

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART E REQUIREMENT

OF

Product Name: H-32

Brand Name: Opticon

Model No.: H-32

Model Difference: N/A

FCC ID: Q2Q-H32

Report No.: EF/2013/A0005

Issue Date: Jan. 24, 2014

FCC Rule Part: §15.407

Prepared for: Opticon Sensors Europe B.V.
Opaallaan 35, 2132 XV Hoofddorp,
The Netherlands

Prepared by: SGS Taiwan Ltd.
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24803



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VERIFICATION OF COMPLIANCE

Applicant: Opticon Sensors Europe B.V.
Opaallaan 35, 2132 XV Hoofddorp, The Netherlands

Product Name: H-32

Brand Name: Opticon

Model No.: H-32

Model Difference: N/A

FCC ID: Q2Q-H32

File Number: EF/2013/A0005

Date of test: Oct. 04, 2013 ~ Jan. 23, 2014

Date of EUT Received: Oct. 04, 2013

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2009 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.407.

The test results of this report relate only to the tested sample identified in this report.

Test By:

Marcus Tseng

Date:

Jan. 24, 2014

Marcus Tseng / Engineer

Prepared By:

Tiffany Kao

Date:

Jan. 24, 2014

Tiffany Kao / Clerk

Approved By:

Jim Chang

Date:

Jan. 24, 2014

Jim Chang / Supervisor

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Version

Version No.	Date	Description
00	Jan. 24, 2014	Initial creation of document

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1. GENERAL INFORMATION

1.1. Product Description

General:

Product Name:	H-32	
Brand Name:	Opticon	
Model No.:	H-32	
Model Difference:	N/A	
Hardware Version:	OP1208_B	
Software Version:	H32 BOOT DISK 20130912	
Power Supply:	3.7Vdc from Li-ion Battery	
	Battery:	Part No.: CC-NP120FJ, Supplier: CELLONIC

WLAN 5GHz:

Wi-Fi	Frequency Range	Channels	Rated Power (Avg.)	Modulation Technology
11a	5150~5250	4	13.62dBm (Avg.)	OFDM
11n	HT20 5150~5250	4	Avg. Power: HT 20: 12.74dBm	OFDM
Antenna Designation		Ceramic Chip Antenna 5GHz Gain: 4.2dBi (5150MHz-5250MHz)		
Modulation type		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM		
Transition Rate:		802.11 a: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 72.2Mbps		

This report applies for frequency bands 5150MHz-5250MHz

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IEEE 802.11n Spec:

MCS Index	Nss	Modulation	R	NBPSC	NCBPS		NDBPS		Data rate(Mbps)			
									800nsGI		400nsGI	
					20MHz	40MHz	20MHz	40MHz	20MHz	40MHz	20MHz	40MHz
0	1	BPSK	1/2	1	52	108	26	54	6.5	13.5	7.200	15
1	1	QPSK	1/2	2	104	216	52	108	13.0	27.0	14.400	30
2	1	QPSK	3/4	2	104	216	78	162	19.5	40.5	21.700	45
3	1	16-QAM	1/2	4	208	432	104	216	26.0	54.0	28.900	60
4	1	16-QAM	3/4	4	208	432	156	324	39.0	81.0	43.300	90
5	1	64-QAM	2/3	6	312	648	208	432	52.0	108.0	57.800	120
6	1	64-QAM	3/4	6	312	648	234	486	58.5	121.5	65.000	135
7	1	64-QAM	5/6	6	312	648	260	540	65.0	135.0	72.200	150

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPSC	Number of coded bite per single carrier
NCBPS	Number of coded bite per symbol
NDBPS	Number of data bite per symbol
GI	Guard interval

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1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: Q2Q-H32** filing to comply with Section 15.407 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with Subpart B is authorized under a DoC procedure.

1.3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4:2009 & KDB 789033 D01 published on 04, 08, 2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with FCC KDB789033 D01 for compliance to FCC 47CFR 15.407 requirements.

1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, Wuku Industrial Zone, Taipei County, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4:2009. FCC Registration Number is: 990257. Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 94644.

1.5. Special Accessories

There are no special accessories used while test was conducted.

1.6. Equipment Modifications

There was no modification incorporated into the EUT.

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2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 & 6.2.2, is followed to carry out the test. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna according to the requirements in Section 8 and 13 and of ANSI C63.4:2009,.

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2.4. Configuration of Tested System

Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration

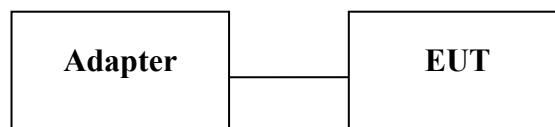


Fig. 2-2 AC Power Line Conducted Emission

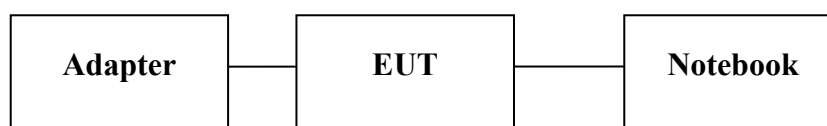


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Test Software	SAU	v3.03.10.00	N/A	N/A	N/A
2.	Notebook	Lenovo	L412	LR-957X7	shielding	Un-shielding

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3. SUMMARY OF TEST RESULT

FCC Rules	Description Of Test	Result
§15.207	AC Power Line Conducted Emission	Compliant
§15.407(a) (1) (2)	26 dB Emission Bandwidth	Compliant
§15.407(a) (1) (2)	The Maximum Output Power Measurement	Compliant
§15.407(a) (5)	Peak Power Spectral Density Measurement	Compliant
15.407(a)(6)	Peak Excursion Measurement	Compliant
§15.407(b) (1) (2) (3)	Undesirable Emission – Conducted Measurement	Compliant
§15.407(b) (1) (2) (3)(6) (7)	Undesirable Emission – Radiated Measurement	Compliant
§15.407(c)	Transmission in case of Absence of Information	Compliant
§15.407(g)	Frequency Stability	Compliant
§15.203	Antenna Requirement	Compliant

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4. DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting mode is programmed.

a mode:

5150MHz-5250MHz: Channel lowest(5180MHz)、Mid(5220MHz) and Highest(5240MHz).
with 6Mbps data rate are chosen for full testing.

n HT 20 mode:

5150MHz-5250MHz: Channel lowest(5180MHz)、Mid(5220MHz) and Highest(5240MHz).
with 6.5Mbps data rate are chosen for full testing

The worst case is determined by the output power that generates the highest emission. As examined in the section of output power measurement, the section 7.5, the lowest data rate at a/b/g/n_HT20 resulted the highest level of fundamental emission, and therefore, the lowest data rate is chosen as the worst-case to conduct the remaining of other mandatory test cases.

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11a/n WLAN Transmitter for channel Low, Mid and High, the worst case H position was reported.

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Duty Cycle Analysis:

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode (a/n_ht20) shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle. All duty cycle is pre-scanned, resulted as obtained below, and showed only the most representative ones

Tabular results as indicates below entails the results of duty factor for all supported modes.

Formula:

$$\text{Duty Cycle} = T_{on} / (T_{on} + T_{off})$$

Test Procedure:

Set span = 0, RBW = 8MHz, the largest as possible, VBW = 8MHz, Detector = Peak, and RBW, and VBW = the highest RBW the spectrum is capable of, where zero-span is permissible, that > 50/T, where T is ~ 4.3ms

Duty Cycle:

5150-5725MHz	Duty Cycle	Duty Factor (dBm)
802.11a	0.95	0.21
802.11n_20	0.95	0.22

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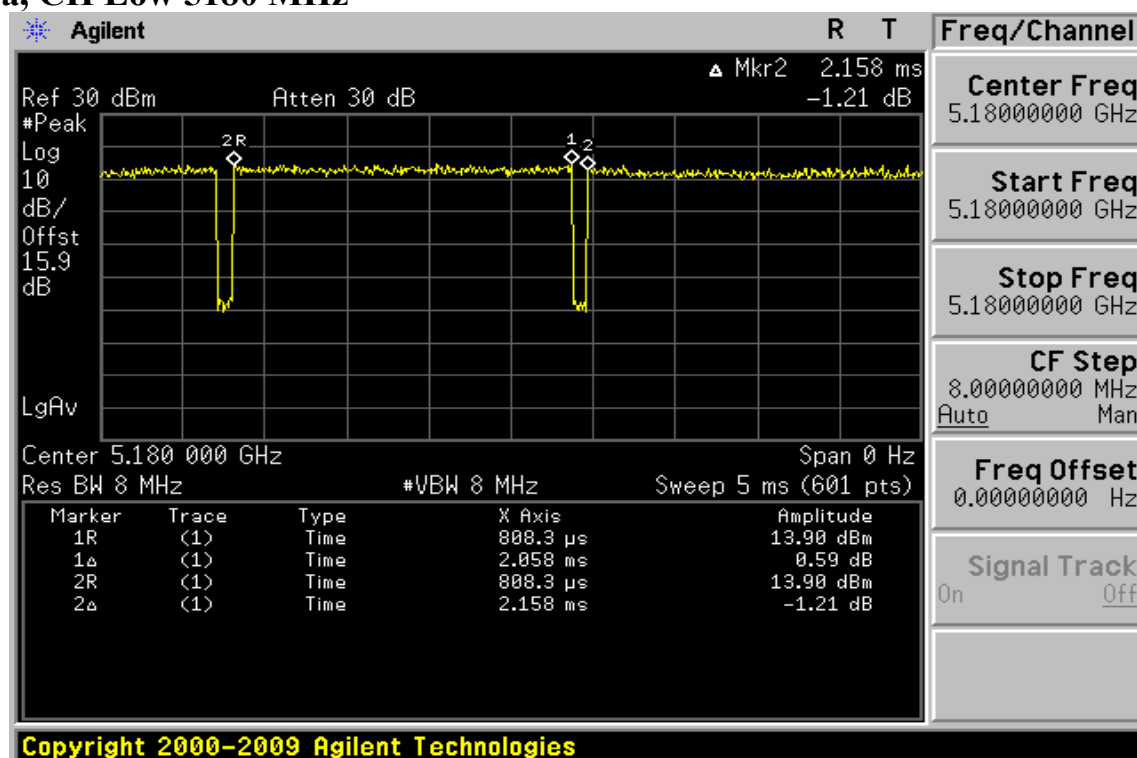
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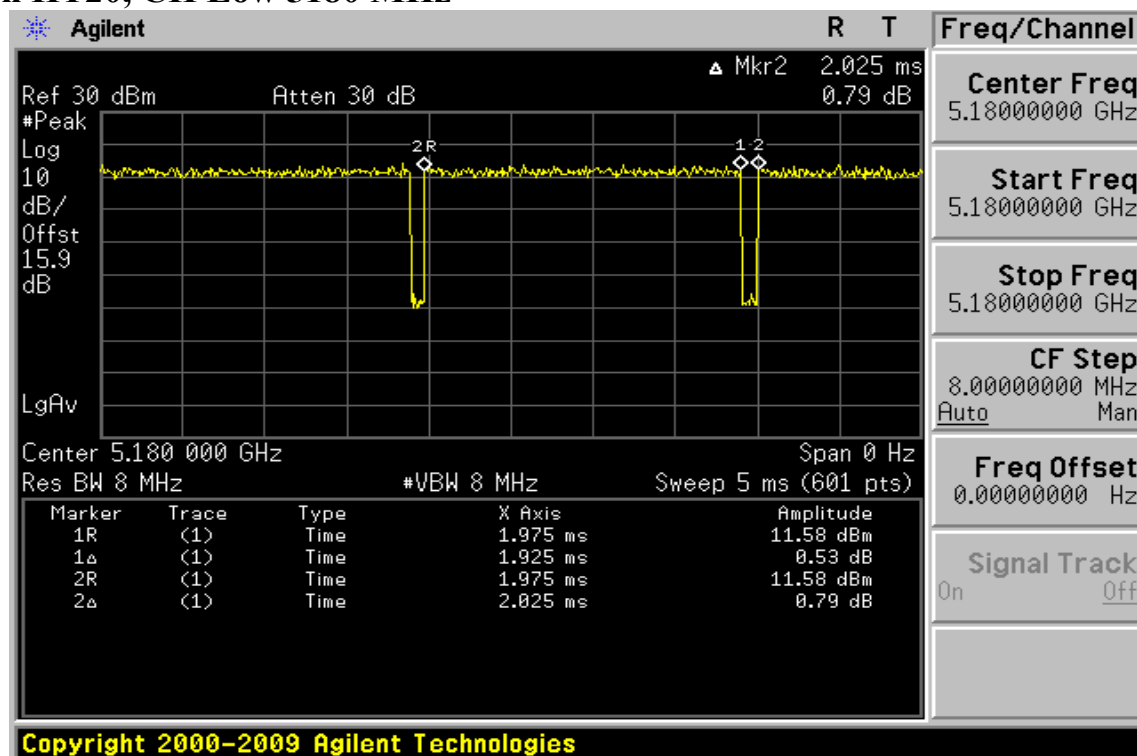
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DUTY CYCLE OF TEST SIGNAL

802.11a, CH Low 5180 MHz



802.11n HT20, CH Low 5180 MHz



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5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
26 dB Emission Bandwidth	+/- 123.36 Hz
The Maximum Output Power Measurement	+/- 1.42 dB
Peak Power Spectral Density Measurement	+/- 1.55 dB
Peak Excursion Measurement	+/- 1.55 dB
Undesirable Emission – Conducted Measurement	+/- 1.55 dB
Transmission in case of Absence of Information	+/- 1.55 dB
Frequency Stability	+/- 123.36 Hz
TPC and DFS Measurement	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC=+/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : Horizontal)	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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6. CONDUCTED EMISSION TEST

6.1. Standard Applicable

According to §15.207, frequency range within 150 KHz to 30 MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	05/27/2013	05/26/2014
LISN	Rolf-Heine	NNB-2/16Z	99012	03/23/2013	03/22/2014
LISN	FCC	FCC-LISN-50/250-25-2-01	04034	03/23/2013	03/22/2014
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2013	11/25/2014

6.3. EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The LISN was connected with 120Vac/60Hz power source.

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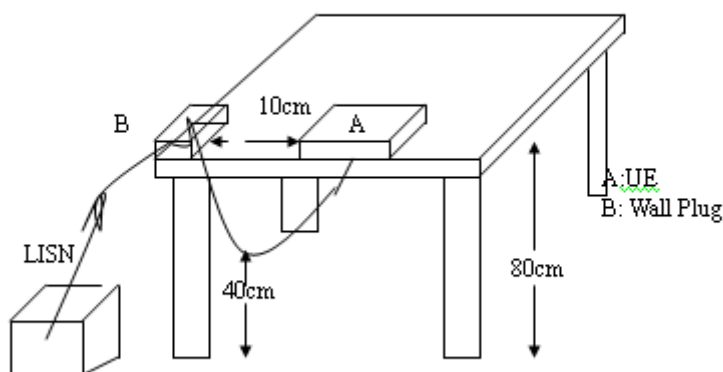
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6.4. Test SET-UP (Block Diagram of Configuration)



6.5. Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6. Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that that closet to the limit

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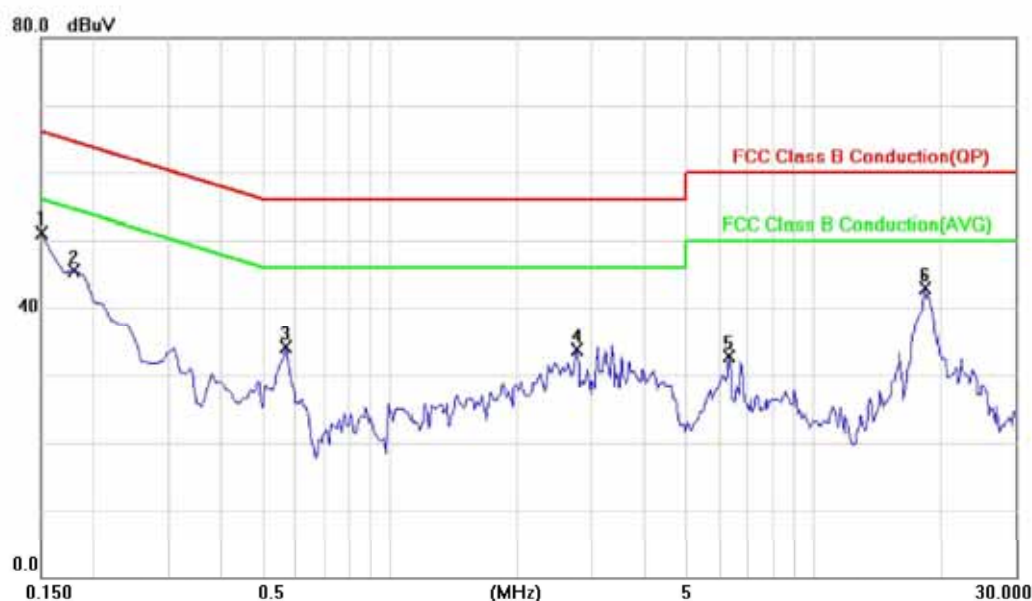
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode			Test Date:	Jan. 16, 2014
Temperature:	26 °C	Humidity:	60 %	Test By:	Vito
				Probe:	L1/N

Site: ConductionRoom Phase: **L1** Temperature: 26 °C
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 60%
Mode: Operationmode
Note:

ConductedEmission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1500	51.04	0.16	51.20	66.00	-14.80	peak	
2		0.1800	45.39	0.16	45.55	64.49	-18.94	peak	
3		0.5700	33.88	0.17	34.05	56.00	-21.95	peak	
4		2.7700	33.54	0.23	33.77	56.00	-22.23	peak	
5		6.3400	32.40	0.30	32.70	60.00	-27.30	peak	
6		18.3600	42.58	0.42	43.00	60.00	-17.00	peak	

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Site: ConductionRoom

Phase: **N**

Temperature: 25 °C

Limit: FCC Class B Conduction(QP)

Power: AC 120V/60Hz

Humidity: 60%

Mode: Operationmode

Note:

ConductedEmission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1500	51.58	0.18	51.76	66.00	-14.24	peak	
2		0.2000	43.19	0.19	43.38	63.61	-20.23	peak	
3		0.5500	33.39	0.21	33.60	56.00	-22.40	peak	
4		2.7200	34.87	0.27	35.14	56.00	-20.86	peak	
5		6.8600	29.43	0.36	29.79	60.00	-30.21	peak	
6		17.6400	34.82	0.53	35.35	60.00	-24.65	peak	

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7. 26dB EMISSION BANDWIDTH MEASUREMENT

7.1 Standard Applicable

According to §15.407(a). No Limit required.

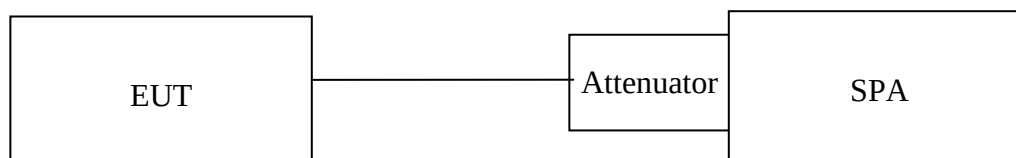
7.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the Antenna port to the spectrum analyzer.
- 3.a. 26dB Band width Measurement: Set the spectrum analyzer as 1% of emission BW Sweep=auto, Detector = Peak, Trace Mode = Max Hold, Manually readjust RBW until the RBW/EBW ratio is 1% based on EBW as observed on the result of pre-sequence measurement.
- b. A) Mark the peak frequency and -26dB (upper and lower) frequency.
4. Repeat the procedures as list above until all test default channels (low, middle, and high) are completed.

7.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	02/08/2012	02/07/2014
Power Sensor	Anritsu	MA2411B	917032	02/08/2012	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/30/2013	05/29/2014
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/15/2013	03/14/2014
DC Block	Mini-Circuits	BLK-18-S+	1	02/28/2013	02/27/2014
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/28/2013	02/27/2014
Splitter	Agilent	11636B	N/A	02/28/2013	02/27/2014

7.4 Test Set-up:



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7.5 Measurement Result

26dB Bandwidth

802.11a, 5150~5250 MHz

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5180	24.65	13.92
5220	23.99	13.80
5240	24.28	13.85

802.11n HT20, 5150~5250 MHz

Frequency (MHz)	26dB Bandwidth (B) (MHz)	10 Log (B) (dB)
5180	22.08	13.44
5220	21.67	13.36
5240	21.28	13.28

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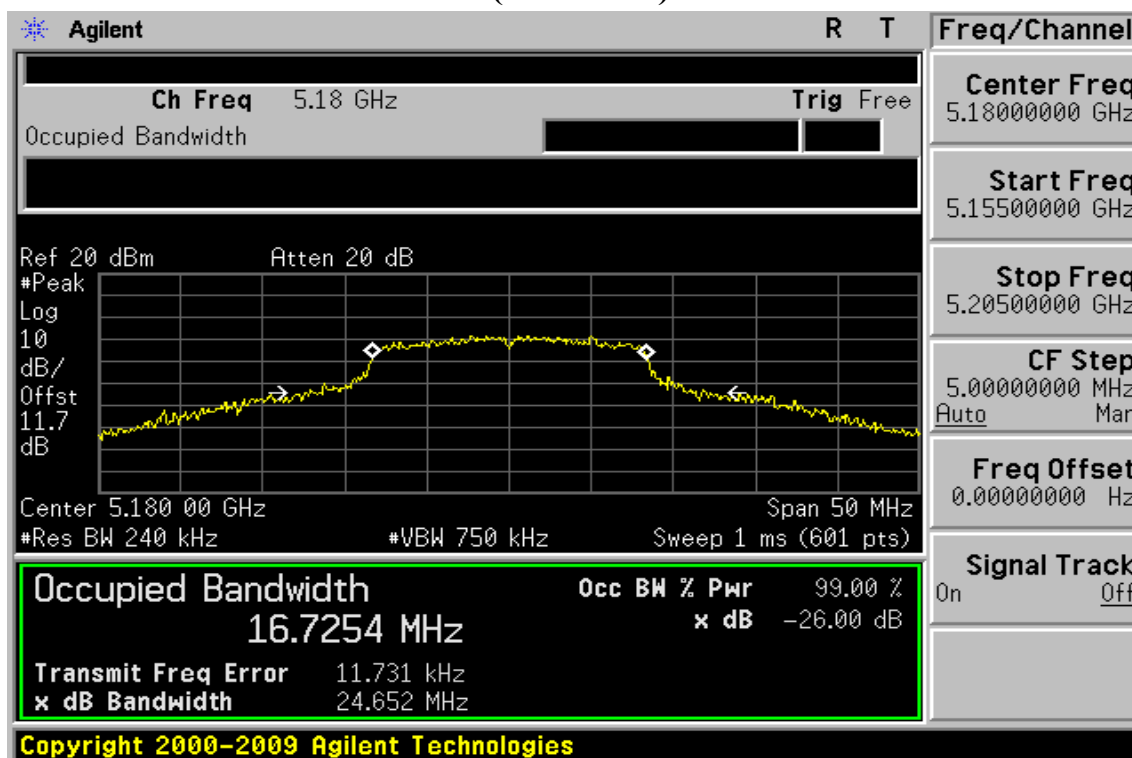
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802.11a, 5150~5250 MHz

26dB Band Width Test Data CH-Low (5180MHz)



26dB Band Width Test Data CH-Mid (5220MHz)



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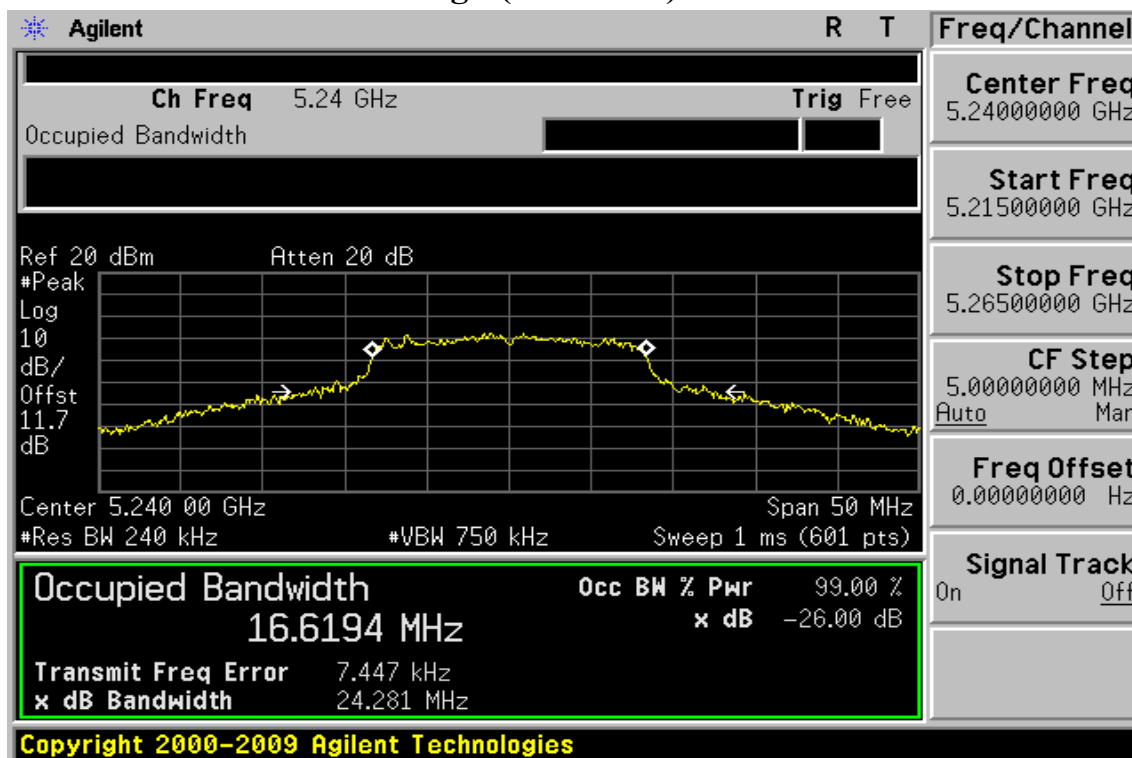
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26dB Band Width Test Data CH-High (5240MHz)



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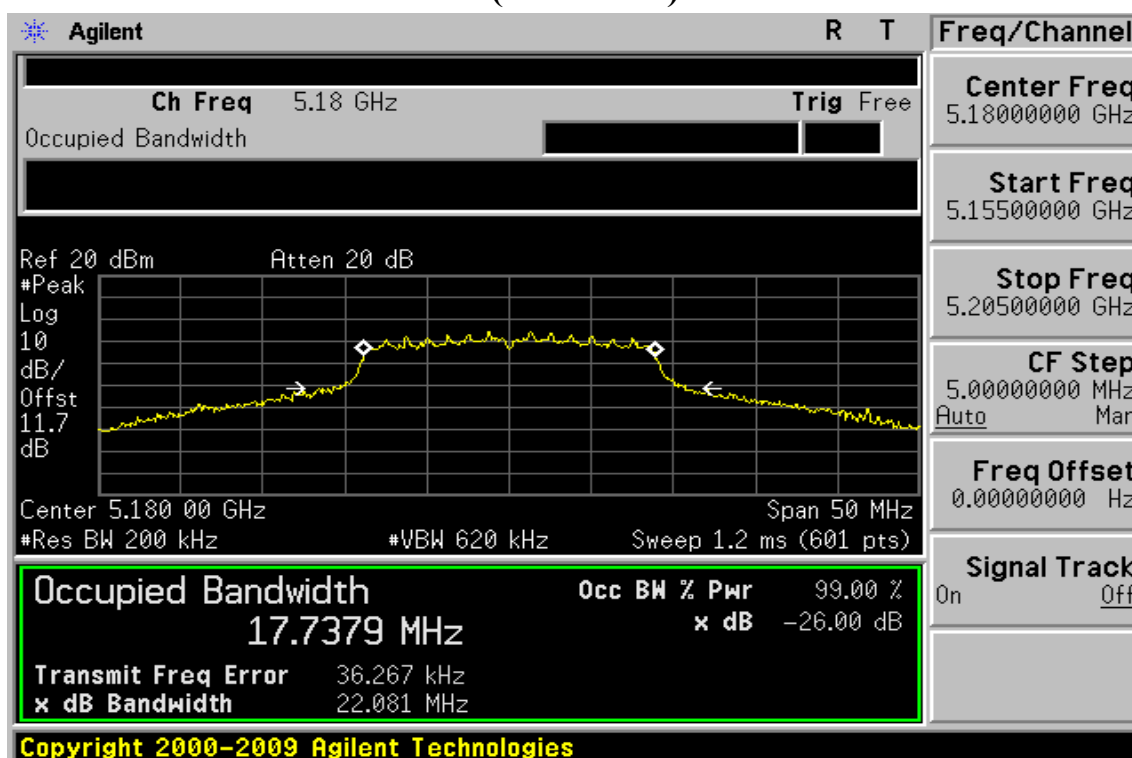
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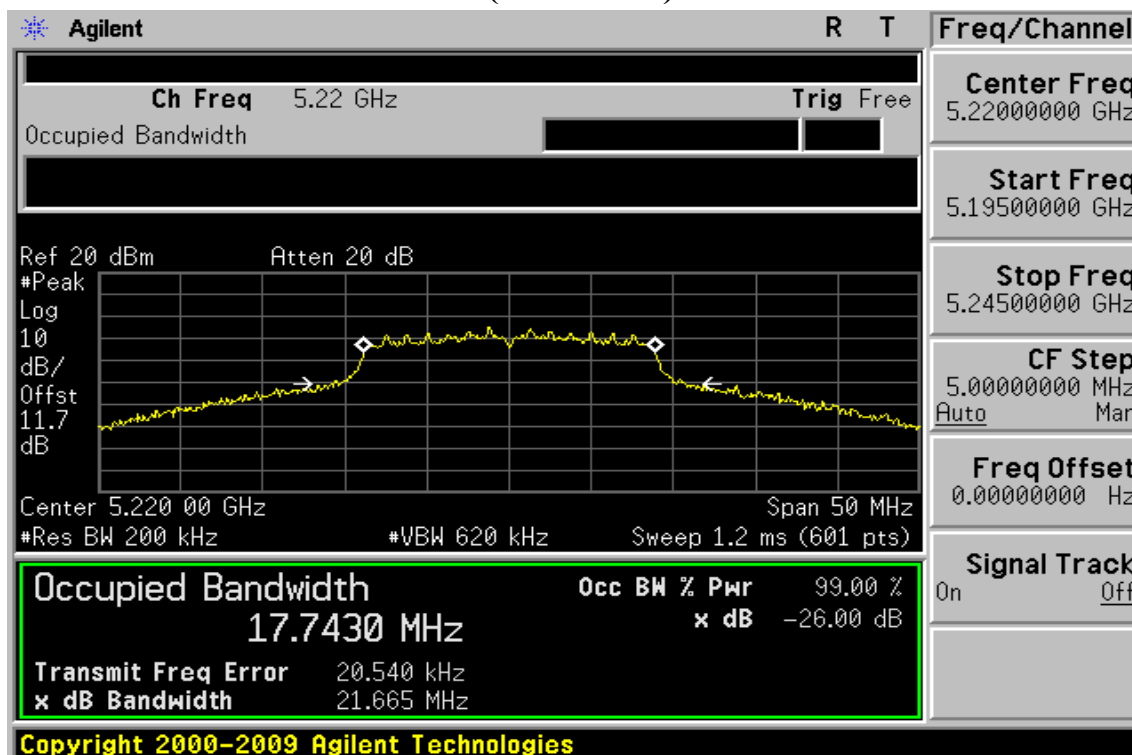
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802.11n HT20, 5150~5250 MHz

26dB Band Width Test Data CH-Low (5180 MHz)



26dB Band Width Test Data CH-Mid (5220 MHz)



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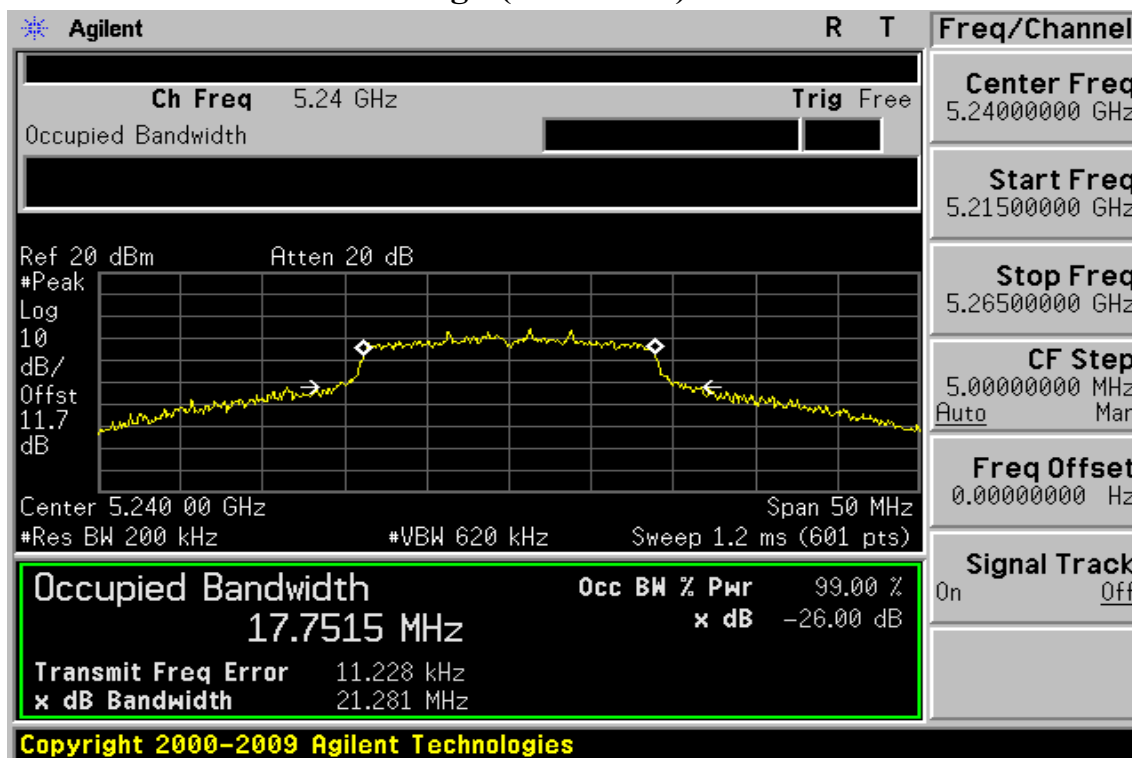
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26dB Band Width Test Data CH-High (5240 MHz)



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8. The MAXIMUM OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

According to §15.407(a)

1. For the band 5.15-5.25 GHz, the maximum conducted power over the frequency of operation shall not exceed the lesser of 50 mW (17dBm) or $4 \text{ dBm} + 10 \log B$.

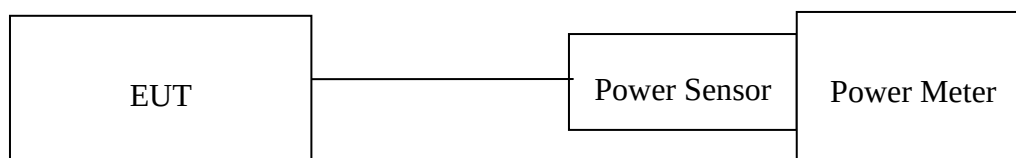
8.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter
3. Set the offset $10 \cdot \log(1/x)$, $n_{\text{HT20}}=0.22$
4. Record the max. reading.
5. Repeat above procedures until all frequency (low, middle, and high channel) measured were complete.

8.3 Measurement Equipment Used:

Refer to section 7.3 for details.

8.4 Test Set-up:



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8.5 Measurement Result

802.11a

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		6	9	12	18	24	36	48	54	
36	5180	12.65	12.59	12.21	12.06	11.10	11.02	9.41	9.35	16.99dBm or $4+10\log(B) = 17.92\text{dBm}$
44	5220	13.62	13.59	13.41	13.15	12.06	11.88	10.20	9.11	16.99dBm or $4+10\log(B) = 17.80\text{dBm}$
48	5240	13.53	13.48	13.22	13.05	12.15	11.75	9.31	9.07	16.99dBm or $4+10\log(B) = 17.85\text{dBm}$

Note: Limit is re-adjusted in terms of dBm

$$10 \cdot \log(50\text{mW}) = 16.99\text{dBm for the limit on the band of } 5150 \sim 5250\text{MHz}$$

Note: Cable loss is 1dB is set as the offset on the spectrum to compensate the loss causing by cable

802.11n HT20

Cable loss = 0		The Maximum Output Power								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
36	5180	12.20	12.11	11.98	11.85	10.93	10.67	9.27	9.12	16.99dBm or $4+10\log(B) = 17.44\text{dBm}$
44	5220	12.72	12.55	12.13	11.95	11.22	10.45	10.33	9.95	16.99dBm or $4+10\log(B) = 17.36\text{dBm}$
48	5240	12.74	12.26	12.09	11.99	10.55	10.21	9.93	9.08	16.99dBm or $4+10\log(B) = 17.28\text{dBm}$

Note: Offset 1dB

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9. PEAK POWER SPECTRAL DENSITY

9.1 Standard Applicable

According to §15.407(a)

1. For the band 5.15-5.25 GHz, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

9.2 Measurement Procedure (following procedure F, & E) d) method SA-2 in KDB789033 D01)

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to Spectrum.
3. Set RBW=1MHz, VBW=3MHz, Span=50MHz/80MHz (Base Mode), where span is enough to capture the entire bandwidth, Sweep time = Auto (601 pts), detector = sample, traces 100 sweeps of video averaging. (SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
4. User the cursor on spectrum to peak search the highest level of trace
5. Add offset, duty factor $n_{HT20}=0.22$
6. Record the max. reading.
7. Repeat above procedures until all default test channel (low, middle, and high) was complete.

9.3 Measurement Equipment Used:

Refer to section 7.3 for details.

9.4 Test Set-up:

Refer to section 7.4 for details.

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9.5 Measurement Result

802.11a, 5150~5250 MHz

Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
5180	-13.61	4.00	-17.61
5220	-12.68	4.00	-16.68
5240	-13.41	4.00	-17.41

Note: Offset 11.7dB

802.11n HT20, 5150~5250 MHz

Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
5180	-13.55	4.00	-17.55
5220	-14.22	4.00	-18.22
5240	-15.16	4.00	-19.16

Note: Offset 11.7dB

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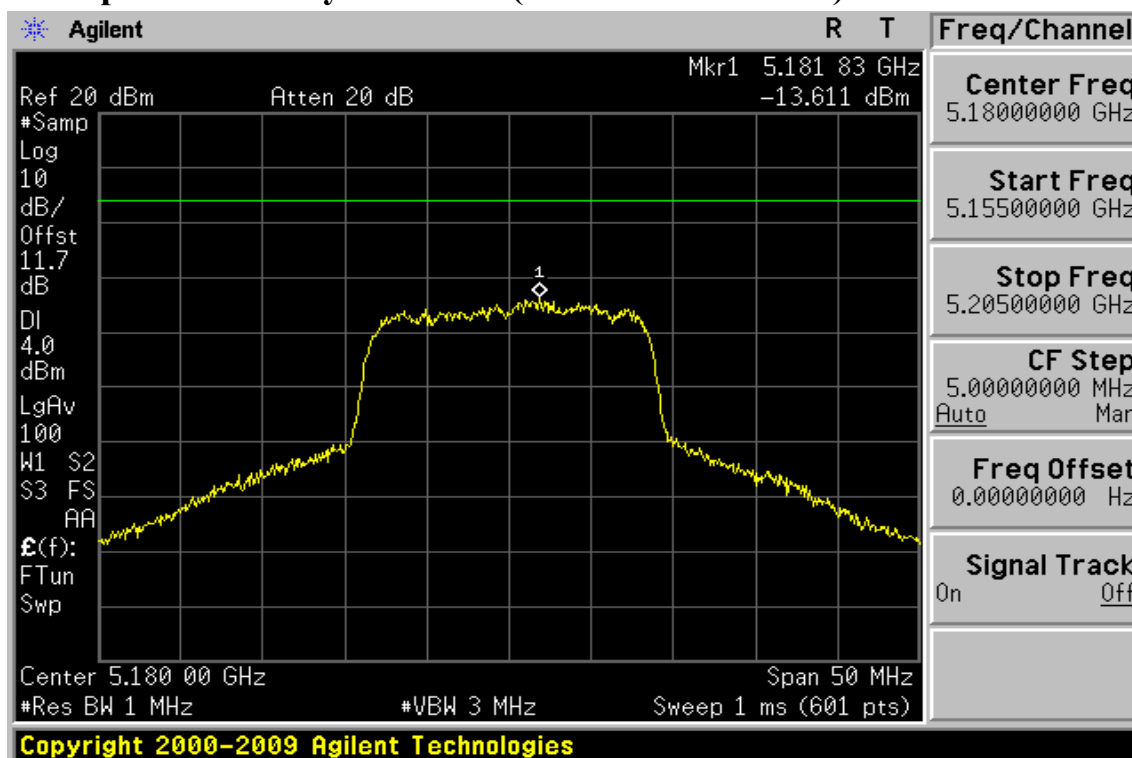
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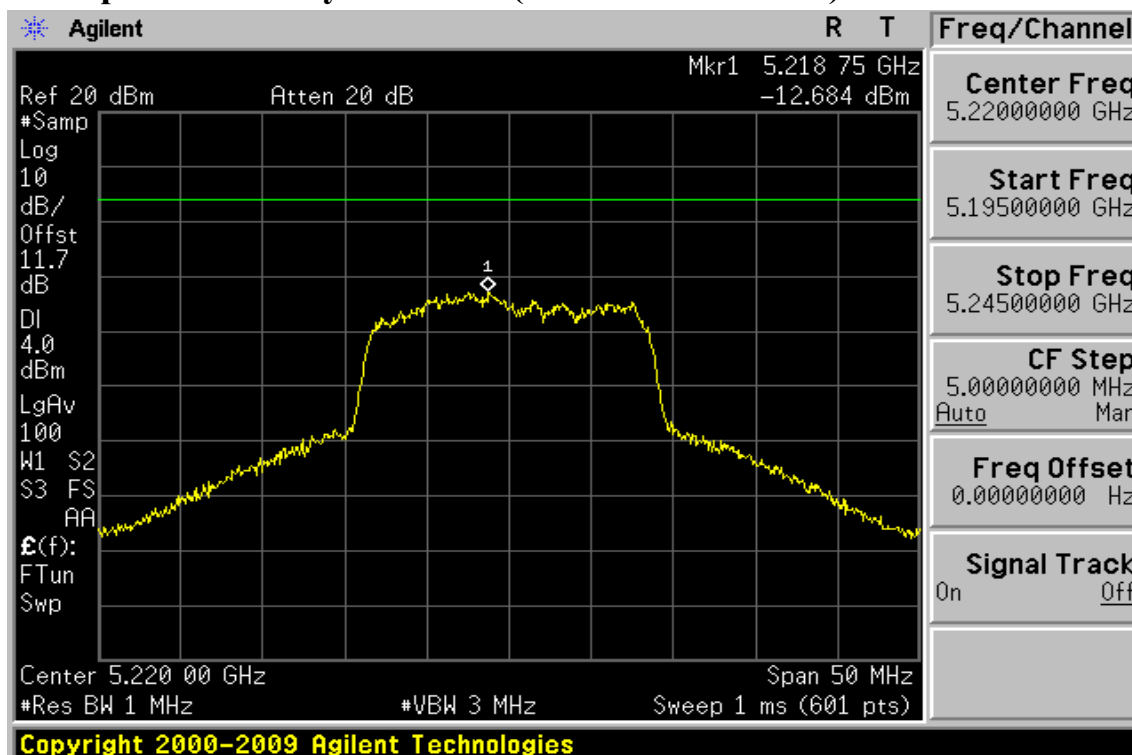
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802.11a, 5150~5250 MHz

Peak Power Spectral Density Data Plot (CH Low 5180 MHz)



Peak Power Spectral Density Data Plot (CH Mid 5220 MHz)



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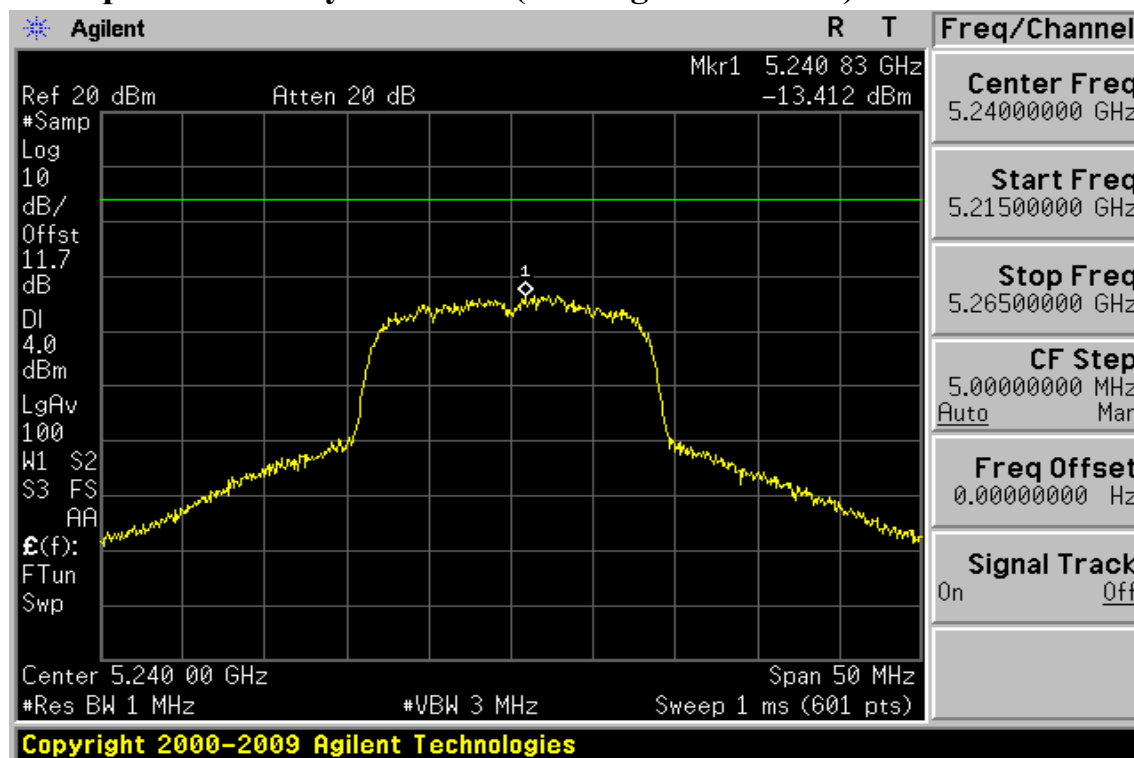
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Peak Power Spectral Density Data Plot (CH High 5240 MHz)



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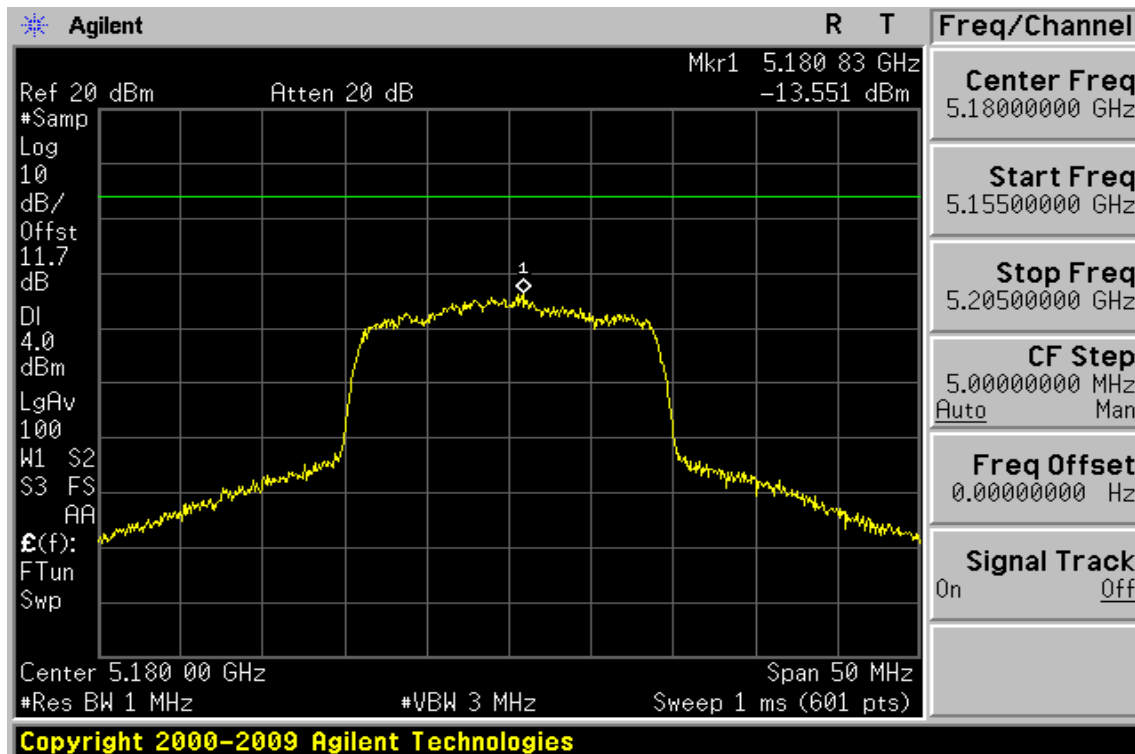
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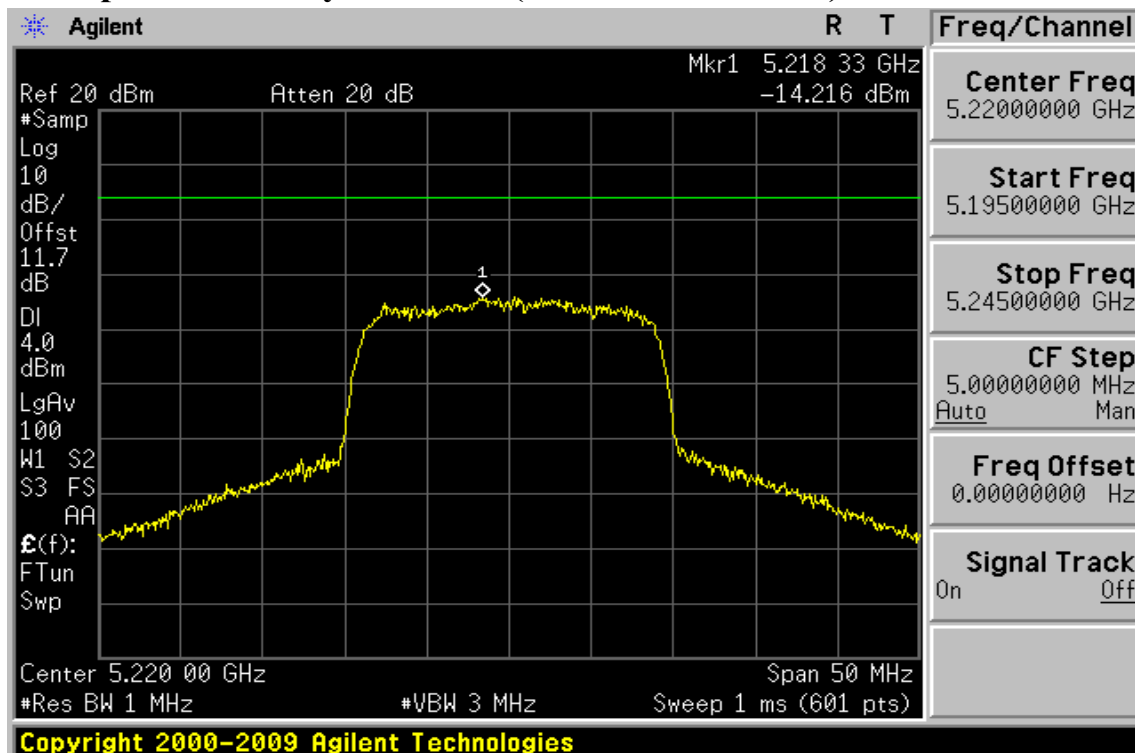
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802.11n HT20, 5150~5250 MHz

Peak Power Spectral Density Data Plot (CH Low 5180 MHz)



Peak Power Spectral Density Data Plot (CH Mid 5220 MHz)



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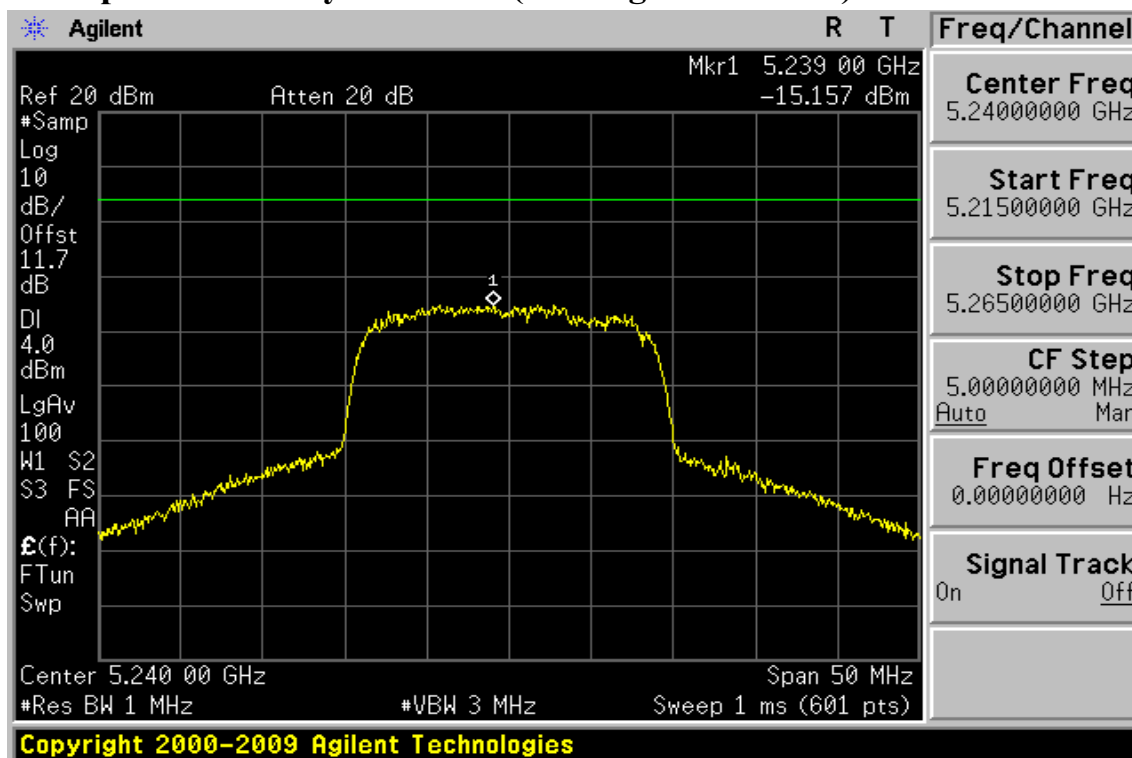
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Peak Power Spectral Density Data Plot (CH High 5240 MHz)



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10. PEAK EXCURSION MEASUREMENT

10.1 Standard Applicable

15.407(a)(6) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

10.2 Measurement Procedure (following procedure G in KDB789033)

1. Pre-evaluation in selection for test mode based on KDB789033
2. Tests mode selection is based on the variations in signal structure,
 - (i) All signal types - OFDM;
 - (ii) All modulation types (BPSK, QPSK, 16-QAM, 64-QAM);
 - (iii) All bandwidth modes (20MHz, and 40MHz for 802.11n);
 - (iv) All variations in signal parameters (inapplicable);
 - (v) Error-correction coding rate (not required);
3. Place the EUT on the table and set it in transmitting mode.
4. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to spectrum.
5. Set RBW=1MHz, VBW = 3MHz, span =enough to capture the signal of the interest, Max. Hold, Detector = peak
6. use the procedure specified in KDB 789033 F) to determine the PPSD
7. compute the ratio of the maximum of the peak-max-hold spectrum to the PPSD by the subtraction
8. Repeat above procedures until all default test mode of default frequency band of the test is completed.

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802.11a

Table 18-4—Modulation-dependent parameters

Modulation	Coding rate (R)	Coded bits per subcarrier (N_{BPSK})	Coded bits per OFDM symbol (N_{CBPS})	Data bits per OFDM symbol (N_{DBPS})	Data rate (Mb/s) (20 MHz channel spacing)	Data rate (Mb/s) (10 MHz channel spacing)	Data rate (Mb/s) (5 MHz channel spacing)
BPSK	1/2	1	48	24	6	3	1.5
BPSK	3/4	1	48	36	9	4.5	2.25
QPSK	1/2	2	96	48	12	6	3
QPSK	3/4	2	96	72	18	9	4.5
16-QAM	1/2	4	192	96	24	12	6
16-QAM	3/4	4	192	144	36	18	9
64-QAM	2/3	6	288	192	48	24	12
64-QAM	3/4	6	288	216	54	27	13.5

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802.11n_20

Table 20-30—MCS parameters for mandatory 20 MHz, $N_{SS} = 1$, $N_{ES} = 1$

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
0	BPSK	1/2	1	52	4	52	26	6.5	7.2
1	QPSK	1/2	2	52	4	104	52	13.0	14.4
2	QPSK	3/4	2	52	4	104	78	19.5	21.7
3	16-QAM	1/2	4	52	4	208	104	26.0	28.9
4	16-QAM	3/4	4	52	4	208	156	39.0	43.3
5	64-QAM	2/3	6	52	4	312	208	52.0	57.8
6	64-QAM	3/4	6	52	4	312	234	58.5	65.0
7	64-QAM	5/6	6	52	4	312	260	65.0	72.2

NOTE—Support of 400 ns GI is optional on transmit and receive.

Note: The test mode to be performed is circle in red as presents above

10.3 Measurement Equipment Used:

Refer to section 7.3 for details.

10.4 Test Set-up:

Refer to section 7.4 for details.

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10.5 Test Results:**Modulation Type: BPSK****Coding Rate: 1/2**

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-0.21	-12.68	12.47	13.00

802.11n HT20, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-2.11	-14.22	12.11	13.00

Modulation Type: QPSK**Coding Rate: 1/2**

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-0.96	-10.62	9.66	13.00

802.11n HT20, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-0.46	-12.27	11.81	13.00

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Modulation Type: 16-QAM
Coding Rate: 1/2

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-0.88	-12.18	11.30	13.00

802.11n HT20, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-1.70	-13.56	11.86	13.00

Modulation Type: 64-QAM
Coding Rate: 2/3

802.11a, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-3.79	-12.64	8.85	13.00

802.11n HT20, 5150~5250 MHz

Channel	Frequency (MHz)	Peak Value(dBm)	PPSD (dBm)	Peak Excursion (dB)	Limit (dB)
Mid	5220	-2.33	-12.32	9.99	13.00

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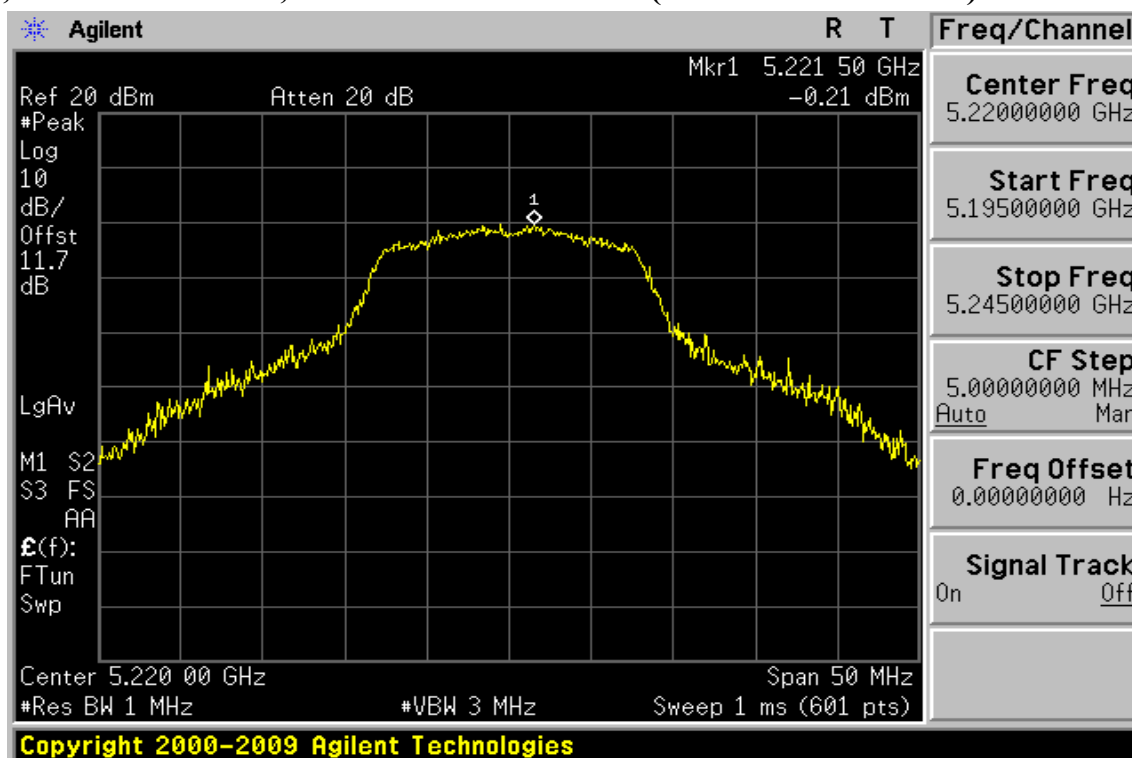
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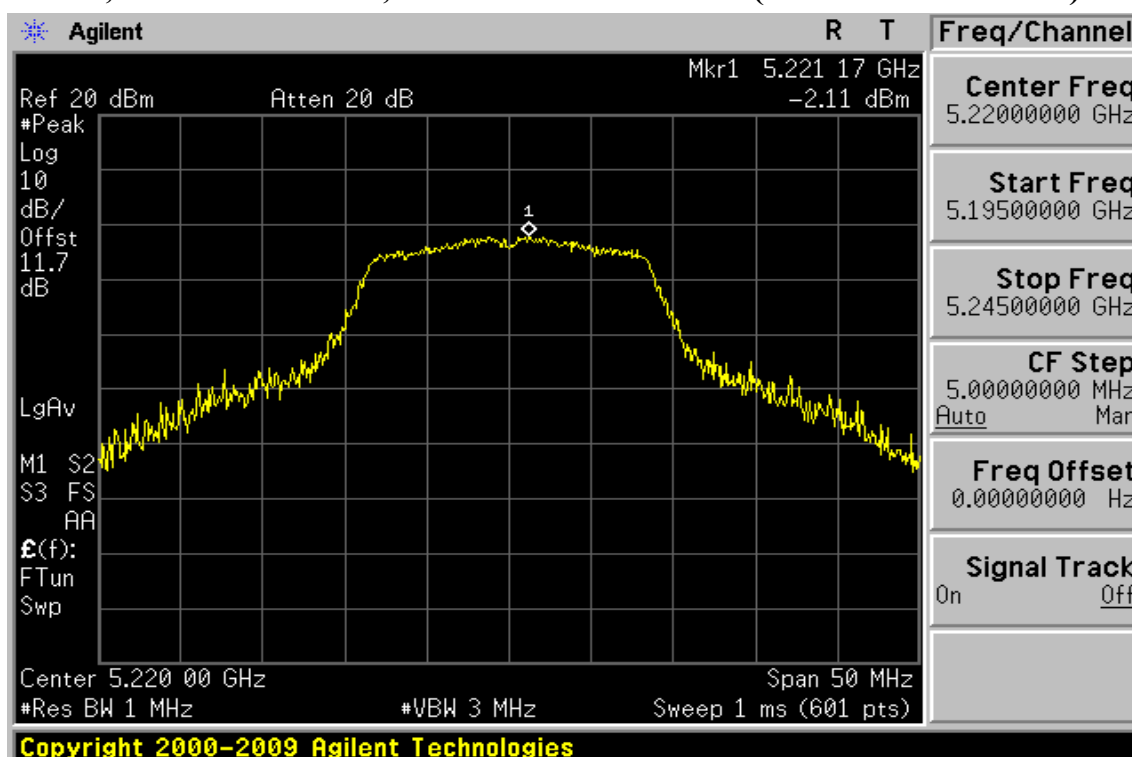
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Modulation Type: BPSK, Coding Rate: 1/2

802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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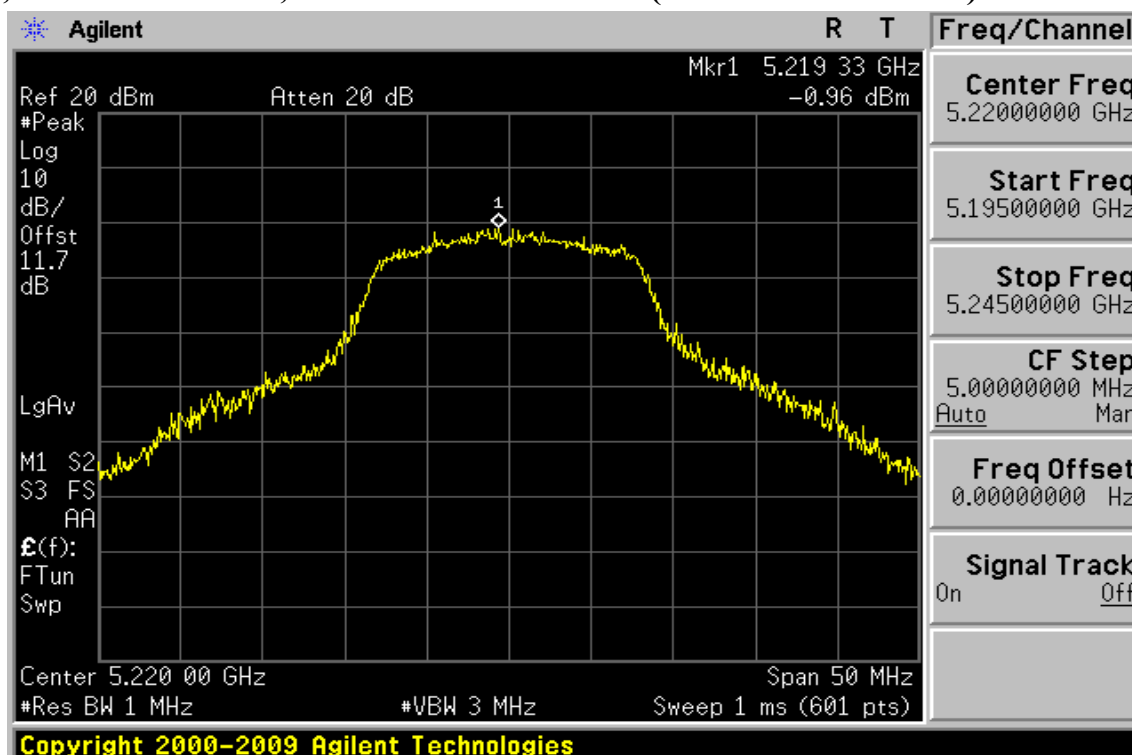
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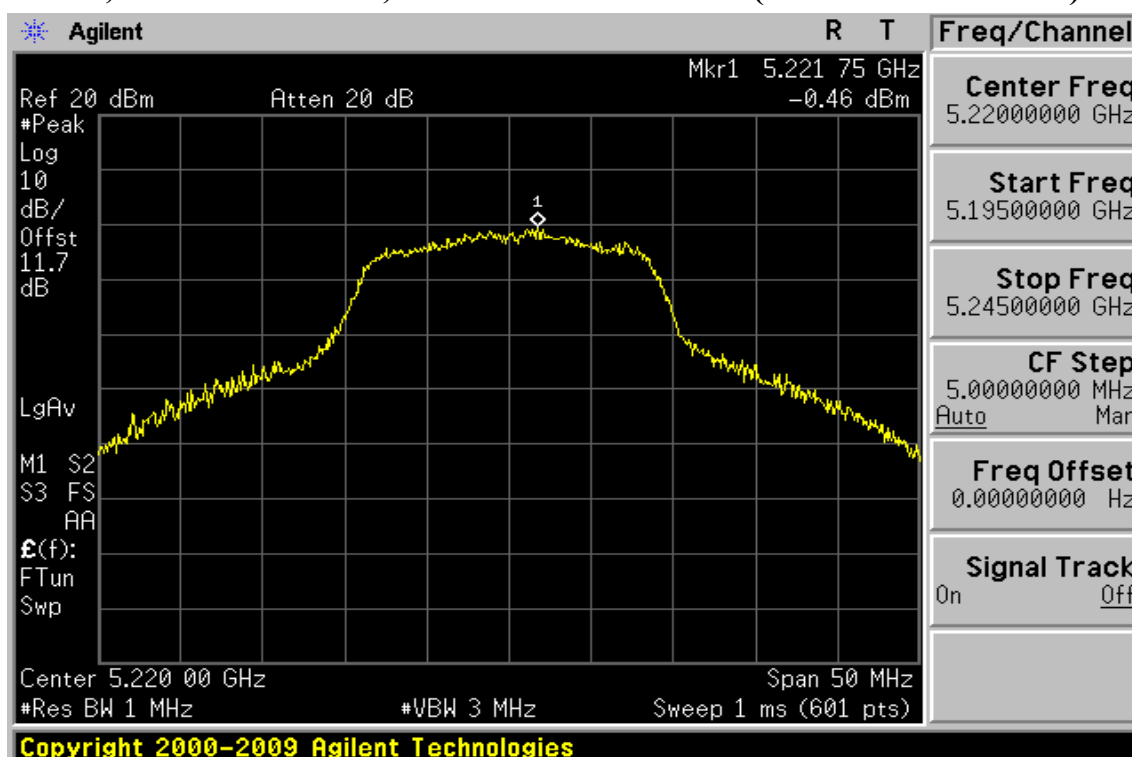
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Modulation Type: QPSK, Coding Rate: 1/2

802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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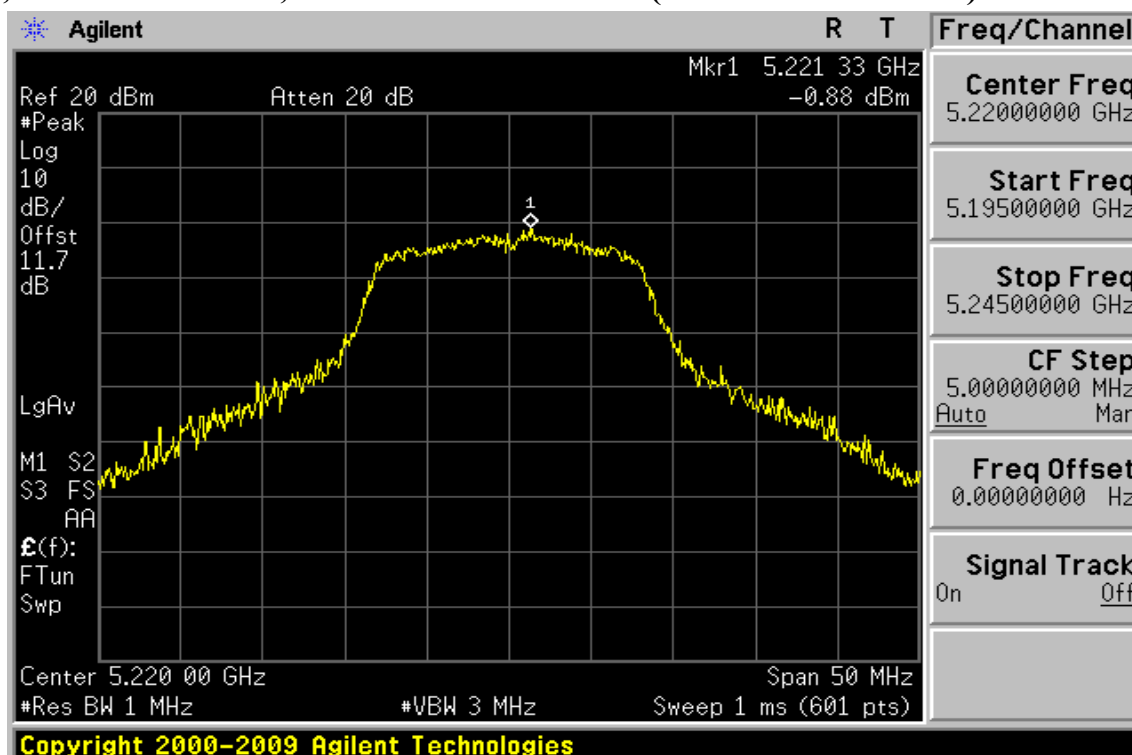
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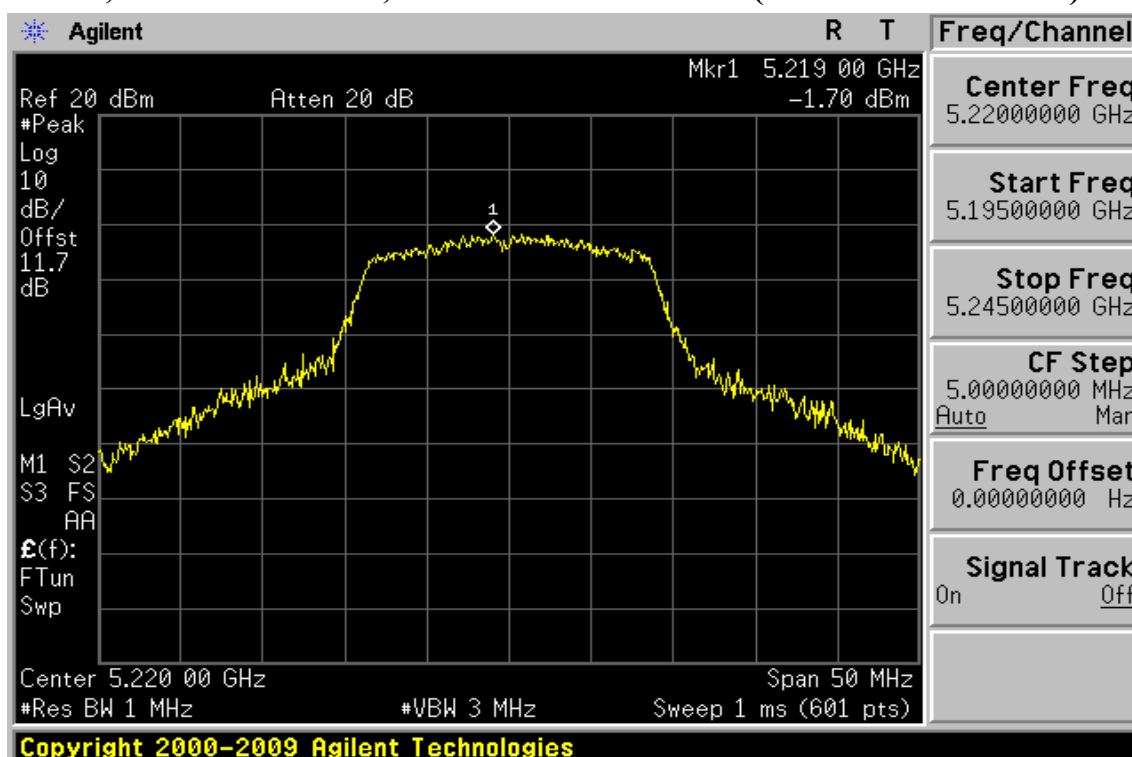
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Modulation Type: 16-QAM, Coding Rate: 1/2

802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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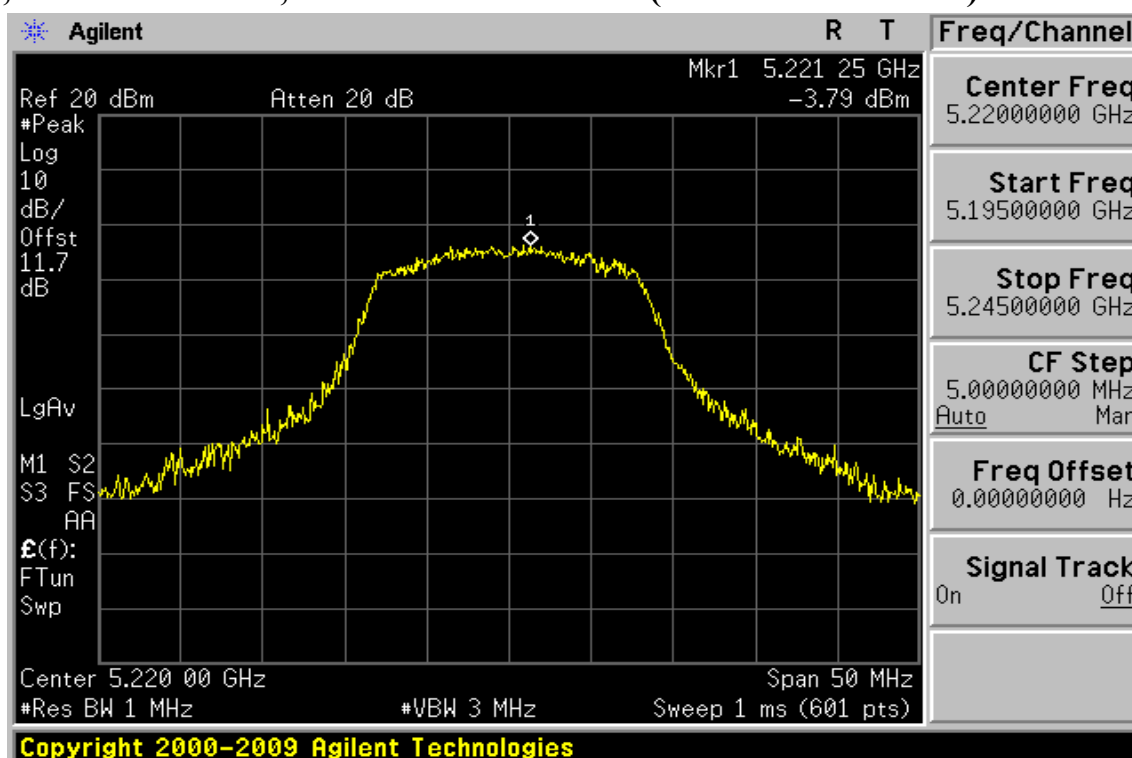
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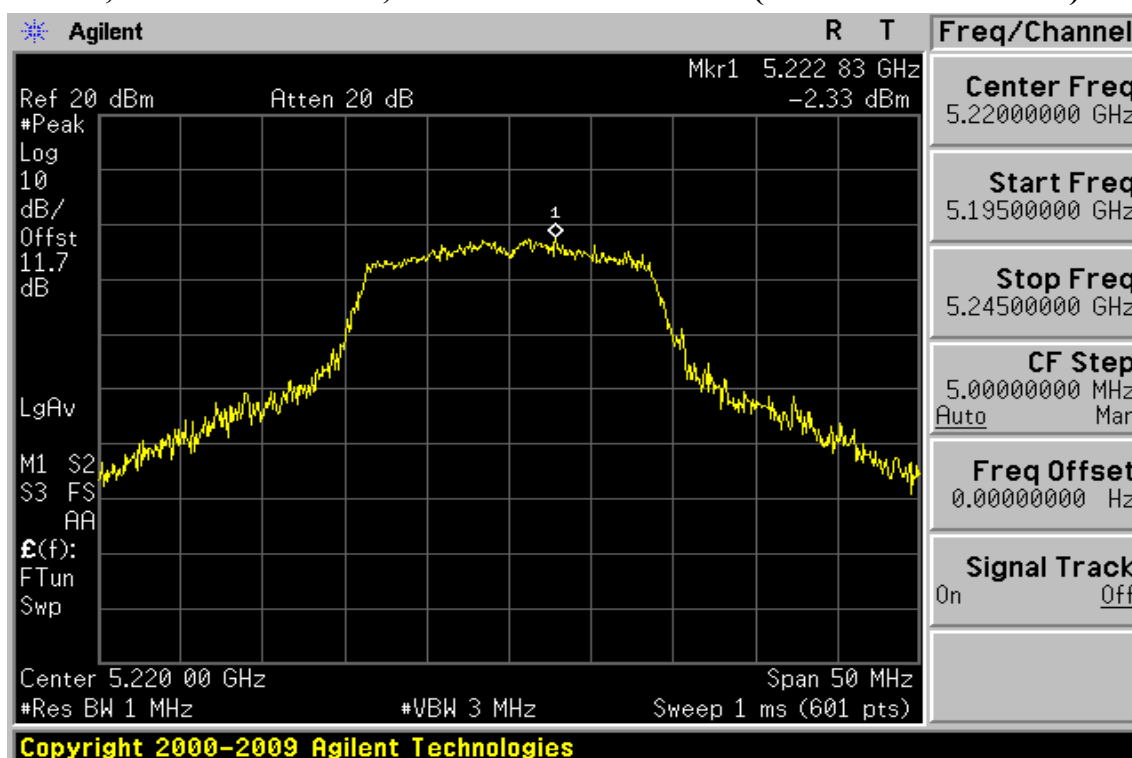
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Modulation Type: 64-QAM, Coding Rate: 2/3

802.11a, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, Peak Value Data Plot (CH Mid 5220 MHz)



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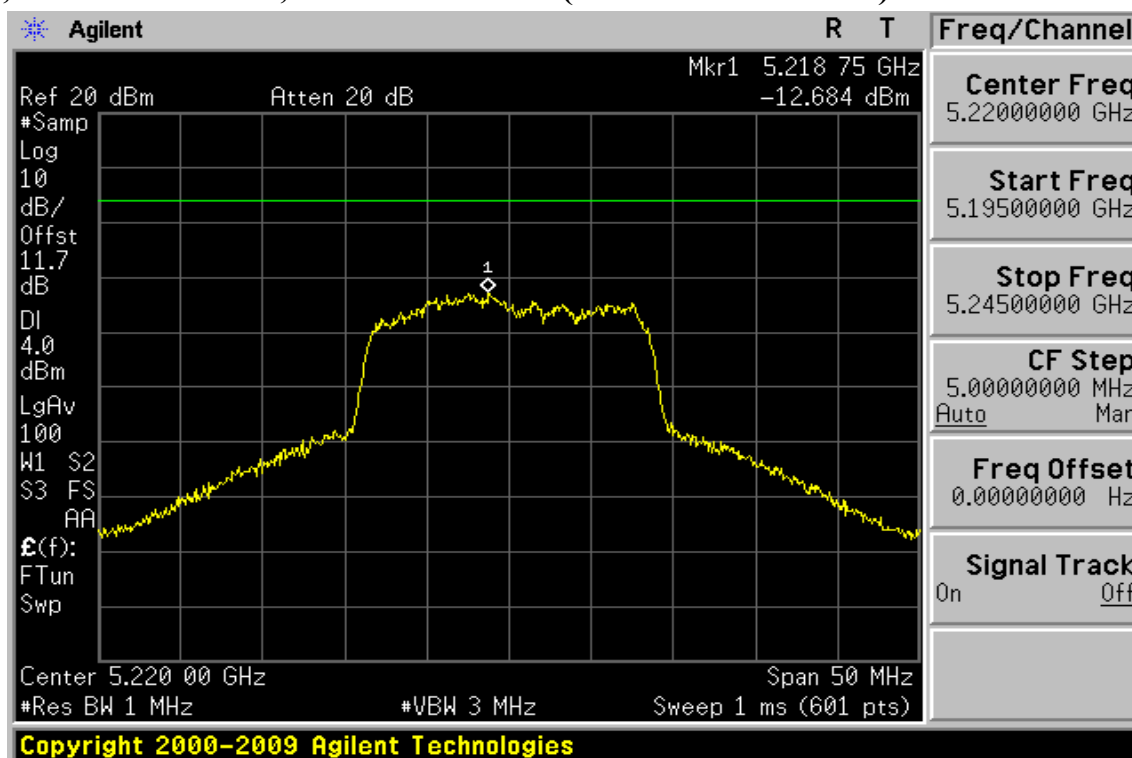
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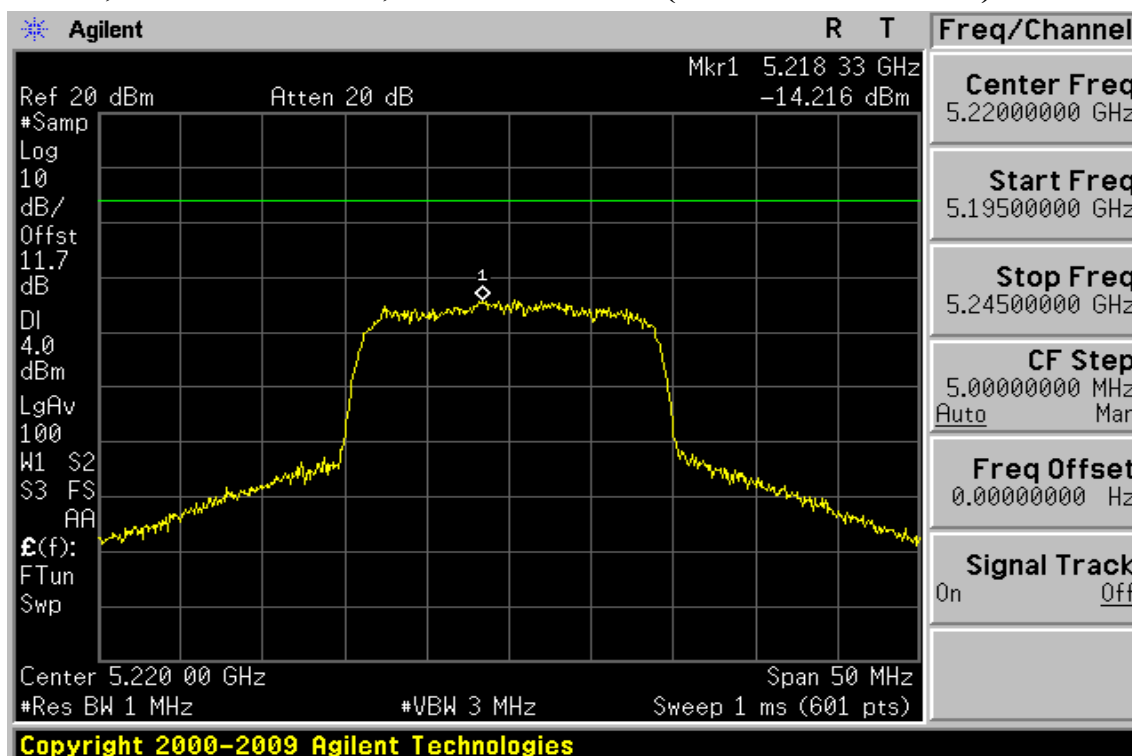
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Modulation Type: BPSK, Coding Rate: 1/2

802.11a, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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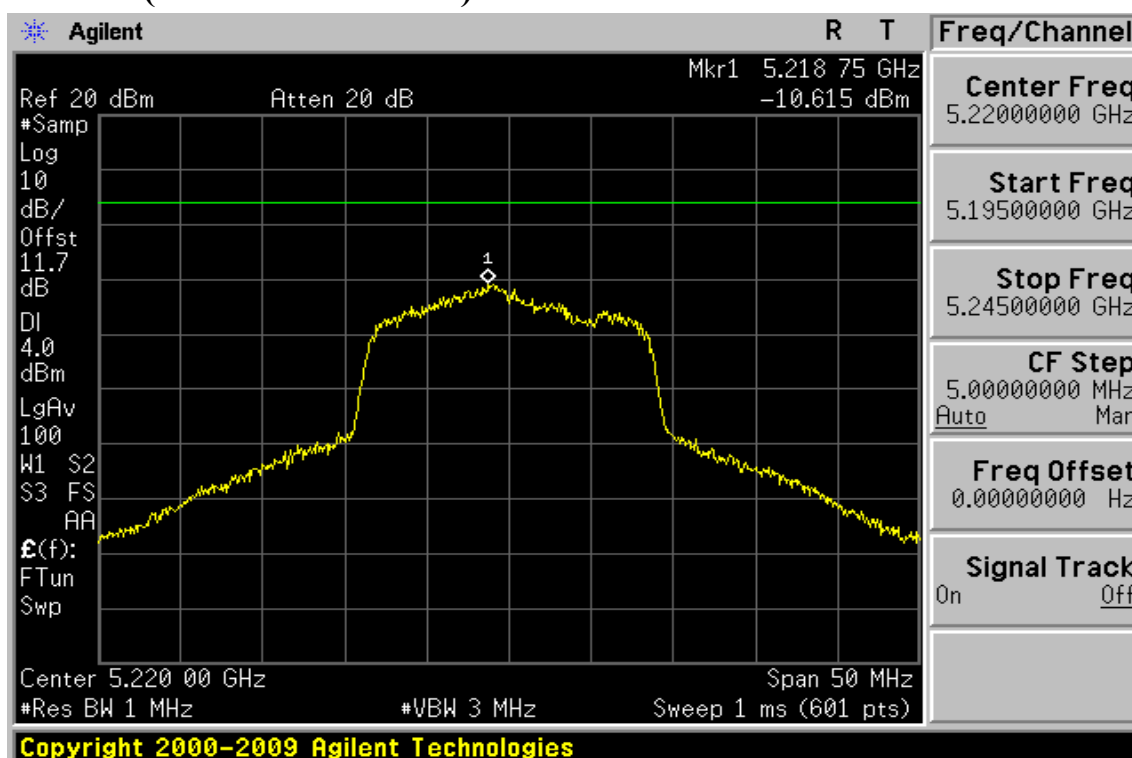
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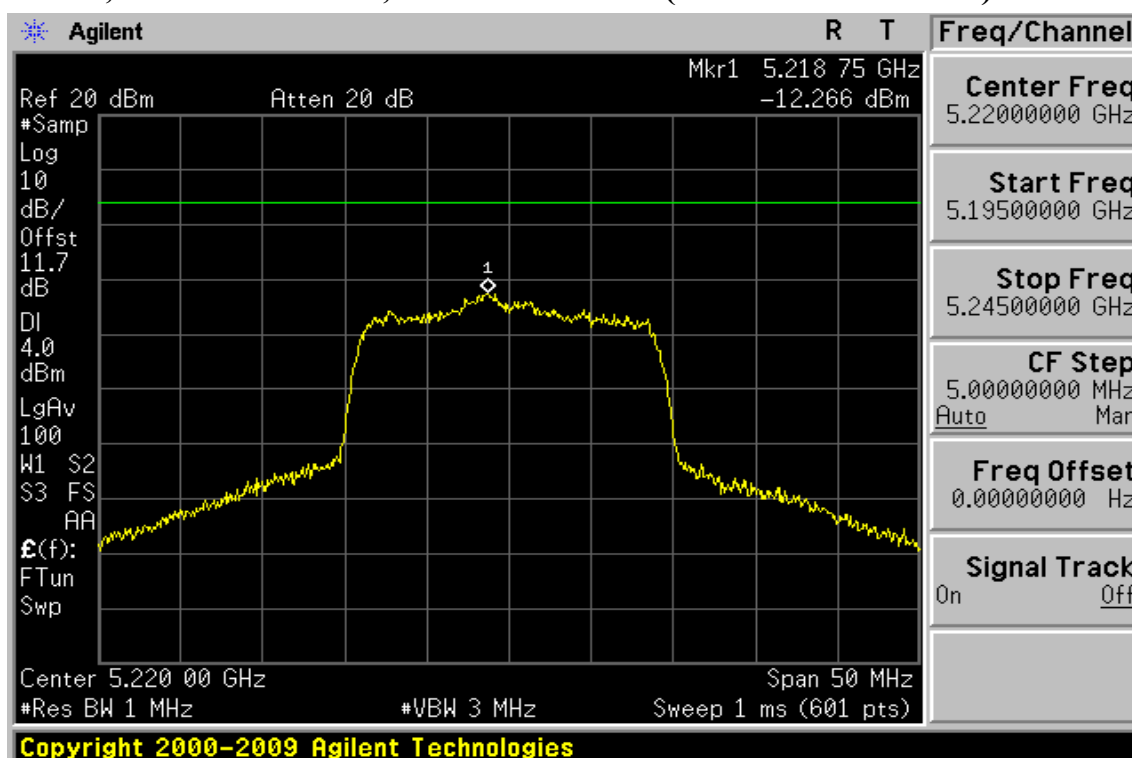
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Modulation Type: QPSK, Coding Rate: 1/2

PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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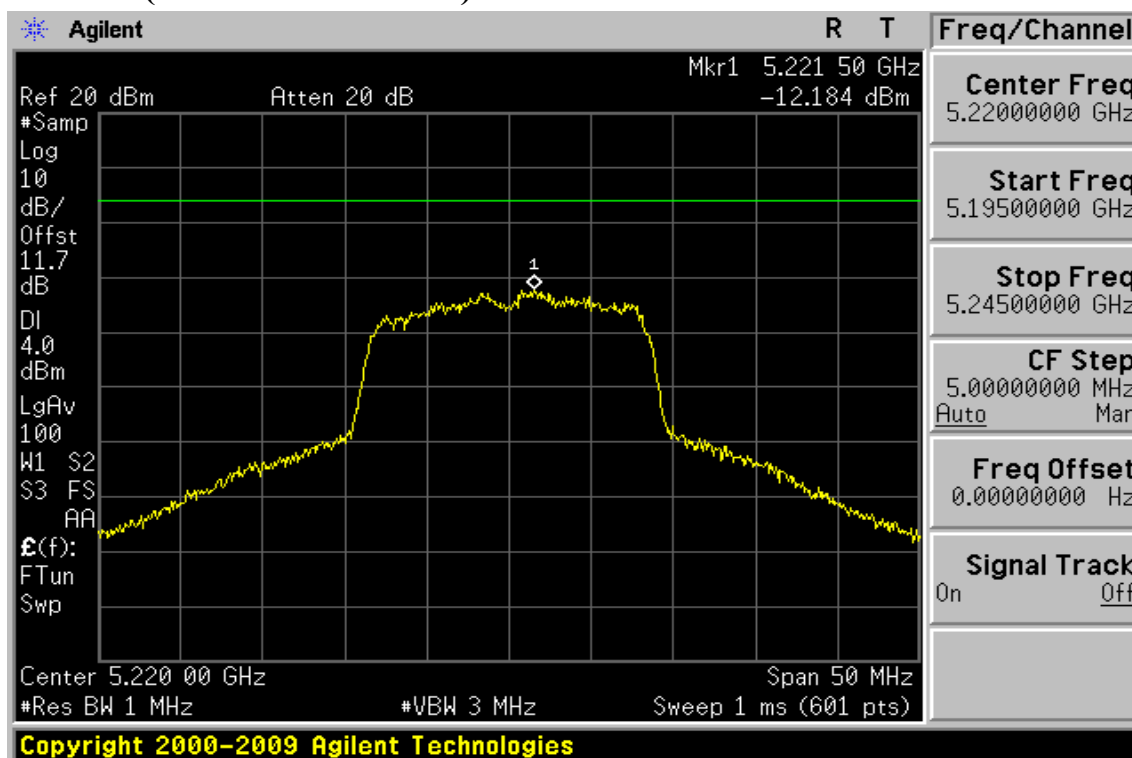
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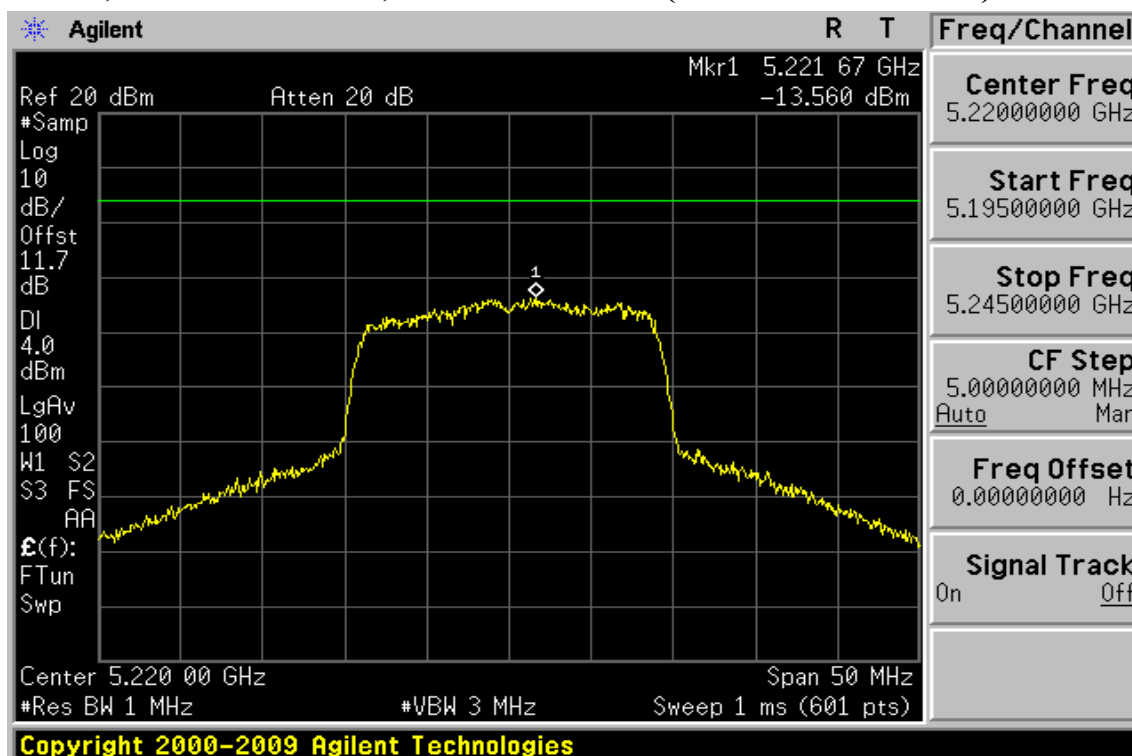
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Modulation Type: 16-QAM, Coding Rate: 1/2

PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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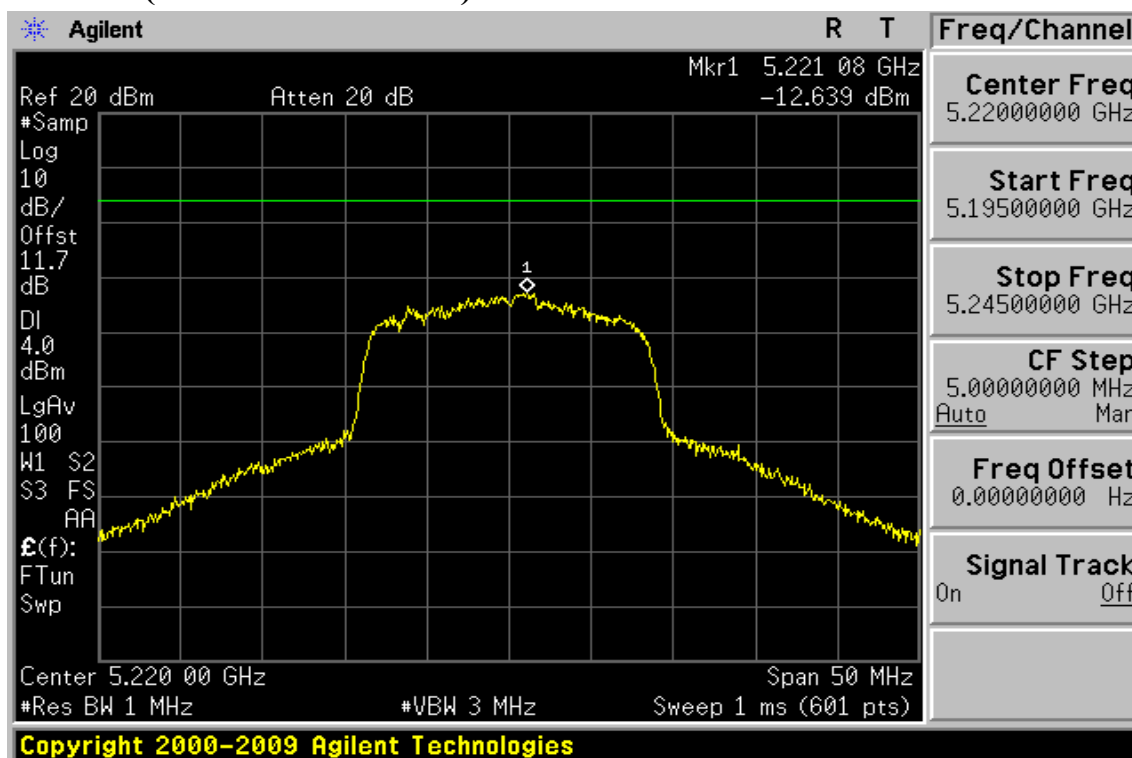
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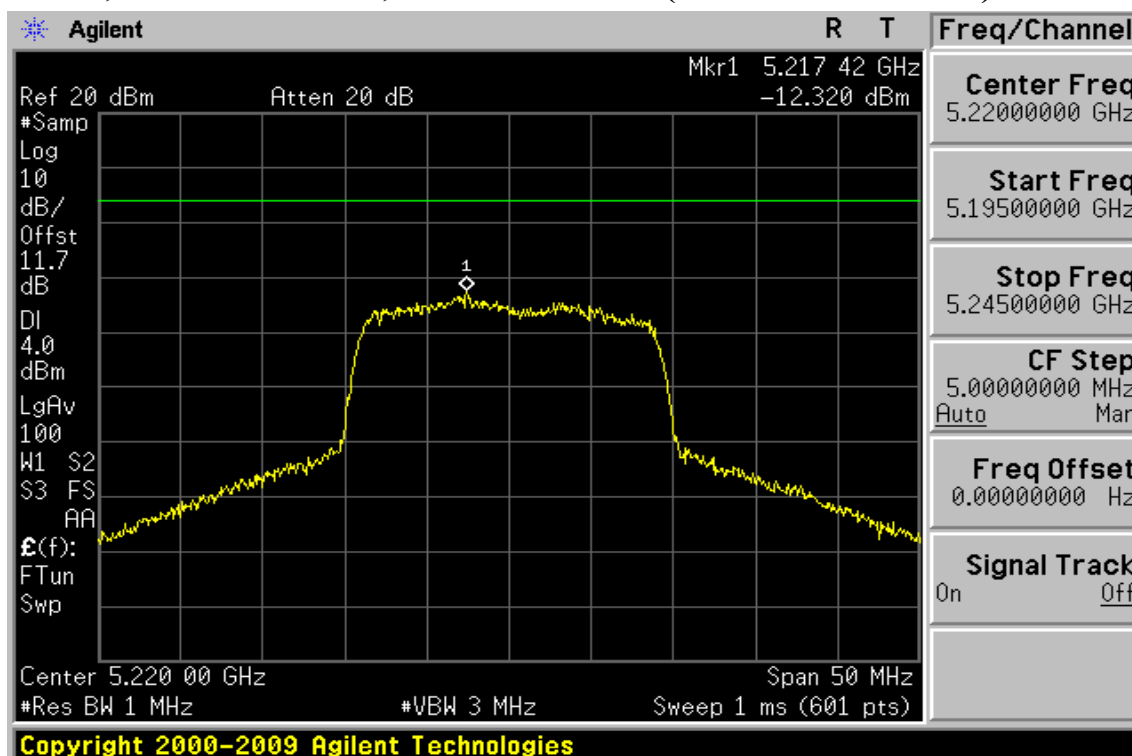
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Modulation Type: 64-QAM, Coding Rate: 2/3

PPSD Data Plot (CH Mid 5220 MHz)



802.11n HT20, 5150~5250 MHz, PPSD Data Plot (CH Mid 5220 MHz)



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11. UNDESIRABLE EMISSION - CONDUCTED MEASUREMENT

11.1 Standard Applicable

According to §15.407(b),

(b) Undesirable Emission Limits: Except as shown in Paragraph (b)(6) of this section, the peak 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 EIRP of -27 dBm/MHz.
- (2) The above 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.

11.2 Measurement Procedure

Conducted Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100 kHz, VBW = 300 kHz while frequency of the measurement is swept below 1GHz, RBW = 1MHz & VBW = 3MHz while frequency of the measurement is swept above 1GHz on Spectrum. Detector = Peak, set DL as the limit line to -27dBm, add the offset = 4.7dB for frequency below 1GHz, and 2dB for frequency above 1GHz.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30 to 1G, 1G to 3G, 3G to 6G, 6G to 13G, 13G to 18G, 18G to 26.5G and 26.5G to 40GHz
4. Via Software, combine 6 spans of frequency range into one plot

Conducted RF measurements of the transmitter output were made at the band edges and the adjacent restricted bands.

Also, conducted RF measurements of the transmitter output over the 30 MHz to 40 GHz band were made in order to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

Note: the spike on the spectrum is the fundamental emission that does not account for the test outside the frequency band as required by associative regulatory provision.

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11.3 Measurement Equipment Used:

Refer to section 7.3 for details.

11.4 Test Set-up:

Refer to section 7.4 for details.

11.5 Measurement Result:

Refer to next page for plots.

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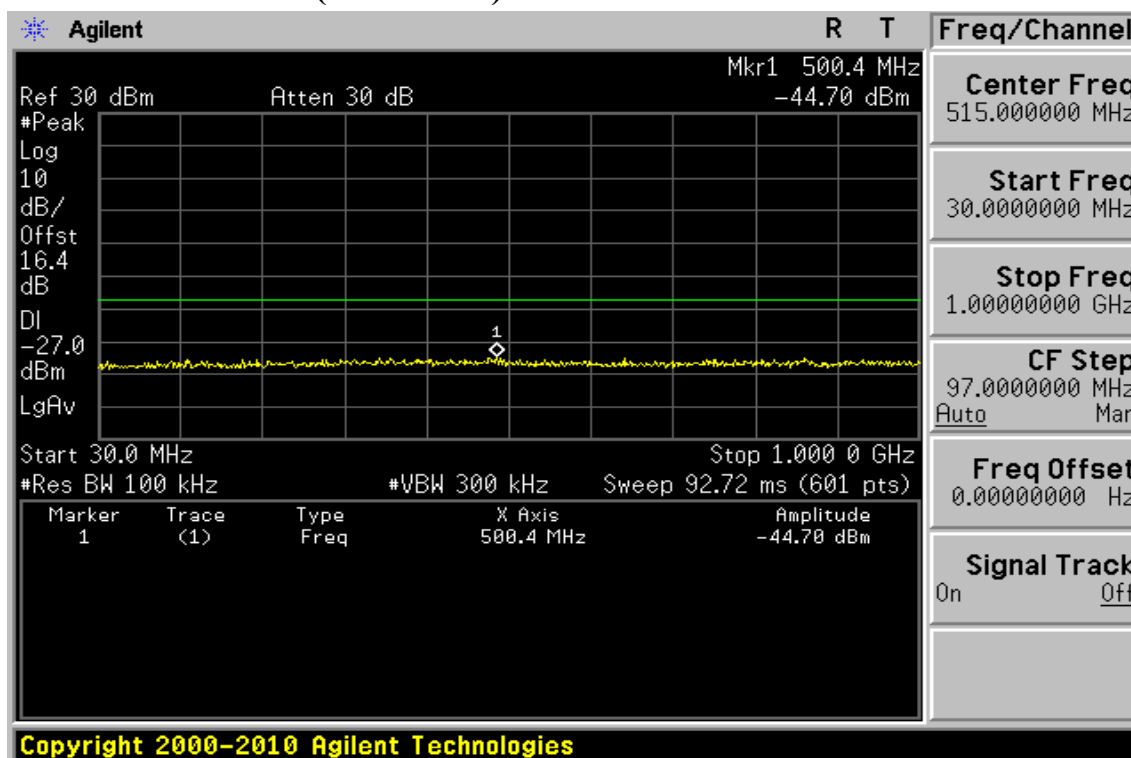
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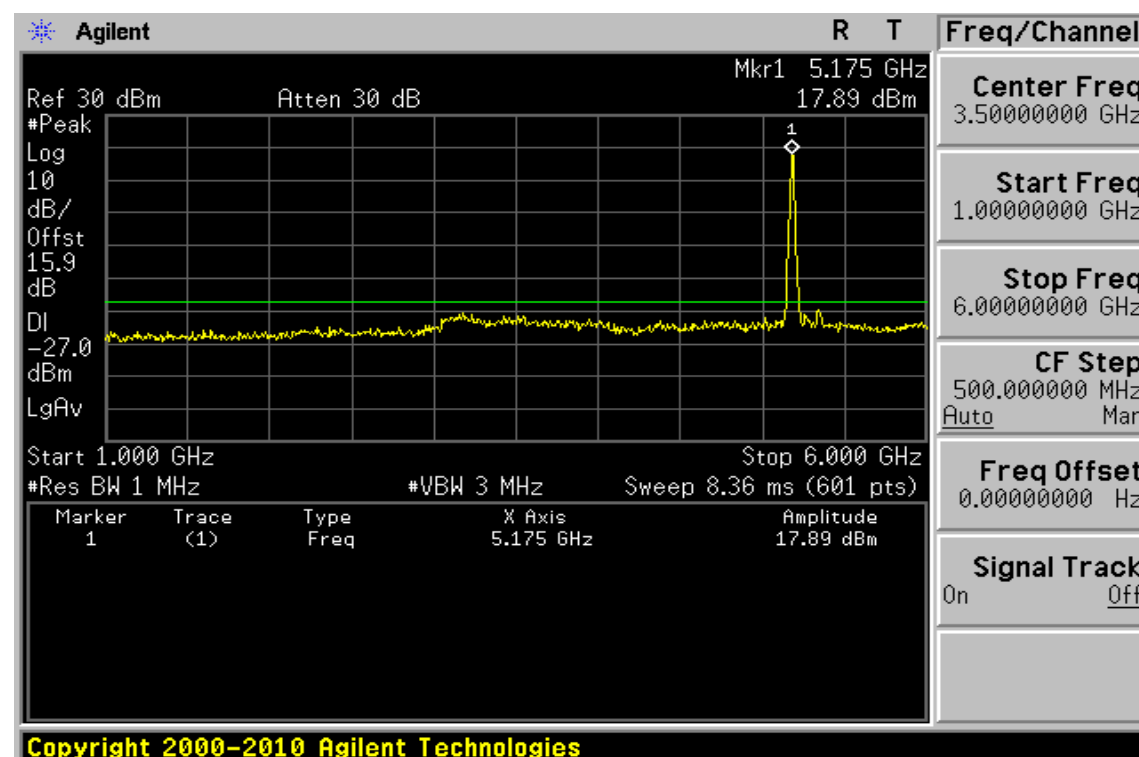
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802.11a, 5150~5250 MHz

Ch Low 30MHz – 1GHz (5180 MHz)



Ch Low 1GHz – 6GHz



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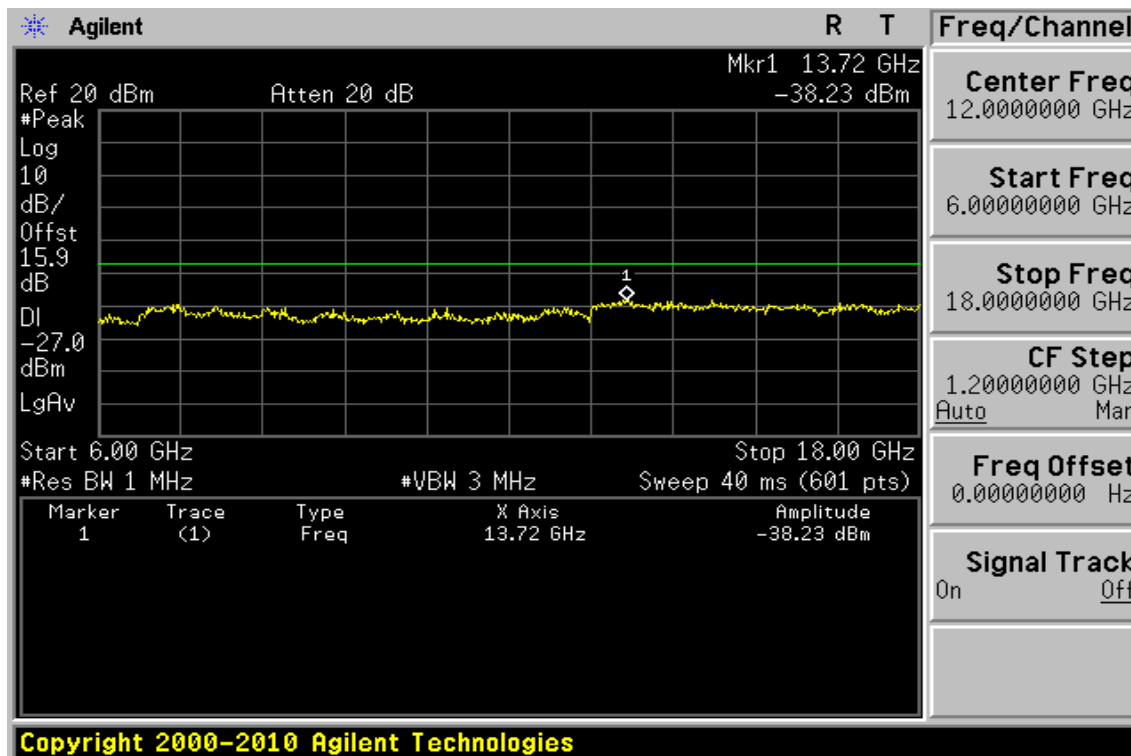
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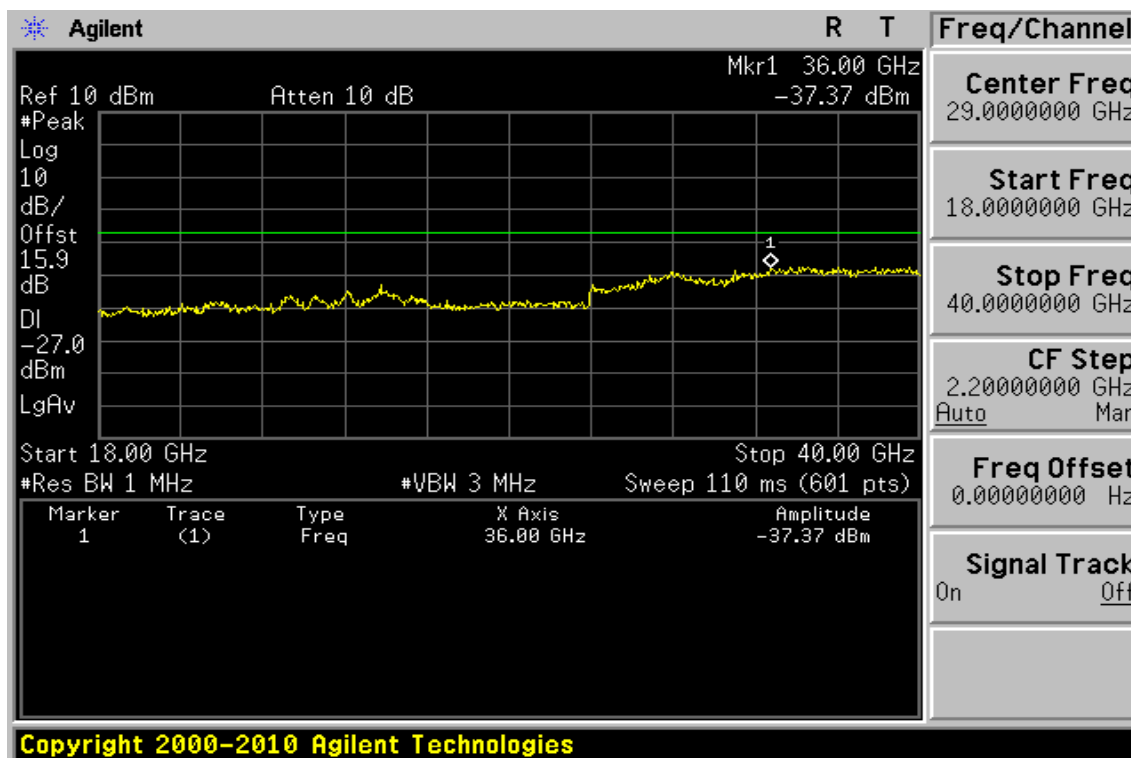
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Ch Low 6GHz – 18GHz



Ch Low 18GHz – 40GHz



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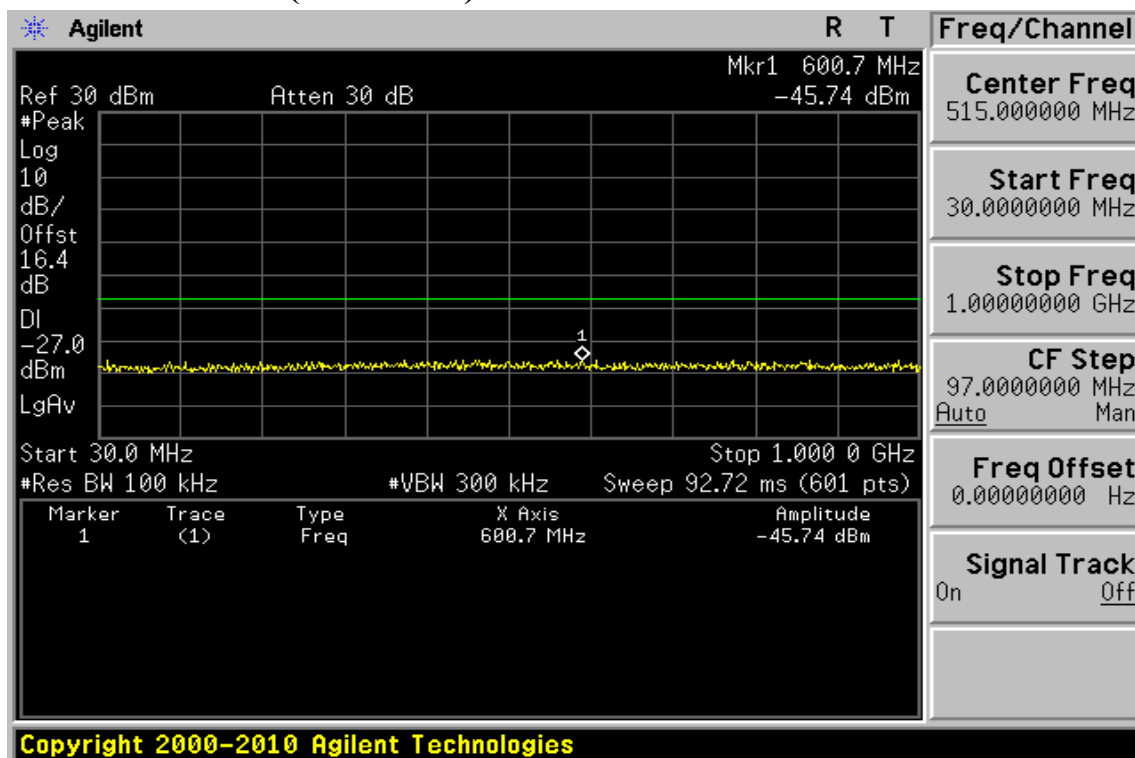
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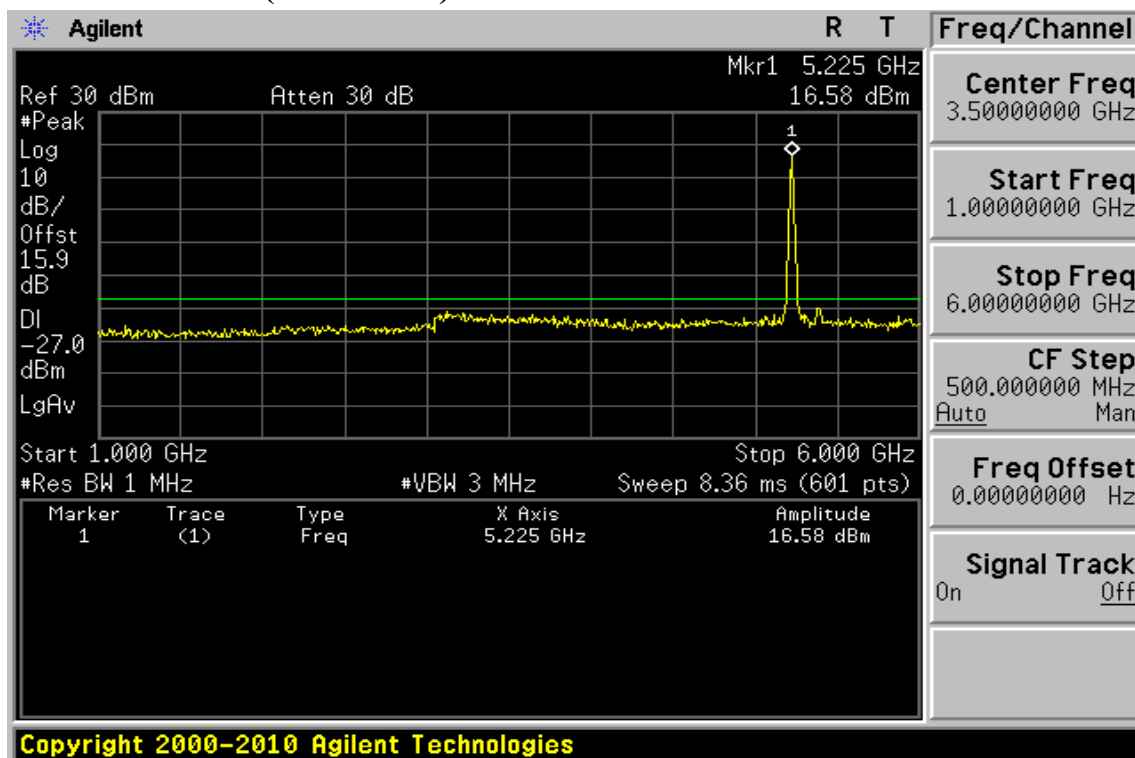
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Ch Mid 30MHz – 1GHz (5220 MHz)



Ch Mid 1GHz – 6GHz (5220 MHz)



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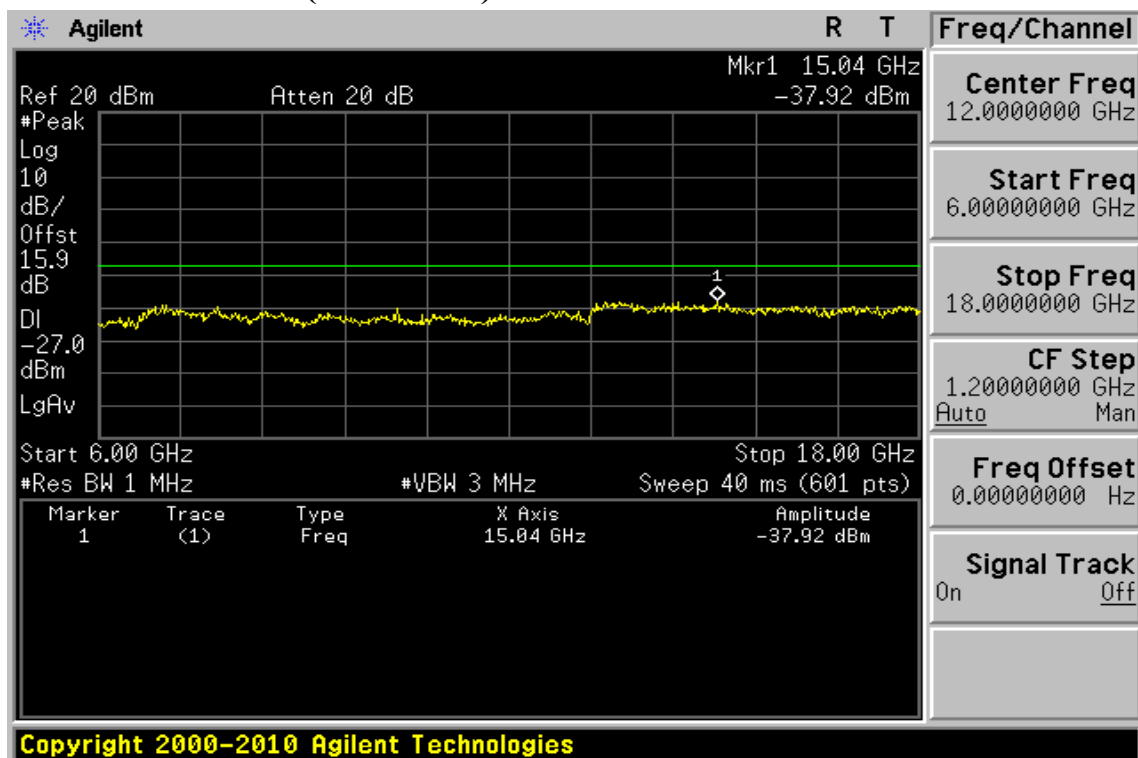
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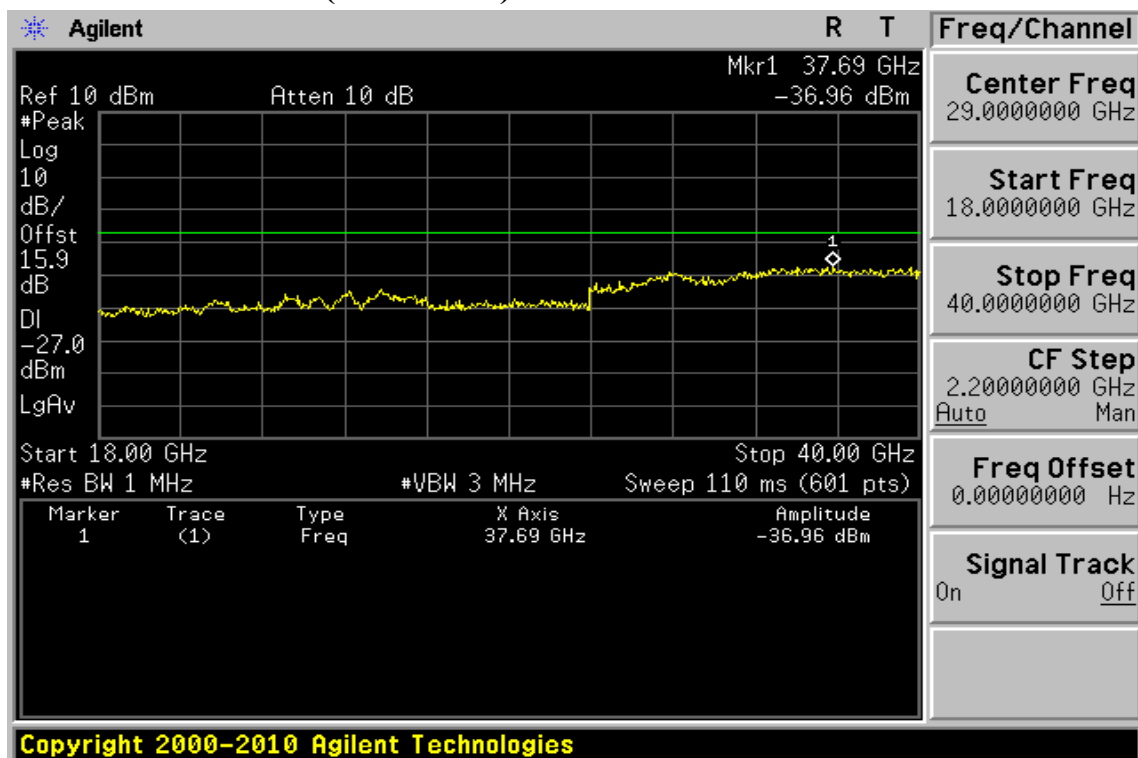
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Ch Mid 6GHz – 18GHz (5220 MHz)



Ch Mid 18GHz – 40GHz (5220 MHz)



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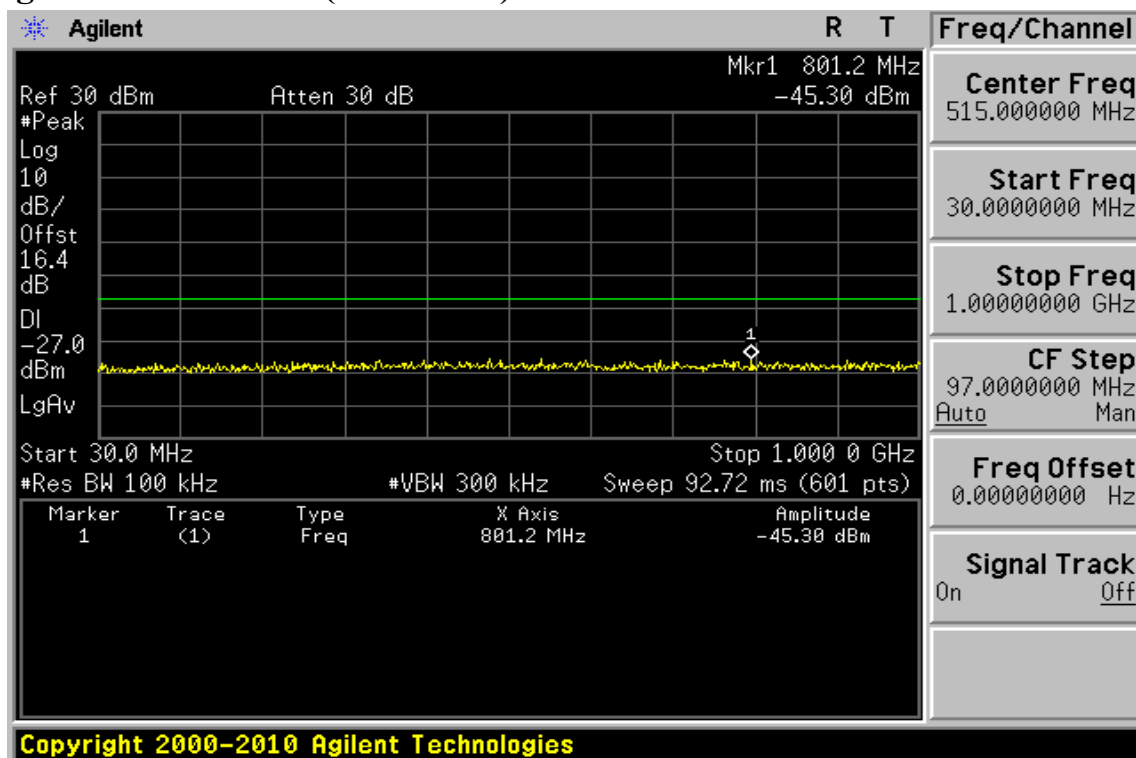
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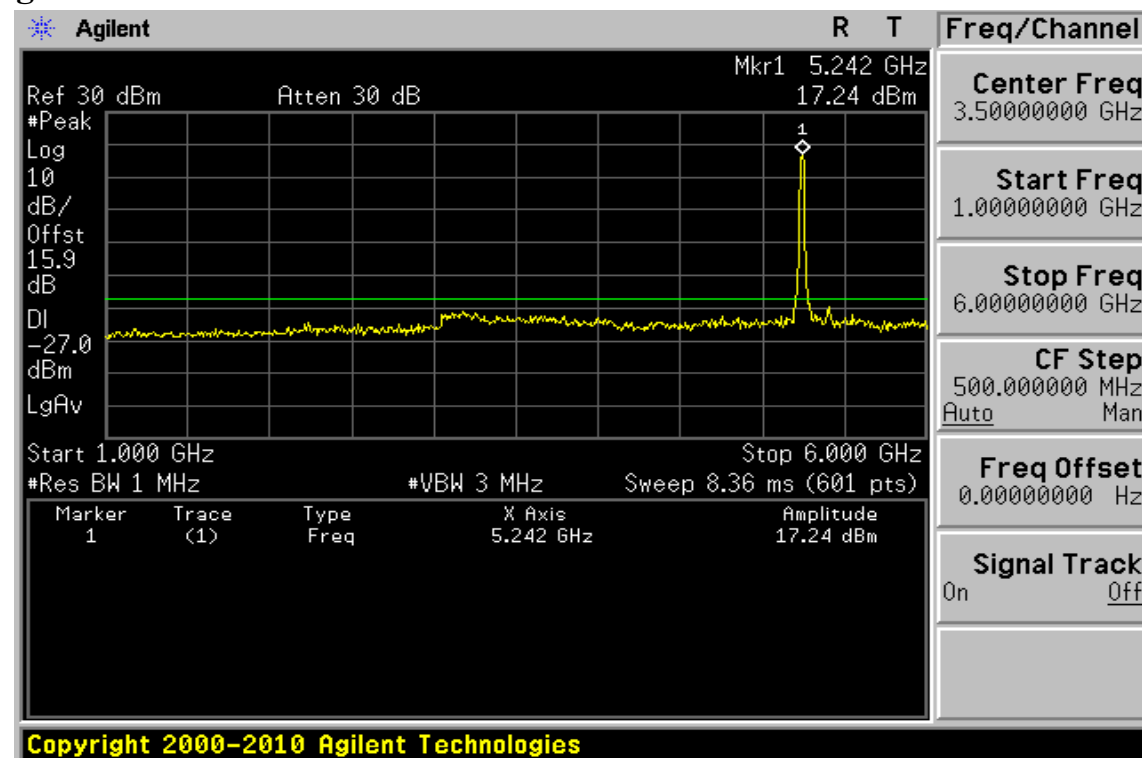
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Ch High 30MHz – 1GHz (5240 MHz)



Ch High 1GHz – 6GHz



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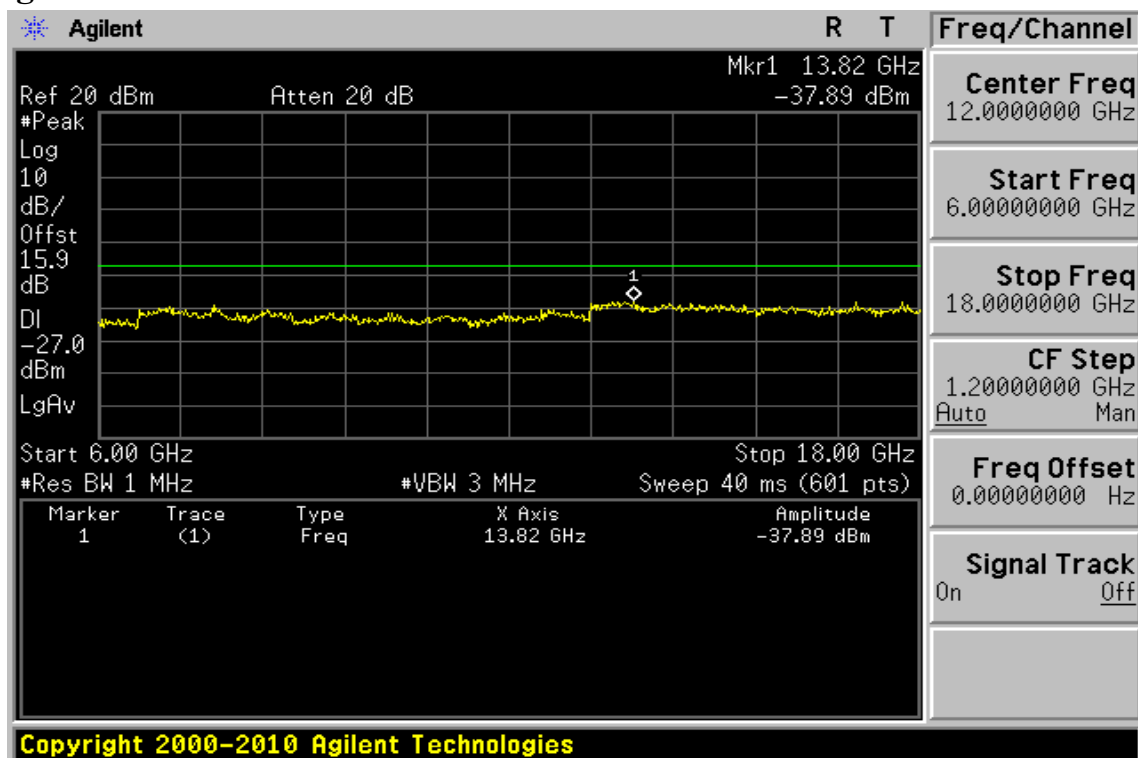
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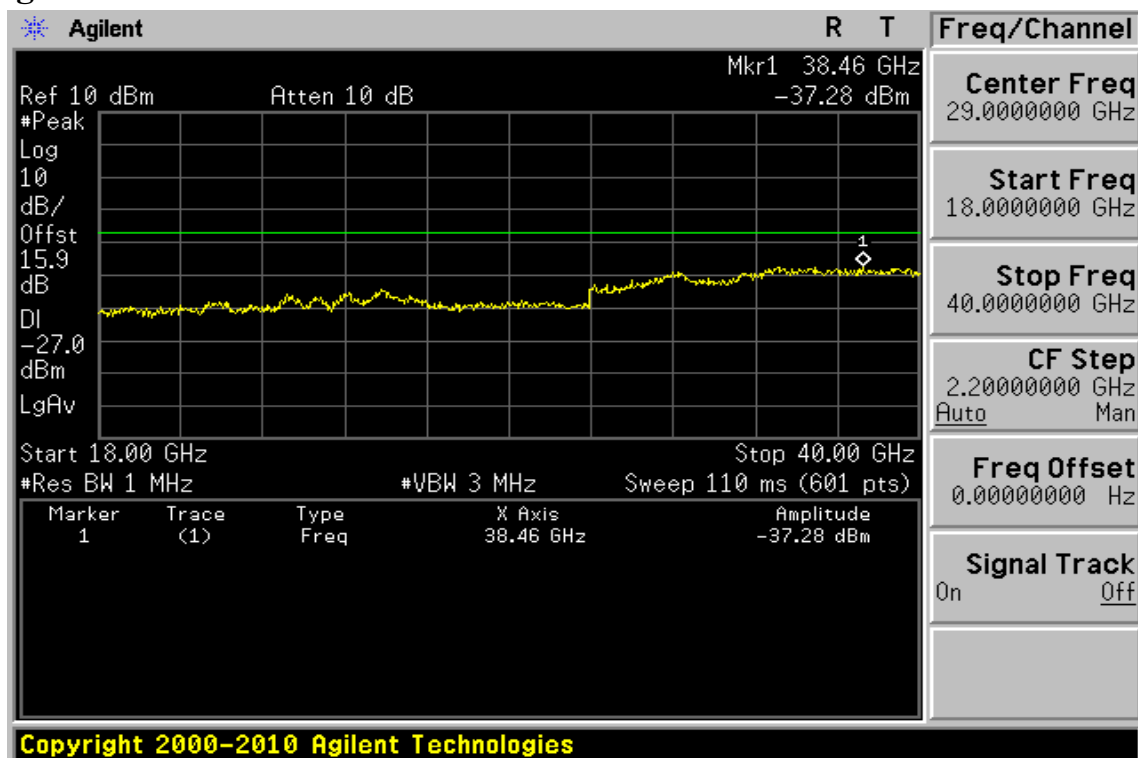
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Ch High 6GHz – 18GHz



Ch High 18GHz – 40GHz



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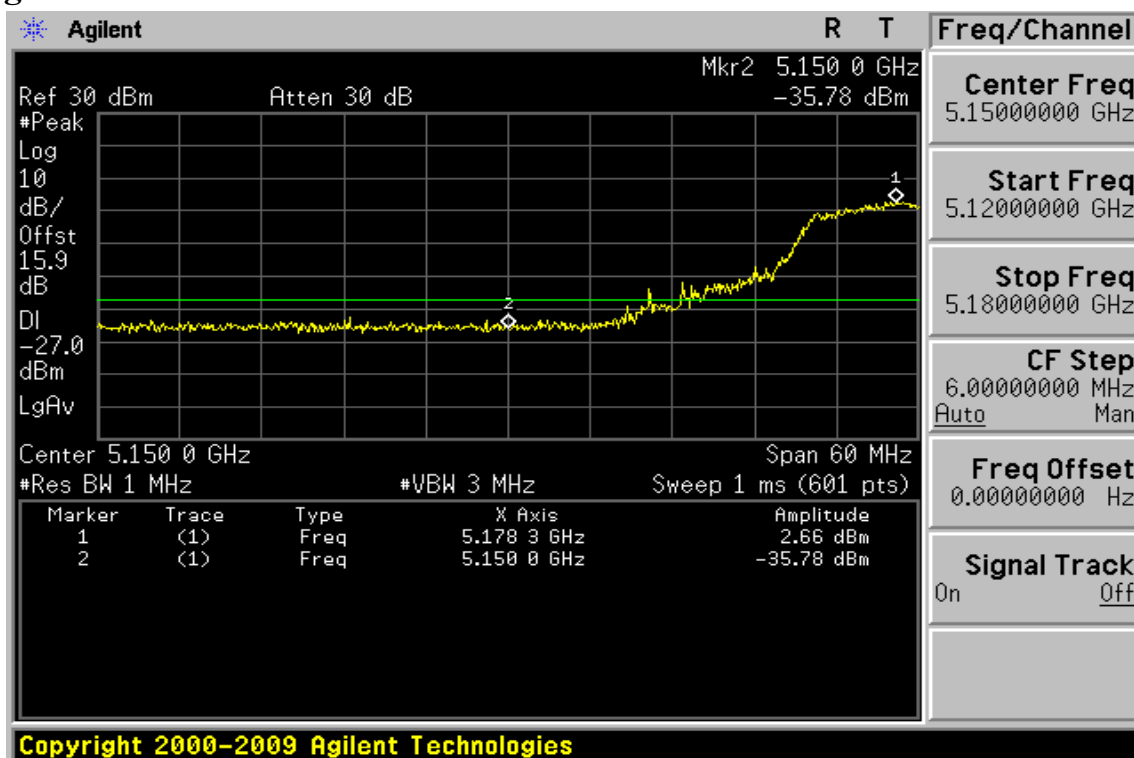
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802.11a 5150~5250 MHz

Band Edges Test Data CH 5150



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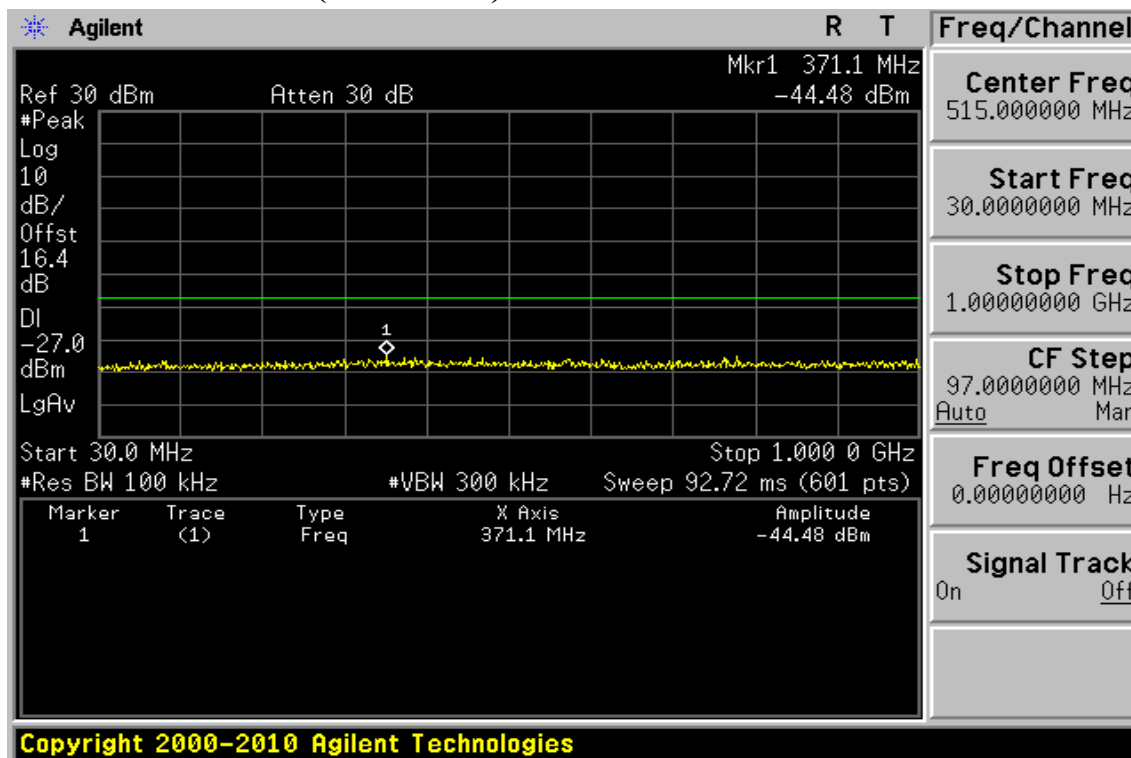
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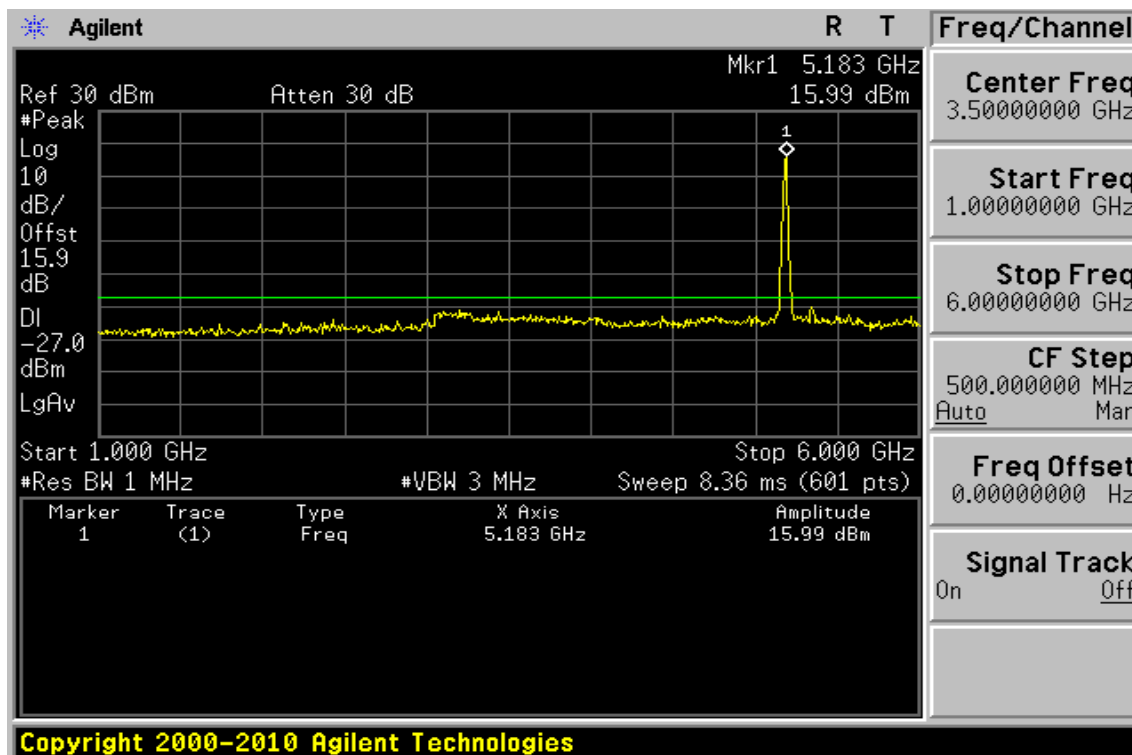
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802.11n HT20, 5150~5250 MHz

Ch Low 30MHz – 1GHz (5180 MHz)



Ch Low 1GHz – 6GHz



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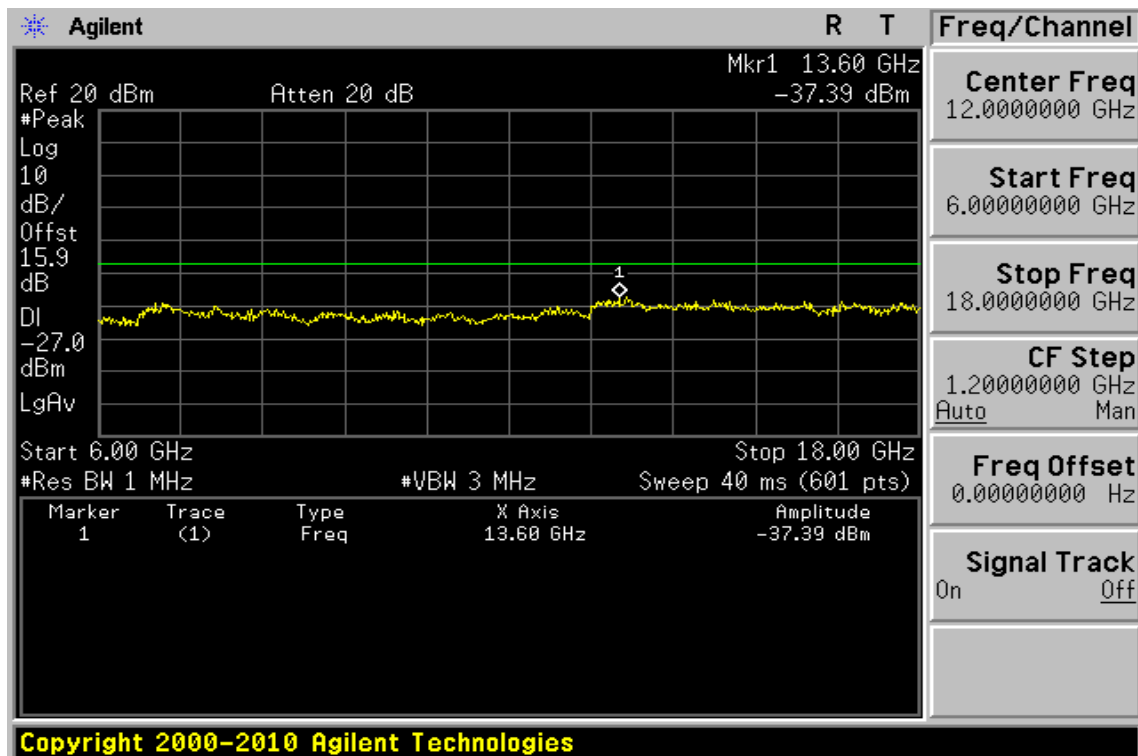
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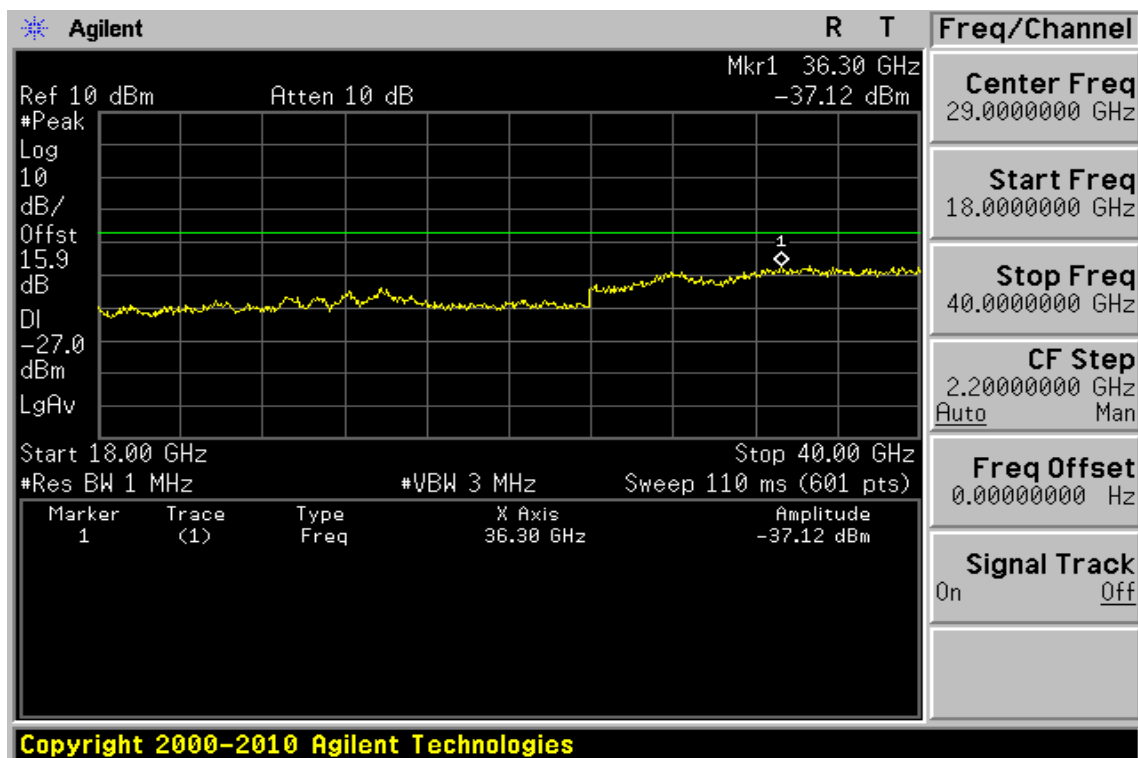
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Ch Low 6GHz – 18GHz



Ch Low 18GHz – 40GHz



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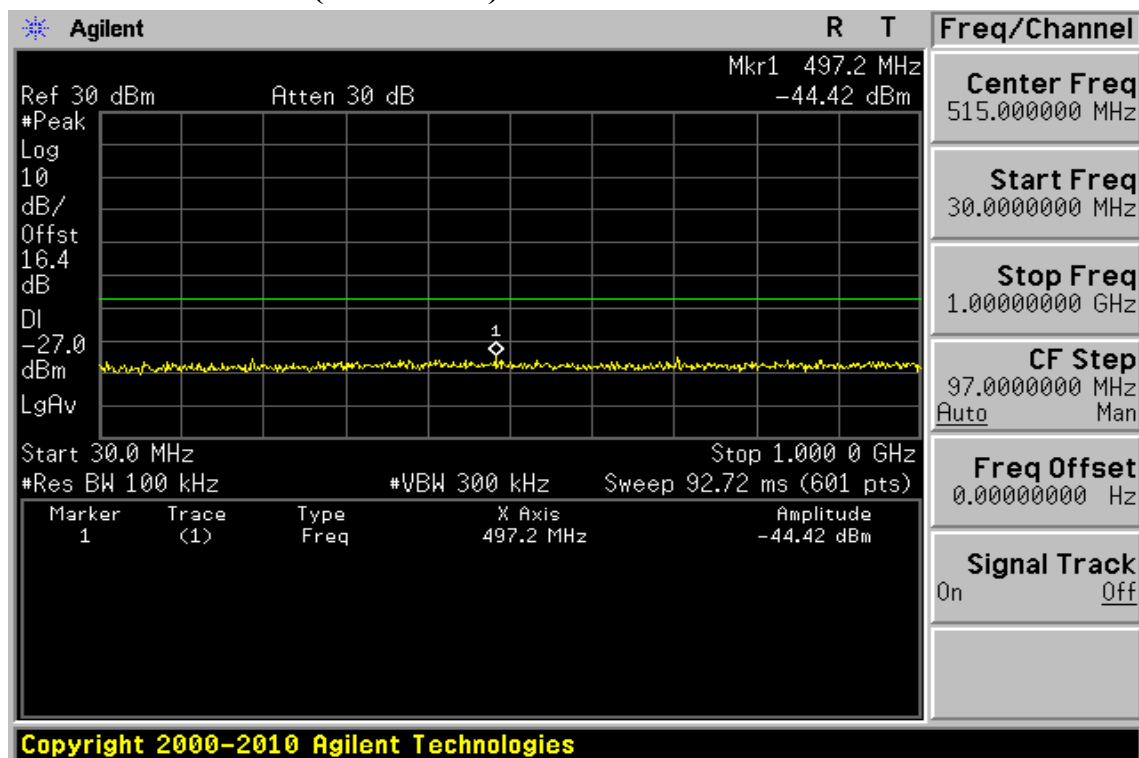
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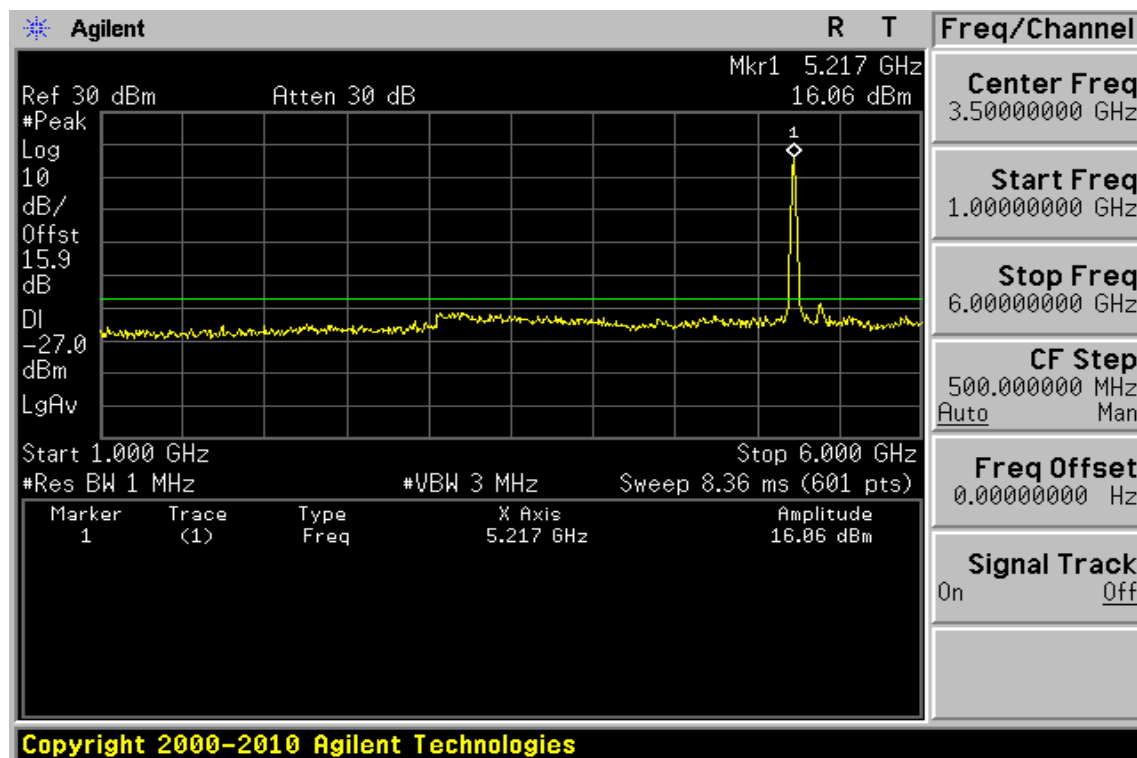
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Ch Mid 30MHz – 1GHz (5220 MHz)



Ch Mid 1GHz – 6GHz



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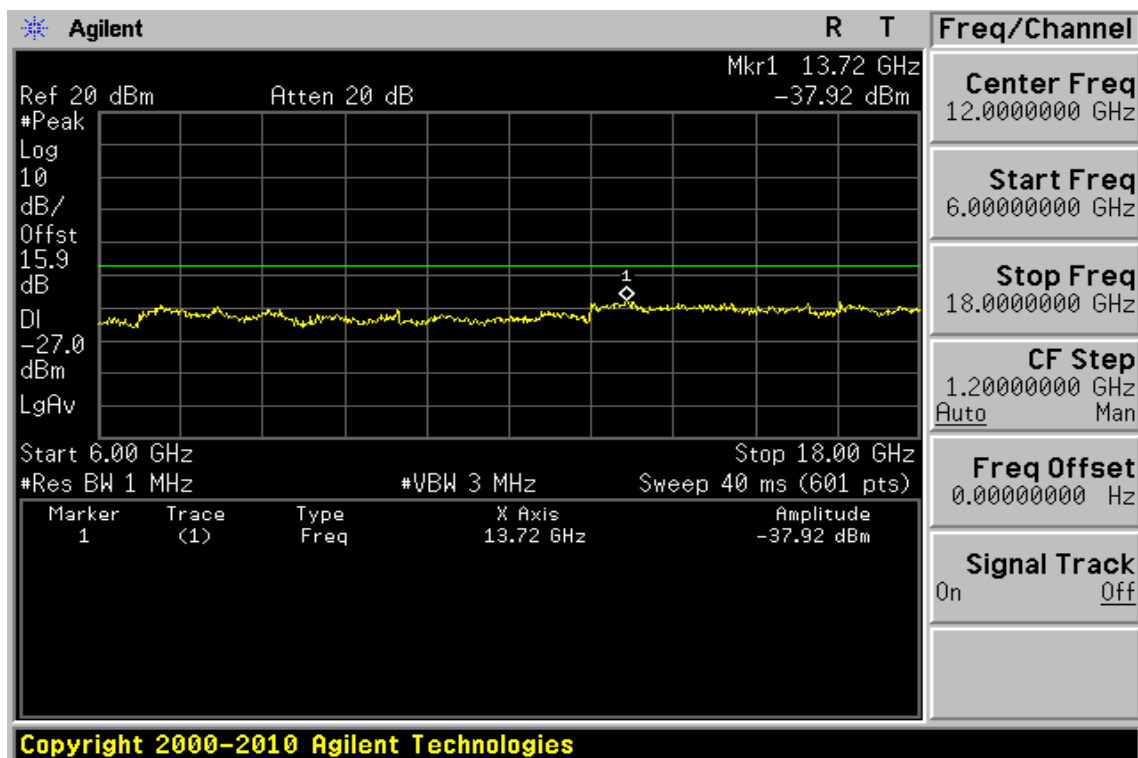
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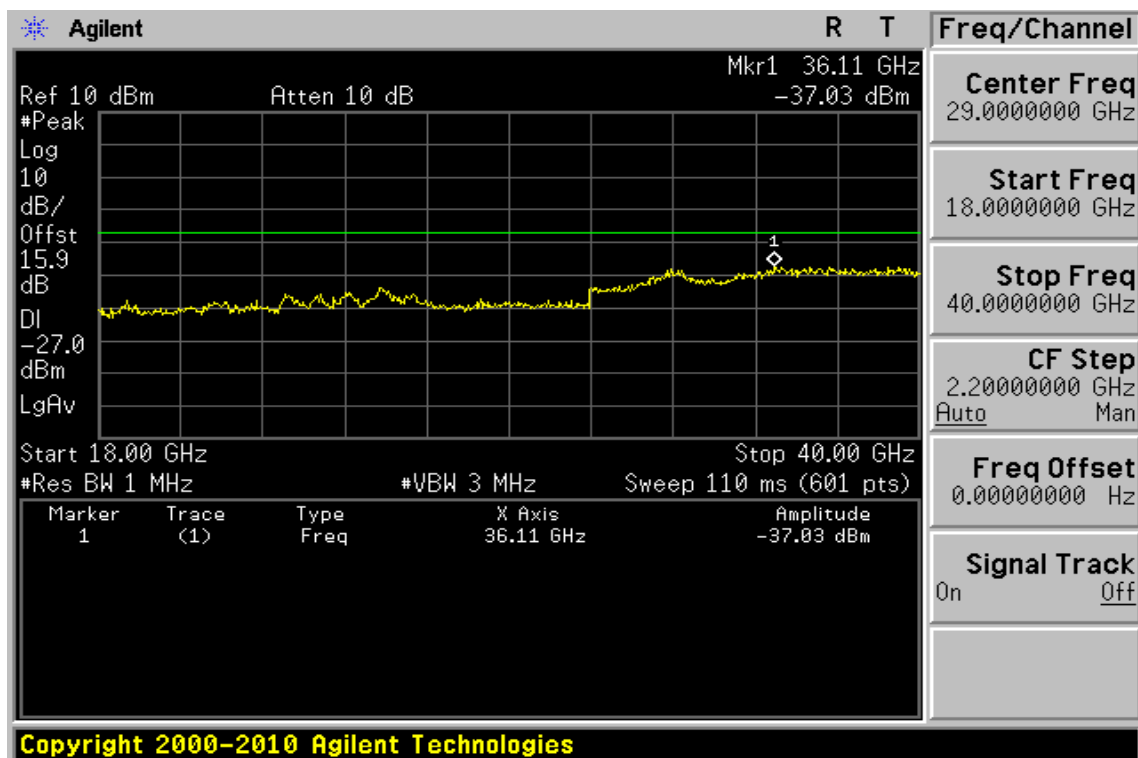
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Ch Mid 6GHz – 18GHz



Ch Mid 18GHz – 40GHz



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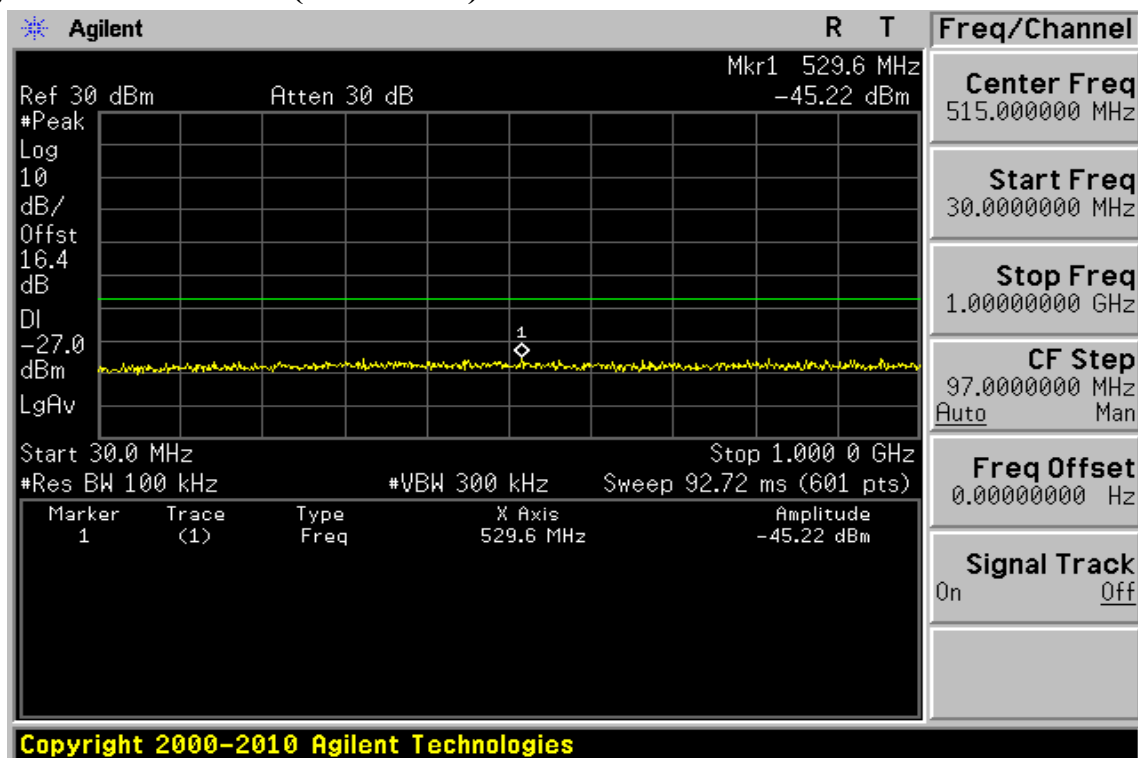
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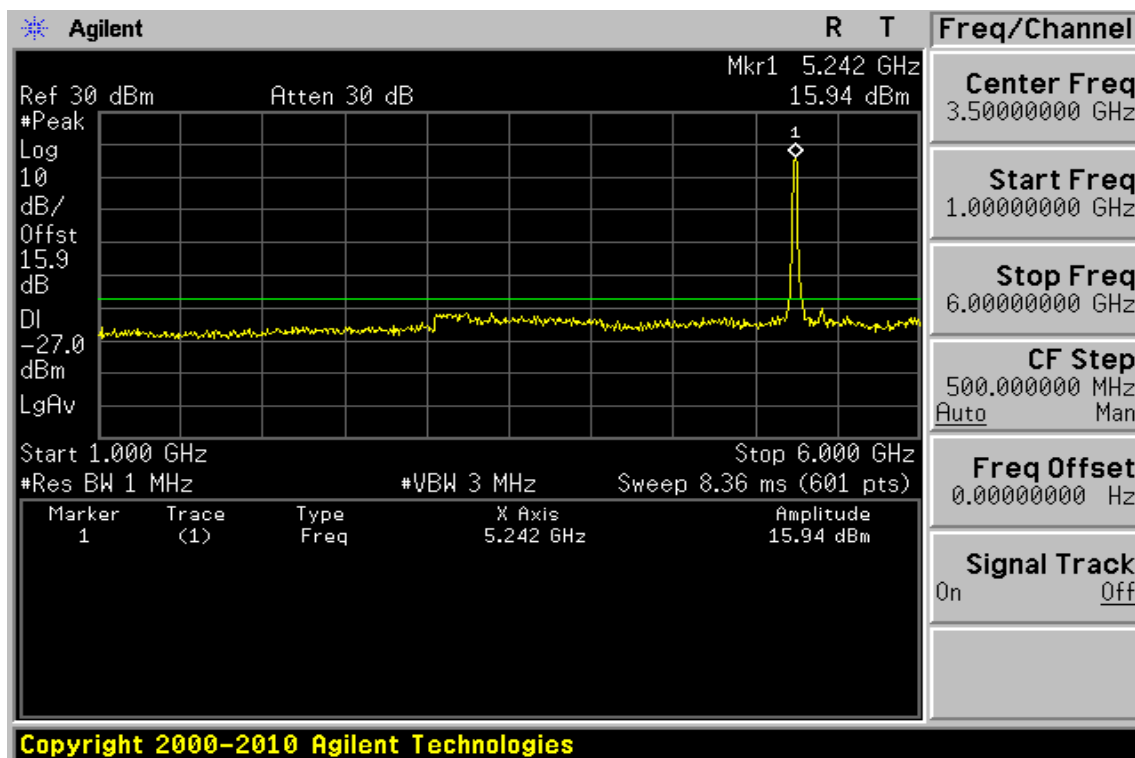
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Ch High 30MHz – 1GHz (5240 MHz)



Ch High 1GHz – 6GHz



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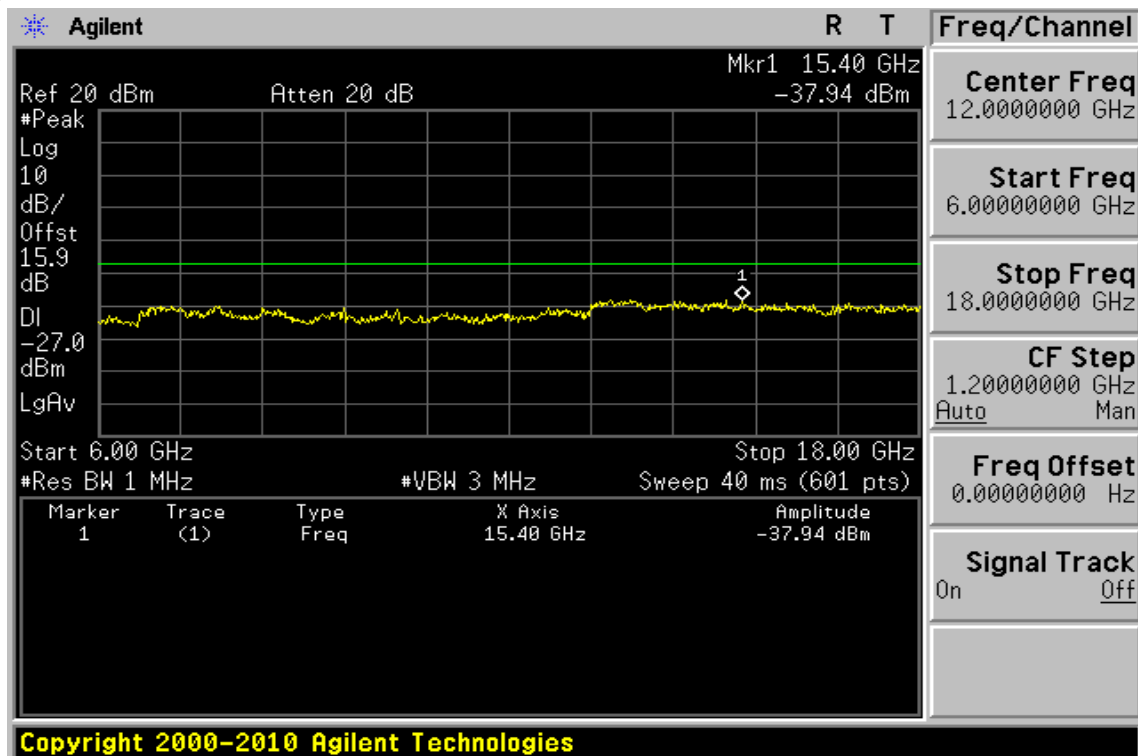
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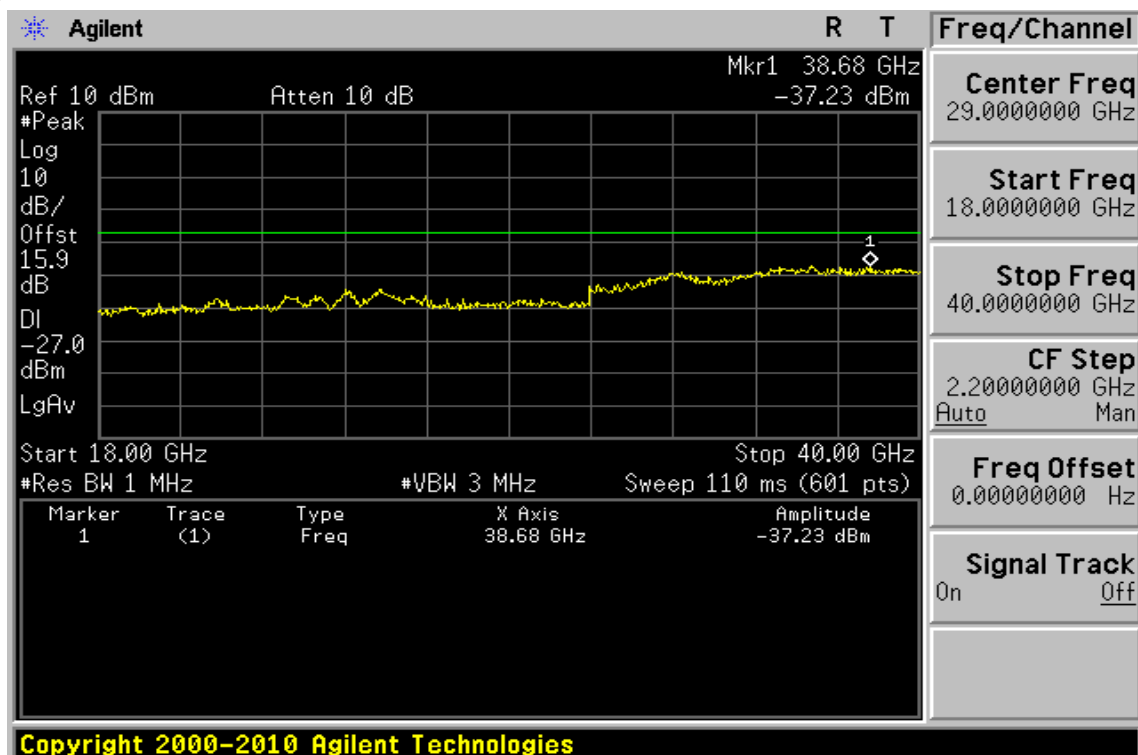
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Ch High 6GHz – 18GHz



Ch High 18GHz – 40GHz



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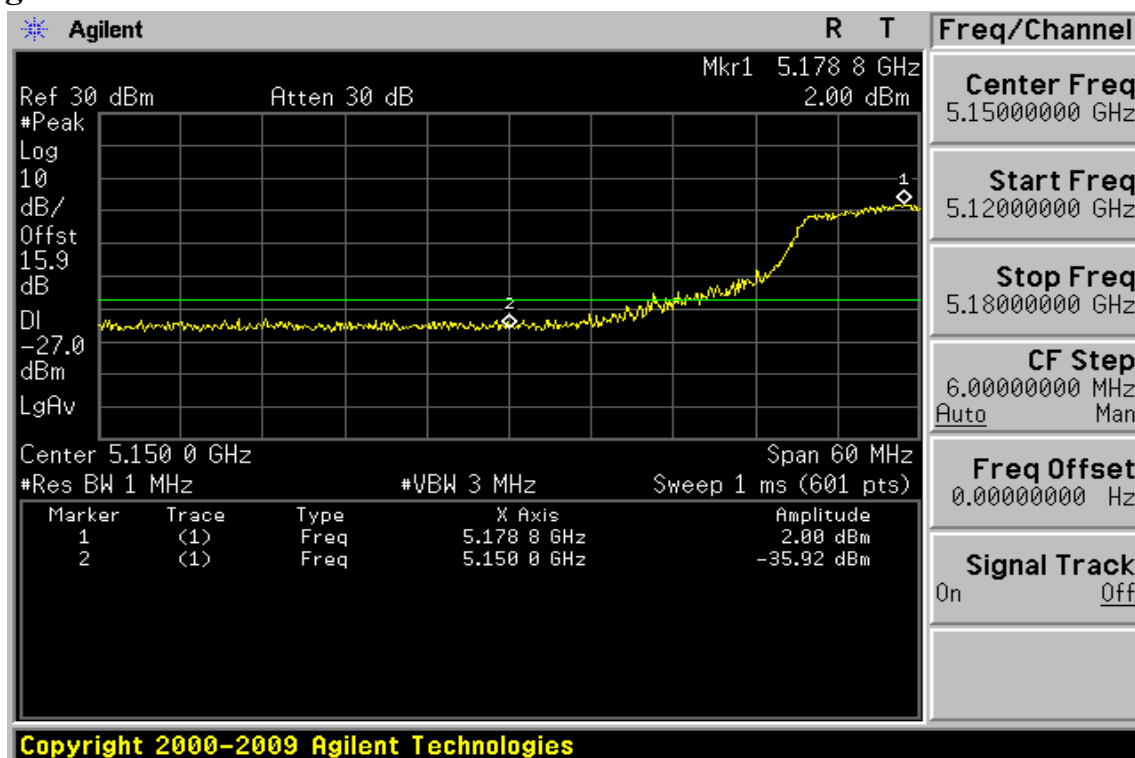
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802.11n HT20 5150~5250 MHz

Band Edges Test Data CH 5150



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12. UNDESIRABLE EMISSION - RADIATED MEASUREMENT

12.1 Standard Applicable

According to §15.407(b) (6) (7),

(b) Undesirable Emission Limits: Except as shown in Paragraph (b)(6) of this section, the peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.
- (2) The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.
- (3) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

Procedure H1) a) b) c) are adopted, KDB 789033 D01, where the conducted measurement is being used to comply with out of emission requirement as per FCC 15.407 b) 6) 7).

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§15.205- RESTRICTED BANDS OF OPERATIONS

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

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(²)
13.36 - 13.41	322 - 335.4		

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

² Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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§15.209- RADIATED EMISSION LIMITS: GENERAL REQUIREMENTS

FCC PART 15.209

MEASURING DISTANCE OF 3 METER		
FREQUENCY RANGE (MHz)	FIELD STRENGTH (Microvolts/m)	FIELD STRENGTH (dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

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12.1.1 Transmitter Spurious Emission Limits

Spurious emissions from licence-exempt transmitters shall comply with the field strength limits shown below. Additionally, the level of any transmitter spurious emission shall not exceed the level of the transmitter's fundamental emission.

Table 5: General Field Strength Limits for Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

Note: Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

12.1.2 Unwanted Emission that complies with the undesirable emission ruling by 15.407 (b) (1) (2) (3)

Frequencies (MHz)	EIRP Limit (dBm)	Equivalent Field Strength at 3m (dBuV/m)
5150 – 5250	-27	68.3

Limit derivation in terms of Field Strength:

$EIRP = (E \cdot d)^2 / 30$, where E is the field in V/m, d is the measurement distance (3m), EIRP is the equivalent isotropically radiated power in Watts.

$$E = 1000000 \cdot (30 \cdot EIRP)^{1/2} / 3 \text{ uV/m}$$

$$= 68.3 \text{ dBuV/m}$$

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12.2 EUT Setup

1. The radiated emission tests were performed in the 3 meter open-test site, using the setup in accordance with the ANSI C63.4:2009.
2. The EUT was put in the front of the test table. The host PC system was placed on the center of the back edge on the test table. The peripherals like modem, monitor printer, K/B, and mouse were placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The keyboard was placed directly in the front of the monitor, flushed with the front tabletop. The mouse was placed next to the Keyboard, flushed with the back of keyboard.
4. The spacing between the peripherals was 10 centimeters.
5. External I/O cables were draped along the edge of the test table and bundle when necessary.
6. The host PC system was connected with 120Vac/60Hz power source.

12.3 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until all frequency measured were complete.

For measurements below 1GHz, follow the KDB 789033 D01 requirements in section H)3), "General Requirements for Unwanted Emissions Measurements" Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

For Measurement above 1GHz, for peak unwanted emission measurements follow the KDB 789033 D01 requirements in section H)5) b), for average unwanted emission measurements follow the KDB 789033 D01 requirements in section H)6) c) or d).

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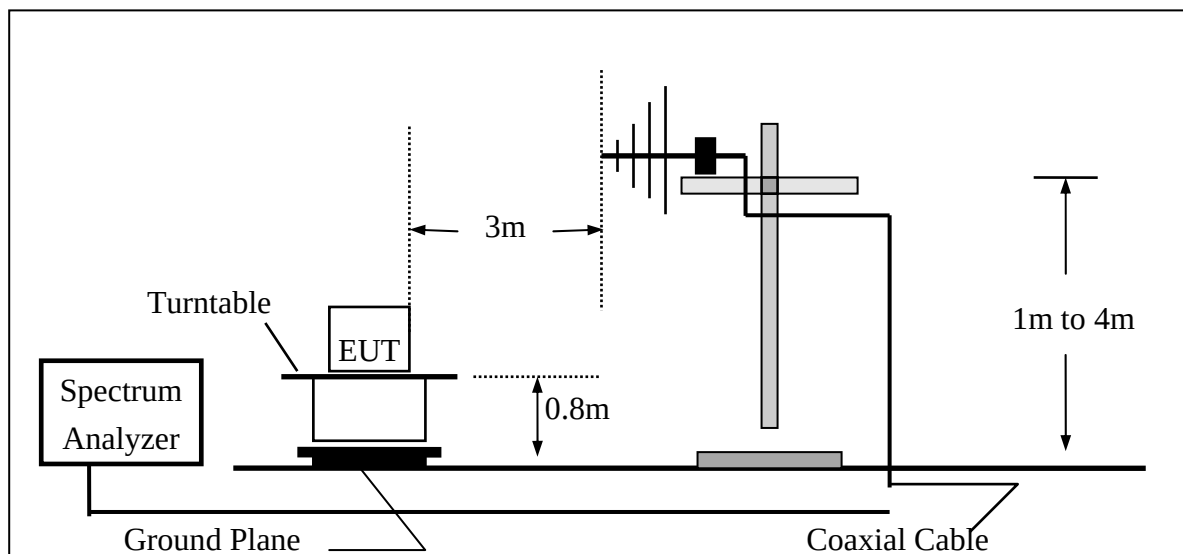
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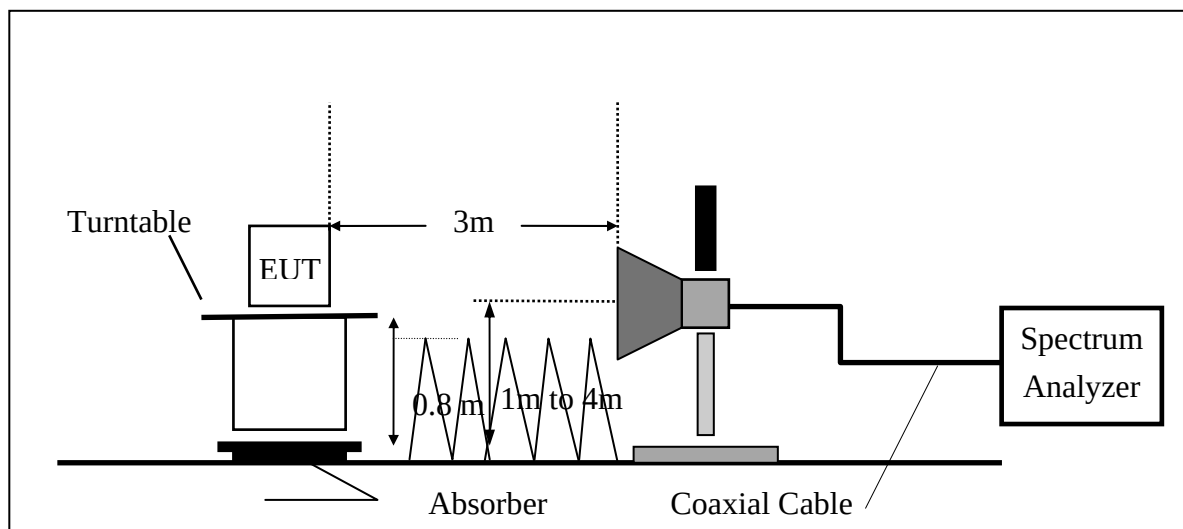
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12.4 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-Up Frequency Over 1 GHz



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12.5 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESC17	100759	02/08/2013	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/30/2013	05/29/2014
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	02/06/2013	02/07/2014
Spectrum Analyzer	R&S	FSV-30	101398	10/22/2013	10/21/2014
Bilog Antenna	SCHWAZBECK	VULB9168	378	01/02/2014	01/02/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/31/2013	05/30/2014
Horn Antenna	Schwarzbeck	BBHA9170	184	01/23/2014	01/22/2015
Pre-Amplifier	Agilent	8447D	2944A07676	01/03/2014	01/02/2015
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/03/2014	01/02/2015
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	02/28/2013	02/28/2014
Attenuator	Mini-Circuit	BW-S10W2+	004	02/28/2013	02/27/2014
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/03/2014	01/02/2015
3m Site NSA	SGS	966 chamber	N/A	07/15/2013	07/14/2014

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12.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

12.7 Measurement Result

Refer to attach tabular data sheets.

NOTE:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 100kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.

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Radiated Spurious Emission Measurement Result 802.11a, 5150~5250 MHz

Operation Band	:802.11 a	Test Date	:2014-01-17
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
408.30	S	Peak	47.00	-8.95	38.05	46.00	-7.95
456.80	S	Peak	47.29	-8.21	39.08	46.00	-6.92
541.19	S	Peak	47.54	-7.60	39.94	46.00	-6.06
672.14	S	Peak	45.67	-3.95	41.72	46.00	-4.28
767.20	S	Peak	42.85	-2.80	40.05	46.00	-5.95
815.70	S	Peak	42.34	-2.14	40.20	46.00	-5.80
10360.00	H	Peak	24.71	15.55	40.26	68.30	-28.04
15540.00	H	---					
20720.00	H	---					
25900.00	H	---					
31080.00	H	---					
36260.00	H	---					

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Operation Band	:802.11 a	Test Date	:2014-01-17
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
515.00	S	Peak	46.44	-7.43	39.01	46.00	-6.99
541.19	S	Peak	47.73	-7.60	40.13	46.00	-5.87
553.80	S	Peak	47.76	-7.12	40.64	46.00	-5.36
579.99	S	Peak	46.93	-5.24	41.69	46.00	-4.31
594.54	S	Peak	46.38	-5.29	41.09	46.00	-4.91
600.36	S	Peak	45.94	-5.51	40.43	46.00	-5.57
10360.00	H	Peak	25.49	15.55	41.04	68.30	-27.26
15540.00	H	---					
20720.00	H	---					
25900.00	H	---					
31080.00	H	---					
36260.00	H	---					

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Operation Band	:802.11 a	Test Date	:2014-01-17
Fundamental Frequency	:5220 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
541.19	S	Peak	47.26	-7.60	39.66	46.00	-6.34
579.99	S	Peak	46.28	-5.24	41.04	46.00	-4.96
672.14	S	Peak	45.87	-3.95	41.92	46.00	-4.08
767.20	S	Peak	42.79	-2.80	39.99	46.00	-6.01
791.45	S	Peak	41.78	-2.47	39.31	46.00	-6.69
815.70	S	Peak	42.51	-2.14	40.37	46.00	-5.63
10440.00	H	Peak	24.98	15.28	40.26	68.30	-28.04
15660.00	H	---					
20880.00	H	---					
26100.00	H	---					
31320.00	H	---					
36540.00	H	---					

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Fundamental Frequency	:5220 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
527.61	S	Peak	47.39	-7.51	39.88	46.00	-6.12
553.80	S	Peak	48.48	-7.12	41.36	46.00	-4.64
566.41	S	Peak	48.04	-6.17	41.87	46.00	-4.13
579.99	S	Peak	46.76	-5.24	41.52	46.00	-4.48
600.36	S	Peak	45.33	-5.51	39.82	46.00	-6.18
607.15	S	Peak	45.34	-5.79	39.55	46.00	-6.45
10440.00	H	Peak	25.99	15.28	41.27	68.30	-27.03
15660.00	H	---					
20880.00	H	---					
26100.00	H	---					
31320.00	H	---					
36540.00	H	---					

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Operation Band	:802.11 a	Test Date	:2014-01-17
Fundamental Frequency	:5240 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
541.19	S	Peak	47.37	-7.60	39.77	46.00	-6.23
672.14	S	Peak	45.31	-3.95	41.36	46.00	-4.64
767.20	S	Peak	42.89	-2.80	40.09	46.00	-5.91
791.45	S	Peak	42.29	-2.47	39.82	46.00	-6.18
815.70	S	Peak	42.03	-2.14	39.89	46.00	-6.11
839.95	S	Peak	42.42	-2.18	40.24	46.00	-5.76
10480.00	H	Peak	24.96	15.69	40.65	68.30	-27.65
15720.00	H	---					
20960.00	H	---					
26200.00	H	---					
31440.00	H	---					
36680.00	H	---					

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Operation Band	:802.11 a	Test Date	:2014-01-17
Fundamental Frequency	:5240 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
479.11	S	Peak	45.74	-7.76	37.98	46.00	-8.02
515.00	S	Peak	47.82	-7.43	40.39	46.00	-5.61
541.19	S	Peak	48.11	-7.60	40.51	46.00	-5.49
579.99	S	Peak	46.19	-5.24	40.95	46.00	-5.05
592.60	S	Peak	46.22	-5.21	41.01	46.00	-4.99
633.34	S	Peak	43.49	-5.42	38.07	46.00	-7.93
10480.00	H	Peak	27.14	15.69	42.83	68.30	-25.47
15720.00	H	---					
20960.00	H	---					
26200.00	H	---					
31440.00	H	---					
36680.00	H	---					

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Operation Band	:802.11 a	Test Date	:2014-01-23
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:Bandedge LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we’ve employed is peak detector.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
5150.00	E	Average	36.41	7.54	43.95	54.00	-10.05
5150.00	E	Peak	55.55	7.54	63.09	74.00	-10.91

Operation Band	:802.11 a	Test Date	:2014-01-23
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:Bandedge LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we’ve employed is peak detector.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
5150.00	E	Average	33.73	7.54	41.27	54.00	-12.73
5150.00	E	Peak	52.70	7.54	60.24	74.00	-13.76

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Radiated Spurious Emission Measurement Result 802.11n HT20, 5150~5250 MHz

Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
408.30	S	Peak	48.21	-8.95	39.26	46.00	-6.74
579.99	S	Peak	46.18	-5.24	40.94	46.00	-5.06
672.14	S	Peak	45.50	-3.95	41.55	46.00	-4.45
767.20	S	Peak	42.77	-2.80	39.97	46.00	-6.03
791.45	S	Peak	42.18	-2.47	39.71	46.00	-6.29
815.70	S	Peak	42.53	-2.14	40.39	46.00	-5.61
10360.00	H	Peak	25.30	15.55	40.85	68.30	-27.45
15540.00	H	---					
20720.00	H	---					
25900.00	H	---					
31080.00	H	---					
36260.00	H	---					

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Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
473.29	S	Peak	46.56	-7.83	38.73	46.00	-7.27
515.00	S	Peak	47.23	-7.43	39.80	46.00	-6.20
553.80	S	Peak	48.42	-7.12	41.30	46.00	-4.70
594.54	S	Peak	46.85	-5.29	41.56	46.00	-4.44
607.15	S	Peak	47.32	-5.79	41.53	46.00	-4.47
643.04	S	Peak	44.21	-4.91	39.30	46.00	-6.70
10360.00	H	Peak	24.65	15.55	40.20	68.30	-28.10
15540.00	H	---					
20720.00	H	---					
25900.00	H	---					
31080.00	H	---					
36260.00	H	---					

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Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5220 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
476.20	S	Peak	47.20	-7.80	39.40	46.00	-6.60
502.39	S	Peak	46.97	-7.51	39.46	46.00	-6.54
553.80	S	Peak	46.61	-7.12	39.49	46.00	-6.51
579.99	S	Peak	46.98	-5.24	41.74	46.00	-4.26
672.14	S	Peak	45.32	-3.95	41.37	46.00	-4.63
839.95	S	Peak	42.22	-2.18	40.04	46.00	-5.96
10440.00	H	Peak	24.40	15.28	39.68	68.30	-28.62
15660.00	H	---					
20880.00	H	---					
26100.00	H	---					
31320.00	H	---					
36540.00	H	---					

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Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5220 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
479.11	S	Peak	45.66	-7.76	37.90	46.00	-8.10
515.00	S	Peak	47.21	-7.43	39.78	46.00	-6.22
553.80	S	Peak	48.91	-7.12	41.79	46.00	-4.21
594.54	S	Peak	47.08	-5.29	41.79	46.00	-4.21
607.15	S	Peak	47.28	-5.79	41.49	46.00	-4.51
645.95	S	Peak	45.90	-4.78	41.12	46.00	-4.88
10440.00	H	Peak	24.87	15.28	40.15	68.30	-28.15
15660.00	H	---					
20880.00	H	---					
26100.00	H	---					
31320.00	H	---					
36540.00	H	---					

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Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5240 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
476.20	S	Peak	47.04	-7.80	39.24	46.00	-6.76
502.39	S	Peak	47.37	-7.51	39.86	46.00	-6.14
553.80	S	Peak	48.44	-7.12	41.32	46.00	-4.68
672.14	S	Peak	45.79	-3.95	41.84	46.00	-4.16
744.89	S	Peak	42.75	-2.92	39.83	46.00	-6.17
839.95	S	Peak	42.69	-2.18	40.51	46.00	-5.49
10480.00	H	Peak	24.13	15.69	39.82	68.30	-28.48
15720.00	H	---					
20960.00	H	---					
26200.00	H	---					
31440.00	H	---					
36680.00	H	---					

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Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5240 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
515.00	S	Peak	46.46	-7.43	39.03	46.00	-6.97
541.19	S	Peak	47.20	-7.60	39.60	46.00	-6.40
553.80	S	Peak	47.25	-7.12	40.13	46.00	-5.87
579.99	S	Peak	46.27	-5.24	41.03	46.00	-4.97
607.15	S	Peak	46.87	-5.79	41.08	46.00	-4.92
633.34	S	Peak	45.51	-5.42	40.09	46.00	-5.91
10480.00	H	Peak	24.27	15.69	39.96	68.30	-28.34
15720.00	H	---					
20960.00	H	---					
26200.00	H	---					
31440.00	H	---					
36680.00	H	---					

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Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:Bandedge LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we’ve employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
5150.00	E	Average	35.85	7.54	43.39	54.00	-10.61
5150.00	E	Peak	55.61	7.54	63.15	74.00	-10.85

Operation Band	:802.11 n20M	Test Date	:2014-01-23
Fundamental Frequency	:5180 MHz	Temp./Humi.	:20.2deg_C/60RH
Operation Mode	:Bandedge LOW	Engineer	:Curry
EUT Pol.	:H Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we’ve employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
5150.00	E	Average	32.87	7.54	40.41	54.00	-13.59
5150.00	E	Peak	51.29	7.54	58.83	74.00	-15.17

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13. TRANSMISSION IN THE ABSENCE OF DATA

13.1 Standard Applicable

According to §15.407(c)

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

13.2 Result:

No non-compliance noted:

Refer to the theory of operation.

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14. FREQUENCY STABILITY

14.1 Standard Applicable

According to §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 user's manual.

14.2 Result:

Refer to next page for plots.

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Operation Mode	802.11 a	Test Date	2013,10,24
Temperature	:25 °C	Test By	Nick
Humidity	:62 %		

Test Temp.	Test Voltage	Channel	Measured Frequency (MHz)	Spectrum Frequency (MHz)	ΔFrequency (MHz)
25 °C	3.7V	36	5180.0000	5,180.007000	-0.0070
		44	5220.0000	5,220.006883	-0.0069
		48	5240.0000	5,240.006917	-0.0069
50 °C	3.4V	36	5180.0000	5,180.006997	-0.0070
		44	5220.0000	5,220.006737	-0.0067
		48	5240.0000	5,240.006857	-0.0069
50 °C	4.2V	36	5180.0000	5,180.006934	-0.0069
		44	5220.0000	5,220.006847	-0.0068
		48	5240.0000	5,240.006893	-0.0069
-10 °C	3.4V	36	5180.0000	5,180.006973	-0.0070
		44	5220.0000	5,220.006867	-0.0069
		48	5240.0000	5,240.006843	-0.0068
-10 °C	4.2V	36	5180.0000	5,180.006891	-0.0069
		44	5220.0000	5,220.006791	-0.0068
		48	5240.0000	5,240.006887	-0.0069

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15. ANTENNA REQUIREMENT

15.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

15.2 Antenna Connected Construction

The directional gains of antenna used for transmitting is 4.2dBi for frequency band of 5150~5250MHz, and the antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec.for details.

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