 MHz, PCDAC Power 83, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



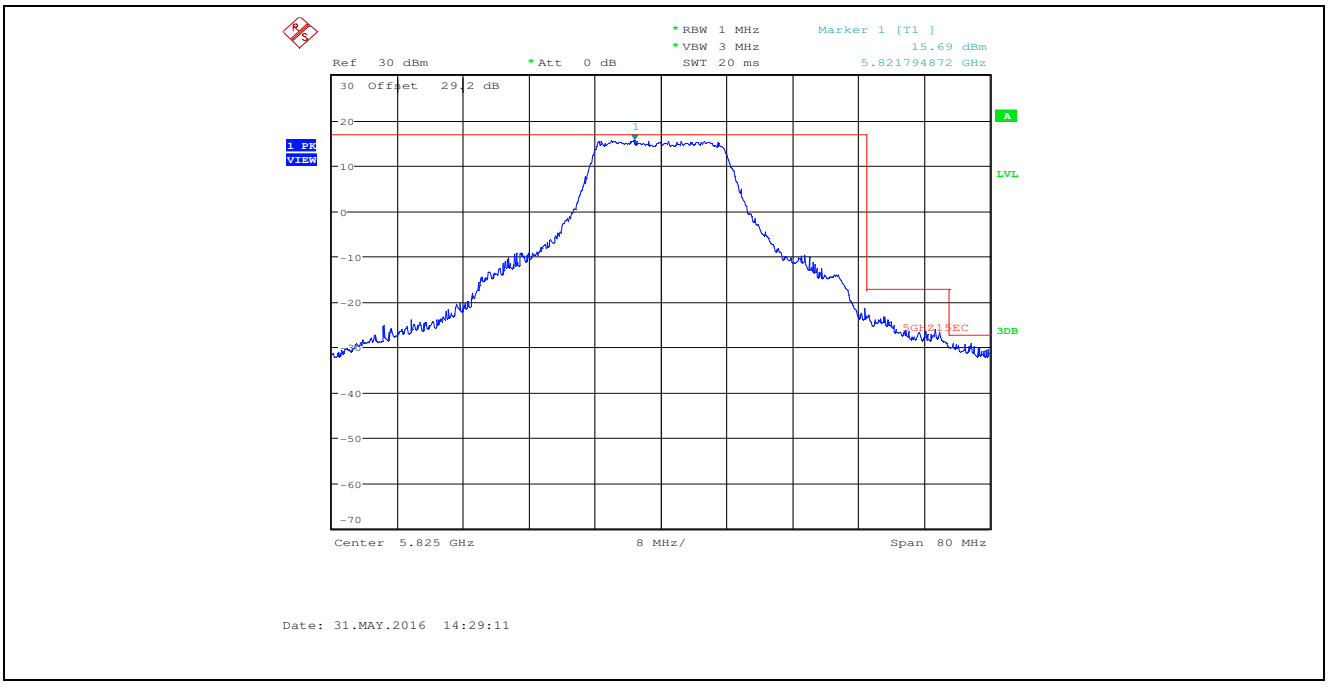
Plot 5.3.4.1.9. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 165, 5825 MHz, PCDAC Power 83, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



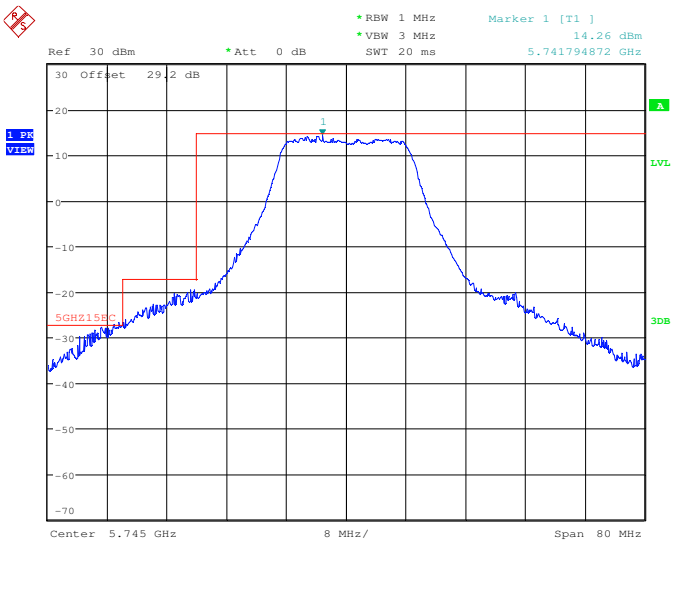
Plot 5.3.4.1.10. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 165, 5825 MHz, PCDAC Power 83, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain, Integration Method



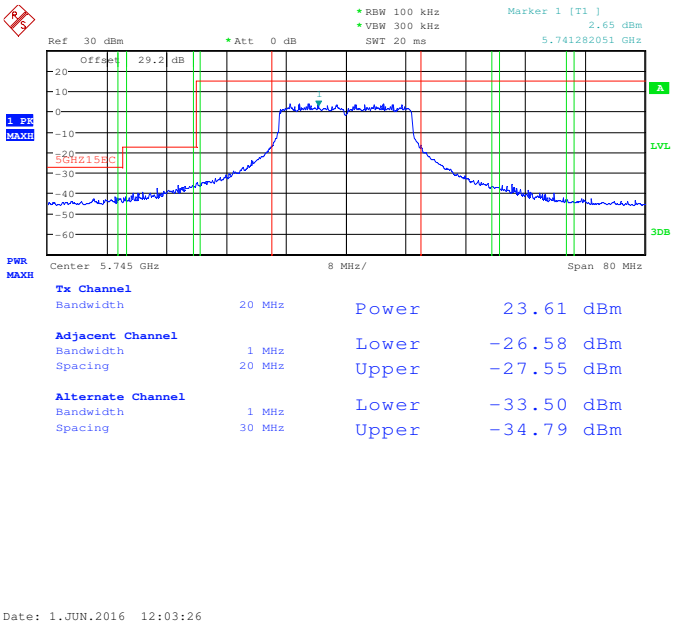
Plot 5.3.4.1.11. Band-Edge Conducted Emissions, 802.11a, 54 Mbps, Ch 165, 5825 MHz, PCDAC Power 83, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



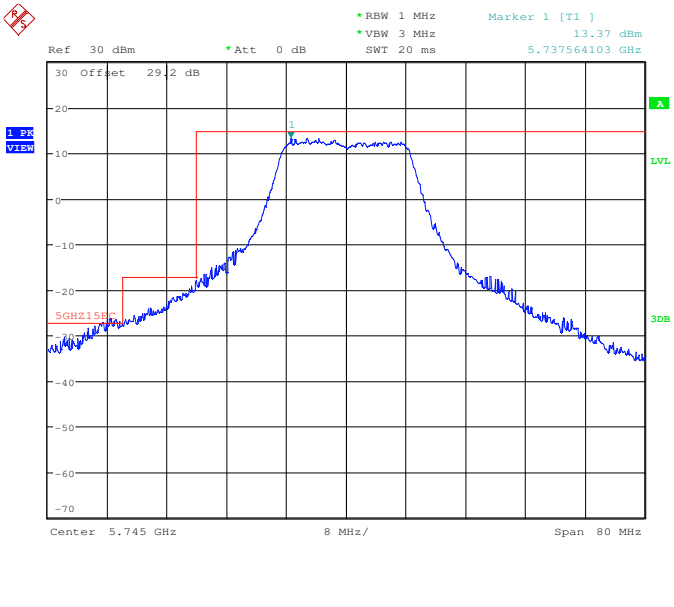
Plot 5.3.4.1.12. Band-Edge Conducted Emissions, 802.11an HT20, 65 Mbps, Ch 149, 5745 MHz, PCDAC Power 40, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



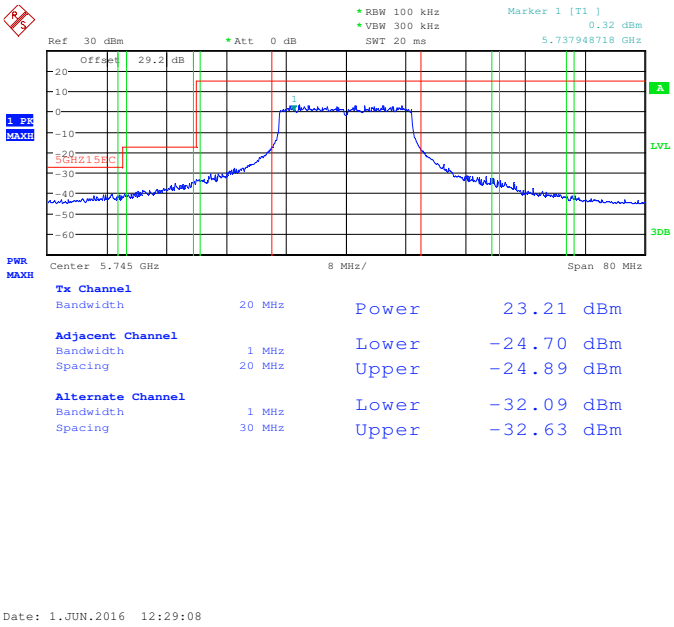
Plot 5.3.4.1.13. Band-Edge Conducted Emissions, 802.11an HT20, 65 Mbps, Ch 149, 5745 MHz, PCDAC Power 40, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain, Integration Method



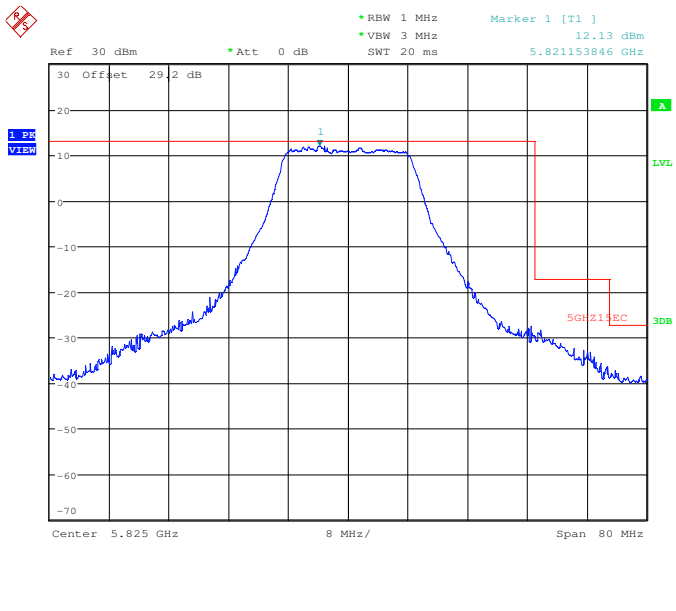
Plot 5.3.4.1.14. Band-Edge Conducted Emissions, 802.11an HT20, 65 Mbps, Ch 149, 5745 MHz, PCDAC Power 40, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



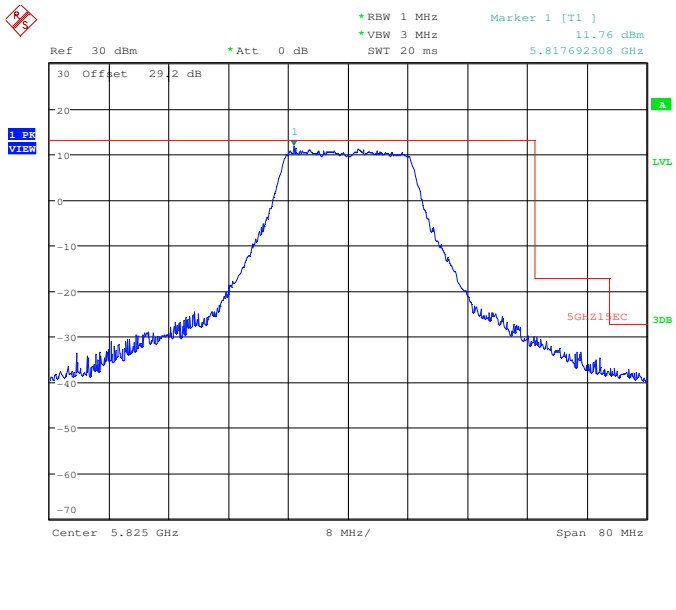
Plot 5.3.4.1.15. Band-Edge Conducted Emissions, 802.11an HT20, 65 Mbps, Ch 149, 5745 MHz, PCDAC Power 40, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain, Integration Method



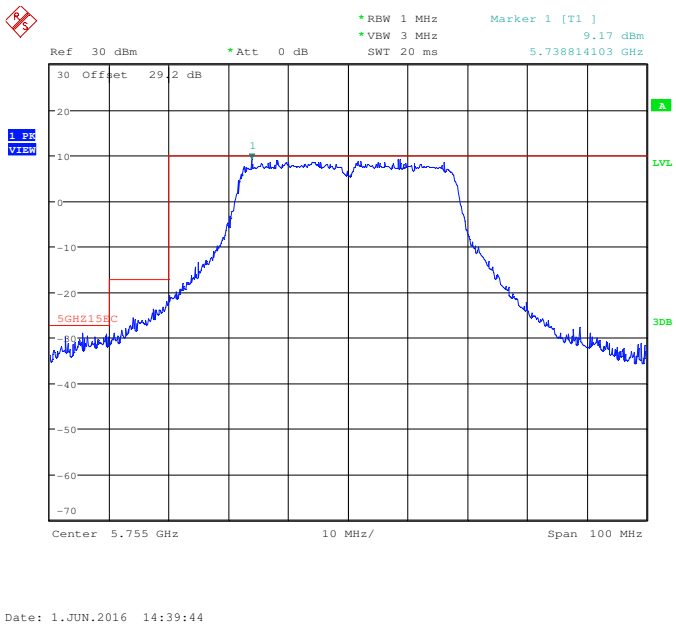
Plot 5.3.4.1.16. Band-Edge Conducted Emissions, 802.11an HT20, 65 Mbps, Ch 165, 5825 MHz, PCDAC Power 40, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



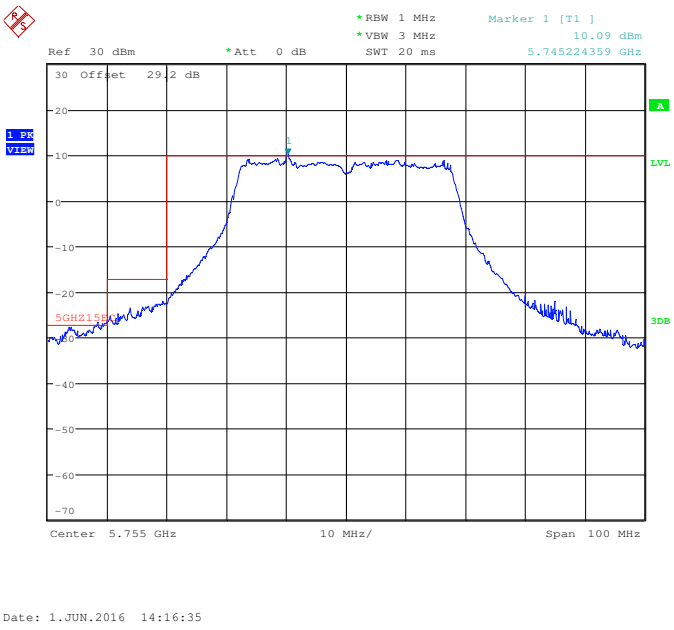
Plot 5.3.4.1.17. Band-Edge Conducted Emissions, 802.11an HT20, 65 Mbps, Ch 165, 5825 MHz, PCDAC Power 40, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



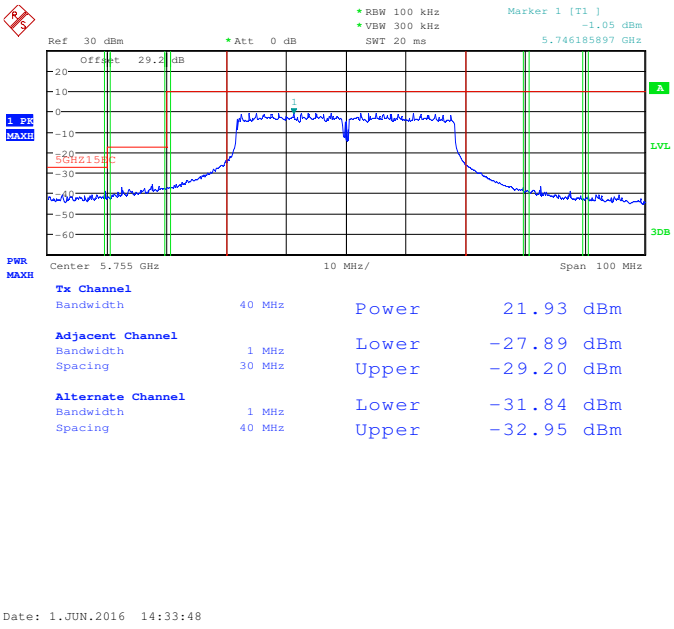
Plot 5.3.4.1.18. Band-Edge Conducted Emissions, 802.11an HT40, 135 Mbps, Ch 151, 5755 MHz, PCDAC Power 40, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



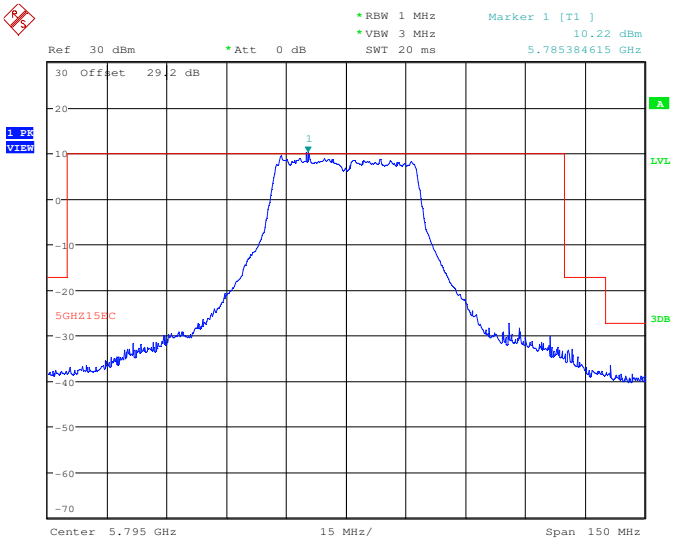
Plot 5.3.4.1.19. Band-Edge Conducted Emissions, 802.11an HT40, 135 Mbps, Ch 151, 5755 MHz, PCDAC Power 40, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



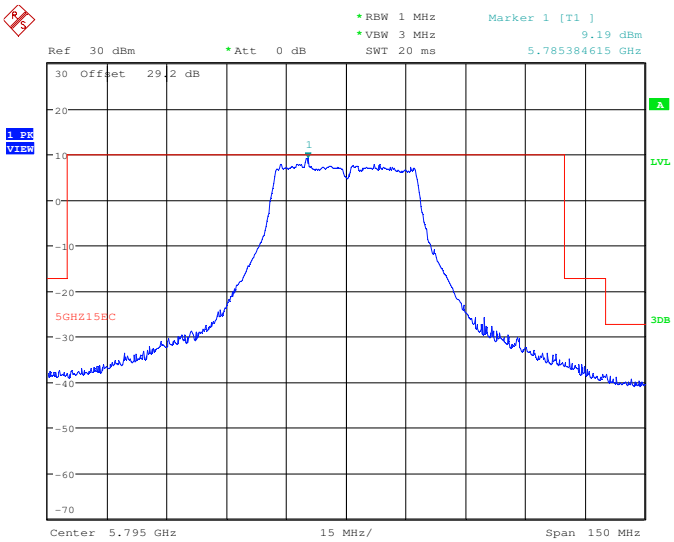
Plot 5.3.4.1.20. Band-Edge Conducted Emissions, 802.11an HT40, 135 Mbps, Ch 151, 5755 MHz, PCDAC Power 40, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain, Integration Method



Plot 5.3.4.1.21. Band-Edge Conducted Emissions, 802.11an HT40, 135 Mbps, Ch 159, 5795 MHz, PCDAC Power 40, ANT 1
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



Plot 5.3.4.1.22. Band-Edge Conducted Emissions, 802.11an HT40, 135 Mbps, Ch 159, 5795 MHz, PCDAC Power 40, ANT 2
Offset = 29.16dB = 27.16dB Insertion Loss + 2dBi EUT antenna gain



5.4. FREQUENCY STABILITY [§ 15.407(g)]

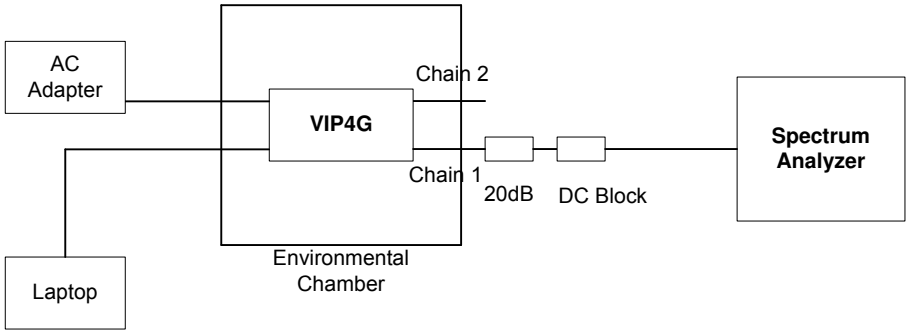
5.4.1. Limit(s)

§ 15.407(g) Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

5.4.2. Method of Measurements

ANSI C63.10-2013, Section 6.8.

5.4.3. Test Arrangement



5.4.4. Test Data

Remarks: Temperature range: -30 °C to +60 °C
Nominal supply voltage: 120 VAC (Input to AC Adaptor)

802.11a Mode						
Test Condition	**Data Rate**	**PCDAC Setting**	**Channel Number**	**Frequency (MHz)**	**Chain # 1**	**Chain # 2**
Frequency stability when varying supply voltage						
+20ºC & 102 VAC	54	45	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		83	165	5825	See Note	See Note
+20ºC & 138 VAC	54	45	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		83	165	5825	See Note	See Note
Frequency stability with respect to ambient temperature						
-30ºC & 120 VAC	54	30	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		40	165	5825	See Note	See Note
-20ºC & 120 VAC	54	32	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		42	165	5825	See Note	See Note
-10ºC & 120 VAC	54	36	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		45	165	5825	See Note	See Note
0ºC & 120 VAC	54	36	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		48	165	5825	See Note	See Note
+10ºC & 120 VAC	54	36	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		70	165	5825	See Note	See Note
NOTE: Emission bandwidth is within the band of operation.						

802.11a Mode						
+20ºC & 120 VAC	54	45	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		83	165	5825	See Note	See Note
+30ºC & 120 VAC	54	30	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		40	165	5825	See Note	See Note
+40ºC & 120 VAC	54	30	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		40	165	5825	See Note	See Note
+50ºC & 120 VAC	54	30	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		40	165	5825	See Note	See Note
+60ºC & 120 VAC	54	30	149	5745	See Note	See Note
		83	153	5765	See Note	See Note
		83	161	5805	See Note	See Note
		40	165	5825	See Note	See Note
NOTE: Emission bandwidth is within the band of operation.						

802.11an HT20 Mode						
Test Condition	**Data Rate**	**PCDAC Setting**	**Channel Number**	**Frequency (MHz)**	**Chain # 1**	**Chain # 2**
Frequency stability when varying supply voltage						
+20ºC & 102 VAC	65	40	149	5745	See Note	See Note
		40	165	5825	See Note	See Note
+20ºC & 138 VAC	65	40	149	5745	See Note	See Note
		40	165	5825	See Note	See Note
NOTE: Emission bandwidth is within the band of operation.						

802.11an HT20 Mode						
Test Condition	**Data Rate**	**PCDAC Setting**	**Channel Number**	**Frequency (MHz)**	**Chain # 1**	**Chain # 2**
Frequency stability with respect to ambient temperature						
-30ºC & 120 VAC	65	26	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	161	5805	See Note	See Note
		36	165	5825	See Note	See Note
-20ºC & 120 VAC	65	30	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	165	5825	See Note	See Note
-10ºC & 120 VAC	65	33	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	165	5825	See Note	See Note
		40	153	5765	See Note	See Note
		40	165	5825	See Note	See Note
0ºC & 120 VAC	65	35	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	165	5825	See Note	See Note
+10ºC & 120 VAC	65	40	149	5745	See Note	See Note
		40	165	5825	See Note	See Note
+20ºC & 120 VAC	65	40	149	5745	See Note	See Note
		40	165	5825	See Note	See Note
+30ºC & 120 VAC	65	26	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	161	5805	See Note	See Note
		36	165	5825	See Note	See Note
+40ºC & 120 VAC	65	26	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	161	5805	See Note	See Note
		36	165	5825	See Note	See Note
+50ºC & 120 VAC	65	26	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	161	5805	See Note	See Note
		36	165	5825	See Note	See Note
+60ºC & 120 VAC	65	26	149	5745	See Note	See Note
		40	153	5765	See Note	See Note
		40	161	5805	See Note	See Note
		36	165	5825	See Note	See Note
NOTE: Emission bandwidth is within the band of operation.						

802.11an HT40 Mode						
Test Condition	**Data Rate**	**PCDAC Setting**	**Channel Number**	**Frequency (MHz)**	**Chain # 1**	**Chain # 2**
Frequency stability when varying supply voltage						
+20ºC & 102 VAC	135	40	151	5755	See Note	See Note
		40	159	5795	See Note	See Note
+20ºC & 138 VAC	135	40	151	5755	See Note	See Note
		40	159	5795	See Note	See Note
Frequency stability with respect to ambient temperature						
-30ºC & 120 VAC	135	25	151	5755	See Note	See Note
		36	159	5795	See Note	See Note
-20ºC & 120 VAC	135	28	151	5755	See Note	See Note
		36	159	5795	See Note	See Note
-10ºC & 120 VAC	135	30	151	5755	See Note	See Note
		40	159	5795	See Note	See Note
0ºC & 120 VAC	135	33	151	5755	See Note	See Note
		40	159	5795	See Note	See Note
+10ºC & 120 VAC	135	36	151	5755	See Note	See Note
		40	159	5795	See Note	See Note
+20ºC & 120 VAC	135	40	151	5755	See Note	See Note
		40	159	5795	See Note	See Note
+30ºC & 120 VAC	135	25	151	5755	See Note	See Note
		36	159	5795	See Note	See Note
+40ºC & 120 VAC	135	25	151	5755	See Note	See Note
		36	159	5795	See Note	See Note
+50ºC & 120 VAC	135	25	151	5755	See Note	See Note
		36	159	5795	See Note	See Note
+60ºC & 120 VAC	135	25	151	5755	See Note	See Note
		36	159	5795	See Note	See Note

5.5. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

5.5.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
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
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.5.2. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.5.3. RF Evaluation

5.5.3.1. Co-location

Pursuant to KDB 447498 D01 General RF Exposure Guidance v06, Section 7.2:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

Co-location MPE Evaluation of WIFI with 2 dBi Antenna and Data Card Module with 5 dBi Antenna						
***Radio Module**	**Frequency (MHz)**	**EIRP (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**FCC MPE Limit (mW/cm^2)**	**MPE Ratio**
WIFI Radio	5745	110	20	0,022	1.0	0.02
Data Card Module (FCC ID: RI7LN930, IC: 5131A-LN930)	824.2	2511.89	20	0.50	0.55	0.91
					Sum of MPE Ratio:	0.93
Verdict: Compliant, the sum of MPE ratio is 0.93 < 1.0.						

* The test data of the radio modules represented in this table is the worst-case configuration (maximum MPE ratio) derived from the original radio modules MPE reports. Refer to these reports for details.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	Nov 21, 2016
Attenuator	Pasternack	7024-20	6	DC–26.5 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
Peak Power Analyzer	Hewlett Packard	8991A	3342A00657	0.5 - 40 GHz	Jul 15, 2016
Peak Power Sensor	Hewlett Packard	84814A	3205A00175	0.5 - 40 GHz	Jul 15, 2016
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	Jul14, 2016
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 °C	Jun 2, 2017

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.79**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**