FCC PART 15, SUBPART C
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

ABB Enterprise Software Inc.

3055 Orchard Drive,

San Jose, CA 95134, USA

FCC ID: P9J-NEPTUNE24
IC: 4751A-NEPTUNE24

Report Type:	**Product Type:**
Original Report	2.4 GHz Wi-Fi Module

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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2004022-247	Original Report	2020-10-21

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report was prepared on behalf of *ABB Enterprise Software Inc.*, and their product model: *NEPTUNE 2.4,* FCC ID: *P9J-NEPTUNE24*; IC: *4751A-NEPTUNE24*, or the "EUT" as referred to in this report. The EUT is a 2.4 GHz Wi-Fi module.

The radio module can simultaneously transmit with cellular module FCC ID: N7NEM75S, IC: 2417C-EM75S.

1.2 Mechanical Description of EUT

The (EUT) measures approximately: 76 mm (L) x 52 mm (W) x 4 mm (H) and weighs approximately 50 grams

The data gathered are from the typical production sample provided by the ABB Enterprise Software Inc. with serial number: R2004022-1 assigned by BACL.

1.3 Objective

This report was prepared on behalf of *ABB Enterprise Software Inc.,* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and ISEDC RSS-247 Issue 2, February 2017.

The objective was to determine compliance with FCC Part 15.247 and ISEDC RSS-247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v05r2: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide

range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)

- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v05r02.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test software used was QCMBR provided by *ABB Enterprise Software Inc.,* the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
802.11b	2412	25
	2437	25
	2462	25
8002.11g	2412	23
	2437	25
	2462	23
802.11n HT20	2412	21
	2437	21
	2462	21
802.11n HT40	2422	21
	2437	21
	2452	21
802.11n HT20 STBC	2412	23
	2437	25
	2462	25
802.11n HT40 STBC	2422	23
	2437	25
	2452	25

Data Rates Tested:
802.11b mode: 1Mbps
802.11g mode: 6Mbps
802.11n HT20 mode: MCS0
802.11n HT40 mode: MCS0
802.11n HT20 STBC: MCS16
802.11n HT40 STBC: MCS16

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v05r02 section 6.0:

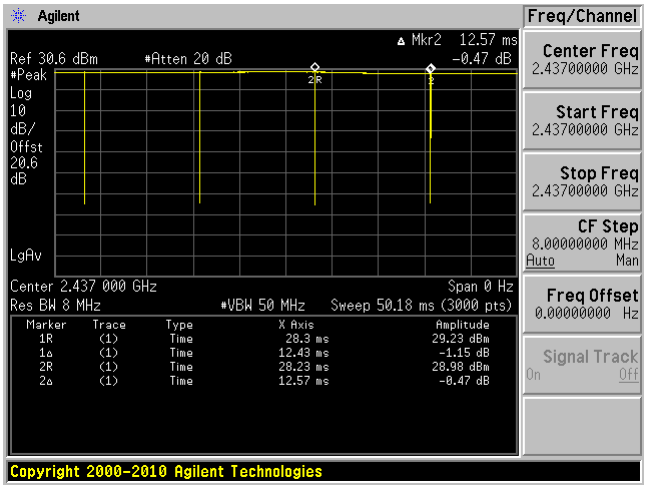
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	12.43	12.57	98.9	0
802.11g	2.136	2.207	96.8	0.14
802.11n HT20/STBC	18.802	20.68	90.9	0.41
802.11n HT40/STBC	9.625	10.42	92.37	0.34

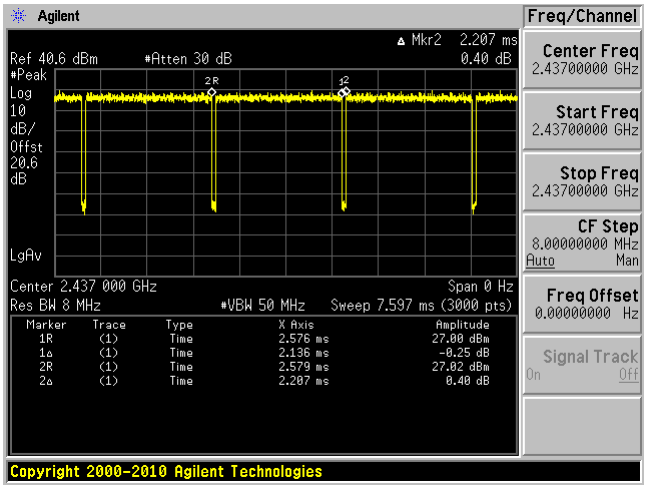
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

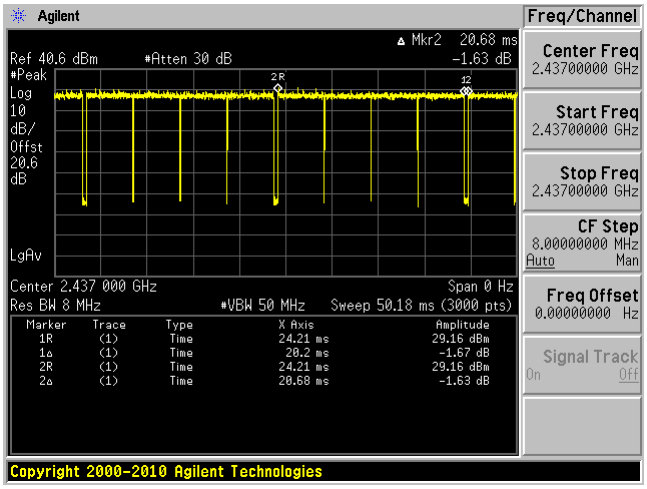
802.11b mode



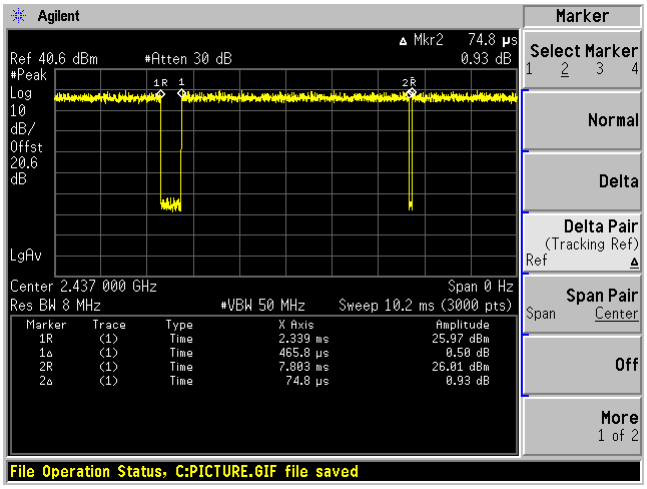
802.11g mode



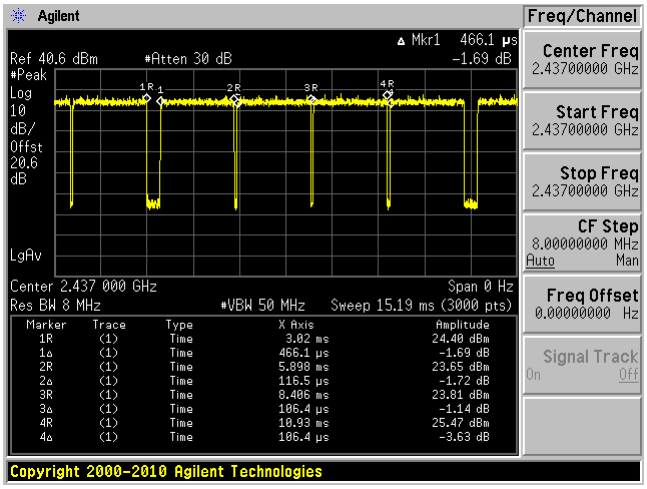
802.11n HT20 mode -1



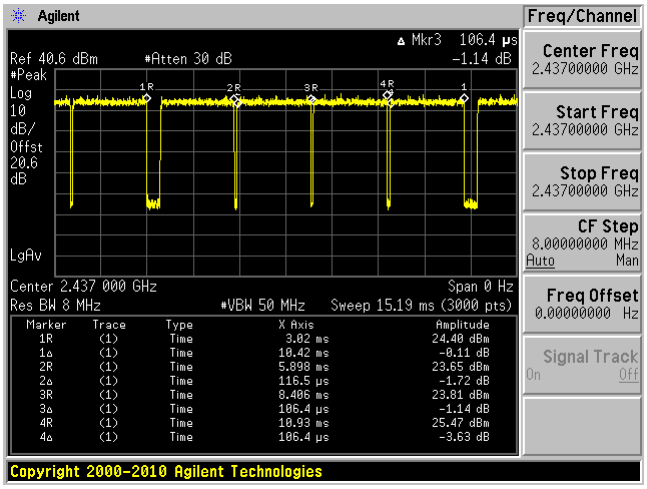
802.11n HT20 mode -2



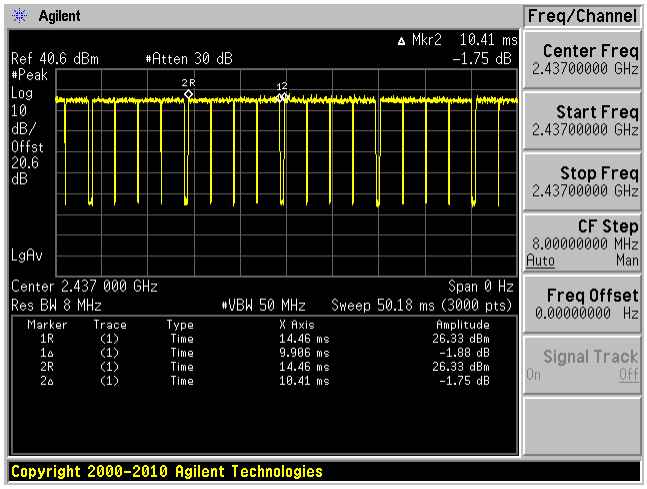
802.11n HT40 mode -1



802.11n HT40 mode -2



802.11n HT40 mode -3



Note: HT20 and HT40 modes have 4 pluses in each period. Thus, the on time was calculated by period minus off time.

2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7450

2.6 Support Equipment

Manufacturer	Description	Model
XP Power	AC/DC Power Supply	VEC65US24

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Ethernet Cable	< 1 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 (1)	6 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (4)	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2 (2)	Power Spectral Density	Compliant

4 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements

4.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

4.2 Antenna Description

The antennas were connected to the u.fl connectors on the EUT via short coaxial cable.

Manufacturer	Model Number	Frequency Range (MHz)	Antenna Type	Maximum Gain (dBi)
PCTEL	MHODB24490507NM-IP	2400-2483.5	Dipole/Omni	5

Note: antenna gain was provided by customer.

5 FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure

5.1 Applicable Standard

According to FCC §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
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

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

According to ISED RSS-102 Issue 5: For the purpose of this standard, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline.

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

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

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

5.3 Test Results

2.4 GHz Wi-Fi Standalone

Worst Case: 802.11n40 STBC, 2437 MHz

FCC:

Maximum peak output power at antenna input terminal (total) (dBm):	30
Maximum peak output power at antenna input terminal (mW):	1000
Prediction distance (cm):	20
Predication frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	5
Maximum Antenna Gain (numeric):	3.16
Power density of prediction frequency at prediction distance (mW/cm^2):	0.63
FCC limit (mW/cm^2):	1.00

For the MIMO system, the sum conducted output power 30 dBm is considered as the worst case, with the separation distance of 20 cm, the power density is 0.63 mW/cm², which complies with the MPE limit of ≤ 1.0.

IC:

Maximum peak output power at antenna input terminal (total) (dBm):	30
Maximum peak output power at antenna input terminal (W):	1.0
Prediction distance (cm):	23
Predication frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	5
Maximum Antenna Gain (numeric):	3.16
Power density of prediction frequency at prediction distance (W/m^2):	4.76
IC limit (W/m^2):	5.404

For the MIMO system, the sum conducted output power 30 dBm is considered as the worst case, with the separation distance of 23 cm, the power density is 4.76 W/m², which complies with the MPE limit of ≤ 5.404.

Cellular Module Standalone

FCC ID: N7NEM75S

Band	Frequency (MHz)	Max Conducted Power (dBm)	Evaluated Distance (cm)	Antenna[1] Gain (dBi)	Antenna Cable Loss (dB)	MPE (mW/cm^2)	MPE Limit (mW/cm^2)	MPE Ratio (%)
WCDMA Band II/ LTE Band 2	1850	24.00	20	1.07	2.5	0.036	1	3.595
WCDMA Band IV/ LTE Band 4	1710	24.00	20	1.07	2.5	0.036	1	3.595
WCDMA Band V/ LTE Band 5	824	24.00	20	1	2.5	0.035	0.549	6.440
LTE Band 7	2500	23.80	20	2.16	2.5	0.044	1	4.413
LTE Band 12	699	24.00	20	1	2.5	0.035	0.466	7.592
LTE Band 13	777	24.00	20	1	2.5	0.035	0.518	6.830
LTE Band 26	814	24.00	20	1	2.5	0.035	0.543	6.519
LTE Band 30	2305	23.00	20	1.48	2.5	0.031	1	3.139
LTE Band 41	2496	23.80	20	1.48	2.5	0.038	1	3.773
LTE Band 14	788	24.00	20	1	2.5	0.035	0.525	6.734
LTE Band 66	1710	24.00	20	1.07	2.5	0.036	1	3.595

IC: 2417C-EM75S

Band	Frequency (MHz)	Max Conducted Power (dBm)	Evaluated Distance (cm)	Antenna[1] Gain (dBi)	Antenna Cable Loss (dB)	MPE (W/m^2)	MPE Limit (W/m^2)	MPE Ratio (%)
WCDMA Band II/ LTE Band 2	1850	24.00	23	1.07	2.5	0.272	4.476	6.073
WCDMA Band IV/ LTE Band 4	1710	24.00	23	1.07	2.5	0.272	4.242	6.409
WCDMA Band V/ LTE Band 5	824	24.00	23	1	2.5	0.268	2.576	10.386
LTE Band 7	2500	23.80	23	2.16	2.5	0.334	5.499	6.068
LTE Band 12	699	24.00	23	1	2.5	0.268	2.302	11.622
LTE Band 13	777	24.00	23	1	2.5	0.268	2.474	10.811
LTE Band 26	814	24.00	23	1	2.5	0.268	2.554	10.473
LTE Band 30	2305	23.00	23	1.48	2.5	0.237	5.202	4.562
LTE Band 41	2496	23.80	23	1.48	2.5	0.285	5.493	5.194
LTE Band 14	788	24.00	23	1	2.5	0.268	2.498	10.708
LTE Band 66	1710	24.00	23	1.07	2.5	0.272	4.242	6.409

Note[1]: multi band swivel mount dipole antenna part number: W5095X by PulseLARSEN Antennas.

Radio Co-location

Worst Case Co-location 2.4 GHz Wi-Fi Radio, and LTE Band FDD12:

FCC

Frequency Band	Max EIRP Power (dBm)	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz Wi-Fi	35	20	0.63	1.0	63%	70.592%	100%
LTE Band FDD12	25	20	0.063	0.466	7.592%		

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum MPE ratio at the distance of 20 cm is 70.592% Limit is 100%.

IC

Frequency Band	Max EIRP Power (dBm)	Evaluated Distance (cm)	Worst-Case MPE (W/cm^2)	MPE Limit (W/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz Wi-Fi	35	23	4.76	5.404	88.03%	99.65%	100%
LTE Band FDD12	25	23	0.268	2.302	11.62%		

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum MPE ratio at the distance of 23 cm is 99.65% Limit is 100%.

6 FCC §15.207 & ISEDC RSS-Gen §8.8 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and ISEDC RSS-Gen §8.8 Conducted limits:

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

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were FCC §15.207 and ISEDC RSS-Gen §8.8 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The AC/DC power adapter of the Debug Board was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cords of support equipment were connected to LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data were recorded in the peak, quasi-peak, and average detection mode. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

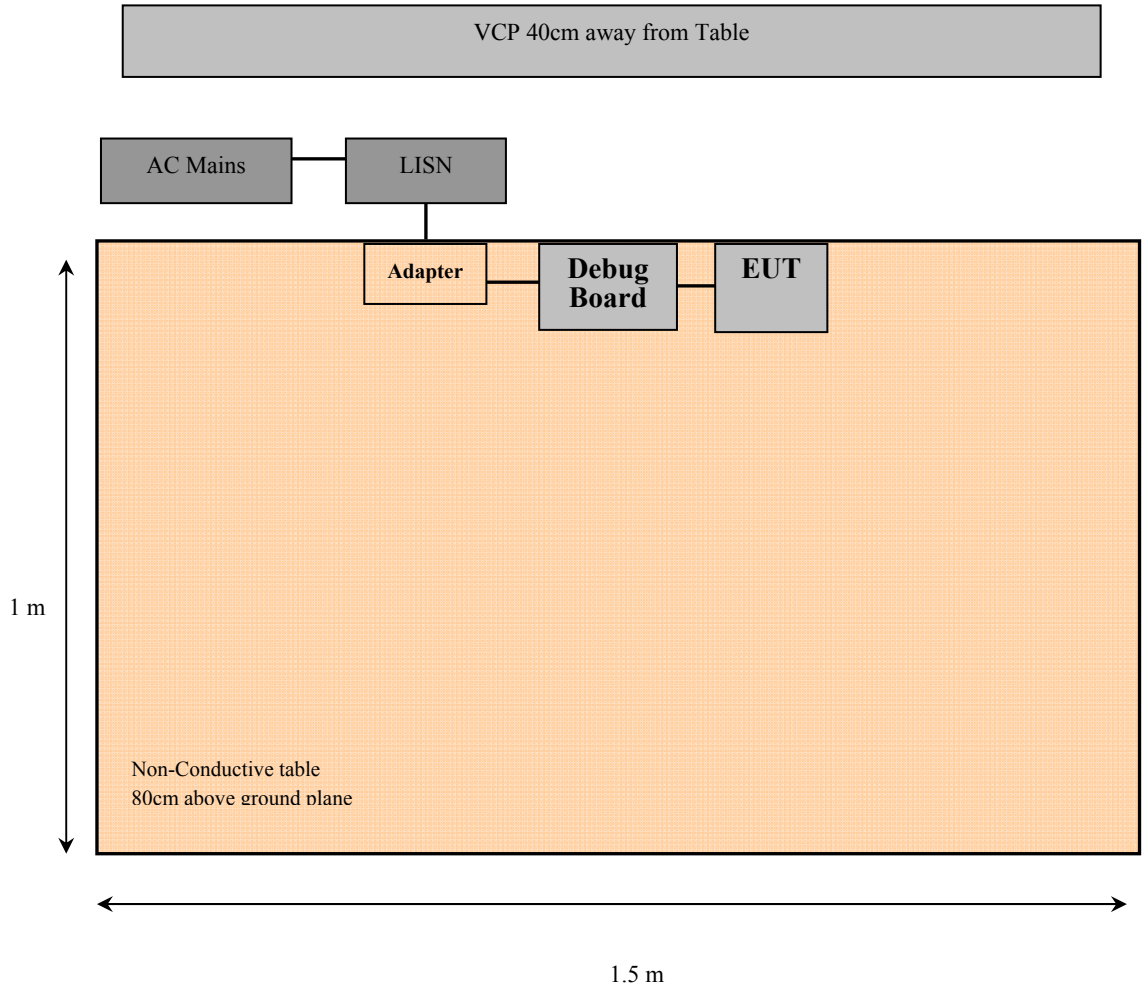
CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude – Limit

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2019-01-05	2 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2019-07-31	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2020-02-27	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160131	2019-12-17	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

6.7 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	101.31 kPa

The testing was performed by Zhao Zhao on 2020-07-22 in 5 chamber 3.

6.8 Summary of Test Results

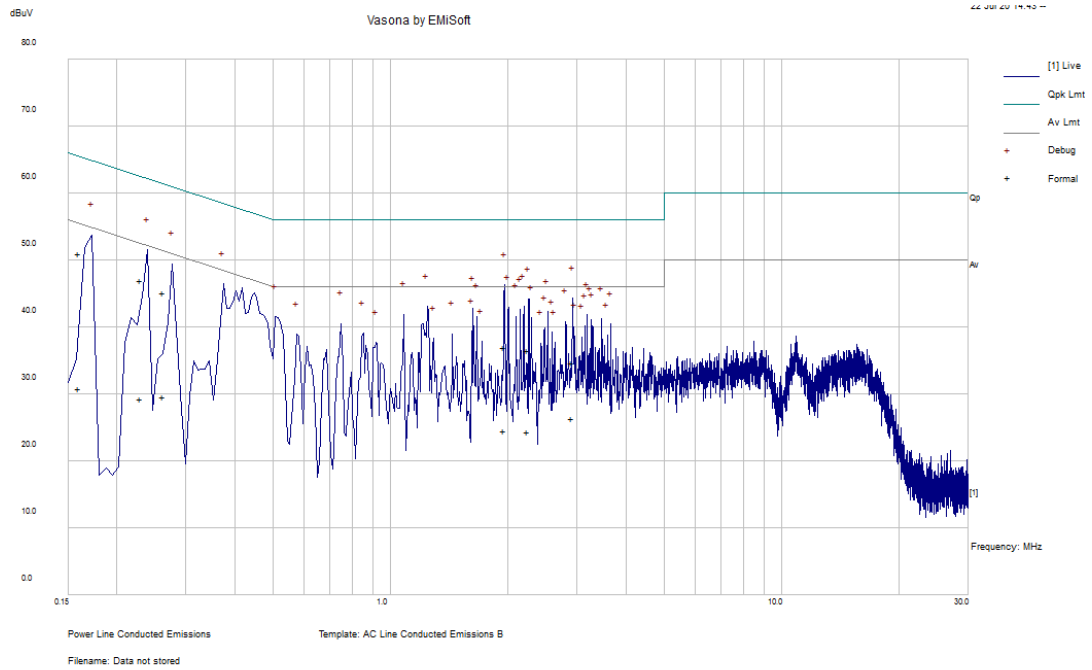
According to the recorded data in following table, the EUT complied with the FCC 15C and ISEDC RSS-Gen standard's conducted emissions limits, with the margin reading of:

2.4 GHz Wi-Fi

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-14.46	0.159626	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

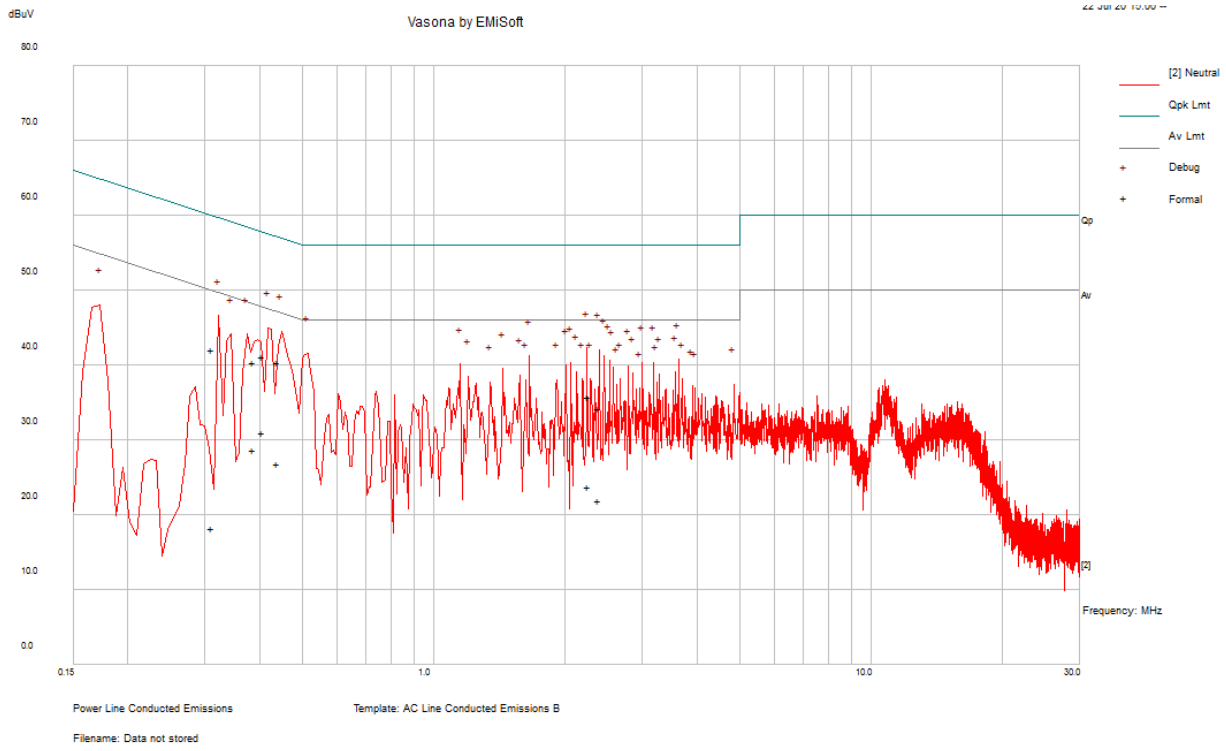
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
1.947188	27.13	Line	56	-18.9	QP
0.229182	37.21	Line	62.48	-15.48	QP
0.159626	41.32	Line	65.48	-14.46	QP
0.261851	35.3	Line	61.37	-16.26	QP
2.91813	24.71	Line	56	-21.29	QP
2.245623	26.62	Line	56	-19.4	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
1.947188	14.62	Line	46	-21.41	Ave.
0.229182	19.47	Line	52.48	-23.22	Ave.
0.159626	21.12	Line	55.48	-24.67	Ave.
0.261851	19.78	Line	51.37	-21.78	Ave.
2.91813	16.44	Line	46	-19.56	Ave.
2.245623	14.43	Line	46	-21.6	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.438456	30.57	Neutral	57.09	-16.65	QP
0.407184	31.33	Neutral	57.71	-16.52	QP
0.310352	32.21	Neutral	59.96	-17.93	QP
2.250372	25.75	Neutral	56	-20.27	QP
2.37705	24.22	Neutral	56	-21.8	QP
0.386691	30.61	Neutral	58.13	-17.67	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.438456	16.98	Neutral	47.09	-20.25	Ave.
0.407184	21.1	Neutral	47.71	-16.75	Ave.
0.310352	8.4	Neutral	49.96	-31.73	Ave.
2.250372	13.76	Neutral	46	-22.26	Ave.
2.37705	11.93	Neutral	46	-24.08	Ave.
0.386691	18.84	Neutral	48.13	-19.44	Ave.

7 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

7.1 Applicable Standards

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) and RSS-Gen except as show 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

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

As per FCC §15.247 (d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

As per ISEDC RSS-Gen 8.9,

> Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

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

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for license-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz or 1/T / Sweep = Auto

7.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2019-01-05	2 years
Rhode & Schwarz	Signal Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-06	1 year
Agilent	Analyzer, Spectrum	E4446A	US44300386	2019-08-24	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2019-11-20	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2 years
Agilent	Preamplifier	8449B	3147A00400	2020-02-27	1 year
IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs on Both Sides	KPS-1571AN-2400	DC 1922	2020-06-06	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2020-02-05	2 years
AH Systems	Preamplifier	PAM 1840 VH	170	2019-09-24	1 year
HP	Pre Amplifier	8447D	2443A04374	2019-08-13	1year
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2020-02-27	2 years
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

7.6 Test Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Zhao Zhao and Matthew Riego de Dios on 2020-07-09, 2020-07-24 and 2020-07-28 in 5m chamber 3.

7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

2.4 GHz Wi-Fi

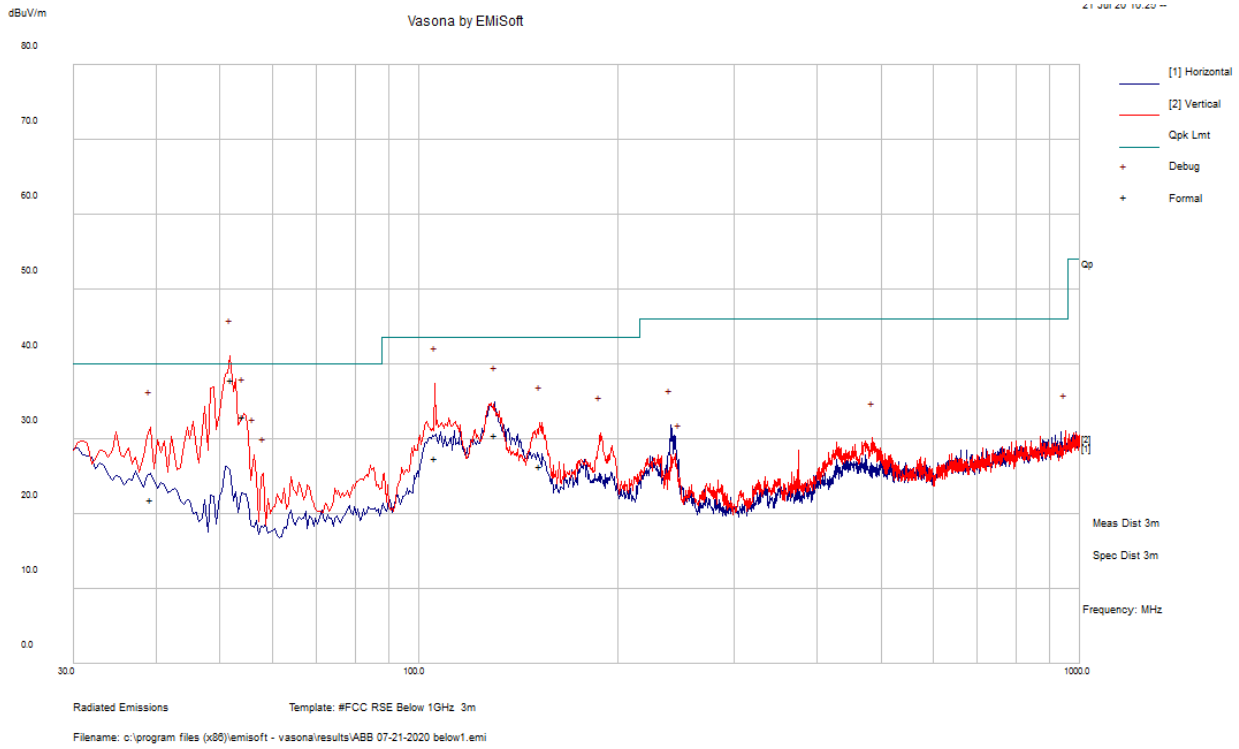
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.01	4924	Vertical	802.11 b high channel

Please refer to the following table and plots for specific test result details

7.8 Radiated Emissions Test Results

1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters

2.4 GHz Wi-Fi



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
52.011	37.91	129	V	45	40	-2.09	QP
105.785	27.47	261	H	285	43.5	-16.03	QP
54.087	33.08	110	V	7	40	-6.92	QP
39.3135	21.89	102	V	241	40	-18.11	QP
130.258	30.54	115	V	160	43.5	-12.96	QP
152.18925	26.48	140	V	248	43.5	-17.02	QP

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2) 1-26.5 GHz Measurements

802.11b mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2390	17.33	0	100	H	32.6	5.6	0	55.53	74	-18.47	PK
2390	7.25	0	100	H	32.6	5.6	0	45.45	54	-8.55	AV
2390	17.66	225	171	V	32.6	5.6	0	55.86	74	-18.14	PK
2390	7.96	225	171	V	32.6	5.6	0	46.16	54	-7.84	AV
4824	45.36	247	205	H	35.0	10.96	35.43	55.89	74	-18.11	PK
4824	36.91	247	205	H	35.0	10.96	35.43	47.44	54	-6.56	AV
4824	50.06	100	187	V	35.0	10.96	35.43	60.59	74	-13.41	PK
4824	42.66	100	187	V	35.0	10.96	35.43	53.19	54	-0.81	AV
Middle Channel 2437 MHz											
4874	45.70	126	174	H	35.2	10.96	35.43	56.43	74	-17.57	PK
4874	37.02	126	174	H	35.2	10.96	35.43	47.75	54	-6.25	AV
4874	48.69	97	190	V	35.2	10.96	35.43	59.42	54	5.42	PK
4874	42.67	97	190	V	35.2	10.96	35.43	53.4	54	-0.6	AV
High Channel 2462 MHz											
2483.5	17.33	180	173	H	33.0	5.6	0	55.93	74	-18.07	PK
2483.5	6.9	180	173	H	33.0	5.6	0	45.5	54	-8.5	AV
2483.5	18.85	199	181	V	33.0	5.6	0	57.45	74	-16.55	PK
2483.5	9.65	199	181	V	33.0	5.6	0	48.25	54	-5.75	AV
4924	44.68	188	165	H	35.3	10.96	35.43	55.51	74	-18.49	PK
4924	35.03	188	165	H	35.3	10.96	35.43	45.86	54	-8.14	AV
4924	48.62	92	173	V	35.3	10.96	35.43	59.45	74	-14.55	PK
4924	**43.16**	**92**	**173**	**V**	**35.3**	**10.96**	**35.43**	**53.99**	**54**	**-0.01**	**AV**

802.11g mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2390	17.42	0	100	H	32.6	5.6	0	55.62	74	-18.38	PK
2390	7.52	0	100	H	32.6	5.6	0	45.72	54	-8.28	AV
2390	22.01	225	171	V	32.6	5.6	0	60.21	74	-13.79	PK
2390	11.38	225	171	V	32.6	5.6	0	49.58	54	-4.42	Ave
4824	44.67	247	198	H	35.0	10.96	35.43	55.2	74	-18.8	PK
4824	33.58	247	198	H	35.0	10.96	35.43	44.11	54	-9.89	AV
4824	48.13	163	139	V	35.0	10.96	35.43	58.66	74	-15.34	PK
4824	38.11	163	139	V	35.0	10.96	35.43	48.64	54	-5.36	AV
Middle Channel 2437 MHz											
4874	45.36	125	174	H	35.2	10.96	35.43	56.09	74	-17.91	PK
4874	34.52	125	174	H	35.2	10.96	35.43	45.25	54	-8.75	AV
4874	49.45	98	182	V	35.2	10.96	35.43	60.18	74	-13.82	PK
4874	37.76	98	182	V	35.2	10.96	35.43	48.49	54	-5.51	AV
High Channel 2462 MHz											
2483.5	18.03	180	173	H	33.0	5.6	0	56.63	74	-17.37	PK
2483.5	7.65	180	173	H	33.0	5.6	0	46.25	54	-7.75	AV
2483.5	22.68	199	181	V	33.0	5.6	0	61.28	74	-12.72	PK
2483.5	12.88	199	181	V	33.0	5.6	0	51.48	54	-2.52	AV
4924	44.58	187	165	H	35.3	10.96	35.43	55.41	74	-18.59	PK
4924	33.69	187	165	H	35.3	10.96	35.43	44.52	54	-9.48	AV
4924	49.56	92	173	V	35.3	10.96	35.43	60.39	74	-13.61	PK
4924	38.62	92	173	V	35.3	10.96	35.43	49.45	54	-4.55	AV

802.11HT20/STBC mode

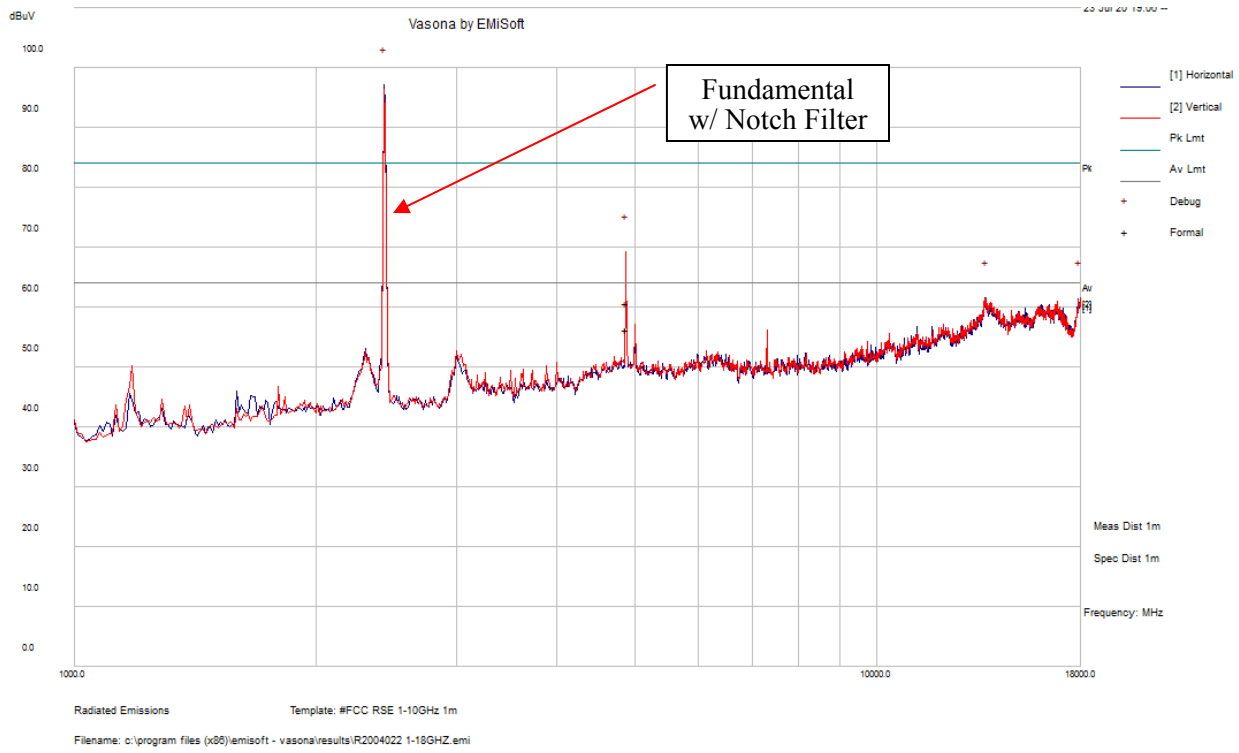
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2390	17.28	0	100	H	32.6	5.6	0	55.48	74	-18.52	PK
2390	7.09	0	100	H	32.6	5.6	0	45.29	54	-8.71	AV
2390	22.08	225	171	V	32.6	5.6	0	60.28	74	-13.72	PK
2390	11.96	225	171	V	32.6	5.6	0	50.16	54	-3.84	Ave
4824	45.26	248	193	H	35.0	10.96	35.43	55.79	74	-18.21	PK
4824	33.74	248	193	H	35.0	10.96	35.43	44.27	54	-9.73	AV
4824	50.53	101	186	V	35.0	10.96	35.43	61.06	74	-12.94	PK
4824	38.44	101	186	V	35.0	10.96	35.43	48.97	54	-5.03	AV
Middle Channel 2437 MHz											
4874	45.65	125	174	H	35.2	10.96	35.43	56.38	74	-17.62	PK
4874	34.78	125	174	H	35.2	10.96	35.43	45.51	54	-8.49	AV
4874	49.52	97	184	V	35.2	10.96	35.43	60.25	74	-13.75	PK
4874	37.75	97	184	V	35.2	10.96	35.43	48.48	54	-5.52	AV
High Channel 2462 MHz											
2483.5	17.58	180	173	H	33.0	5.6	0	56.18	74	-17.82	PK
2483.5	7.83	180	173	H	33.0	5.6	0	46.43	54	-7.57	AV
2483.5	25.06	199	181	V	33.0	5.6	0	63.66	74	-10.34	PK
2483.5	14.91	199	181	V	33.0	5.6	0	53.51	54	-0.49	AV
4924	43.95	182	165	H	35.3	10.96	35.43	54.78	74	-19.22	PK
4924	33.91	182	165	H	35.3	10.96	35.43	44.74	54	-9.26	AV
4924	50.47	92	173	V	35.3	10.96	35.43	61.3	74	-12.7	PK
4924	38.71	92	173	V	35.3	10.96	35.43	49.54	54	-4.46	AV

802.11HT40/STBC mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2422 MHz											
2390	17.24	0	100	H	32.6	5.6	0	55.44	74	-18.56	PK
2390	7.38	0	100	H	32.6	5.6	0	45.58	54	-8.42	AV
2390	22.86	228	168	V	32.6	5.6	0	61.06	74	-12.94	PK
2390	13.92	228	168	V	32.6	5.6	0	52.12	54	-1.88	Ave
4844	43.63	0	100	H	35.0	10.96	35.43	54.16	74	-19.84	PK
4844	33.08	0	100	H	35.0	10.96	35.43	43.61	54	-10.39	AV
4844	44.52	0	100	V	35.0	10.96	35.43	55.05	74	-18.95	PK
4844	34.72	0	100	V	35.0	10.96	35.43	45.25	54	-8.75	AV
Middle Channel 2437 MHz											
4874	47.26	0	100	H	28.47	9.71	39.33	46.12	74	-27.88	PK
4874	33.92	0	100	H	28.47	9.71	39.33	32.78	54	-21.22	AV
4874	47.07	0	100	V	28.64	9.71	39.33	46.09	74	-27.91	PK
4874	33.79	0	100	V	28.64	9.71	39.33	32.81	54	-21.19	AV
High Channel 2452 MHz											
2483.5	17.65	183	177	H	33.0	5.6	0	56.25	74	-17.75	PK
2483.5	7.68	183	177	H	33.0	5.6	0	46.28	54	-7.72	AV
2483.5	21.37	175	168	V	33.0	5.6	0	59.97	74	-14.03	PK
2483.5	12.08	175	168	V	33.0	5.6	0	50.68	54	-3.32	AV
4904	44.33	0	100	H	35.3	7.92	39.27	44.04	74	-29.96	PK
4904	33.16	0	100	H	35.3	7.92	39.27	32.6	54	-21.4	AV
4904	44.94	133	169	V	35.3	10.96	35.43	55.77	74	-18.23	PK
4904	37.76	133	169	V	35.3	10.96	35.43	48.59	54	-5.41	AV

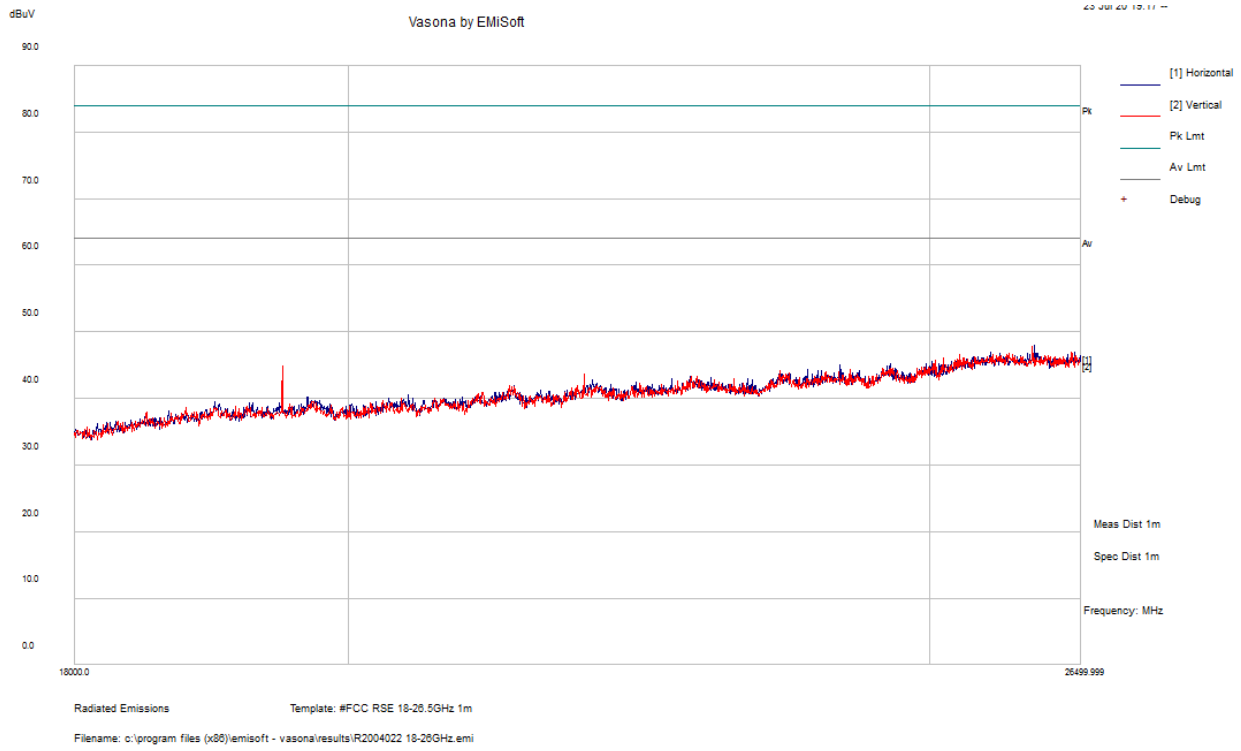
Note: The band edge of 2390MHz and 2483.5MHz are measured at 1 meter, -10 dB distance correction factor was calculated in the table.

1 – 18 GHz, Wi-Fi Worst Case Scan at 1 Meter



Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna		Factor (dB)	Cable Loss (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)				Limit (dBµV/m)	Margin (dB)	
4878.18	50.61	148	165	H	5.27	10.96	60.61	84	-23.39	PK
4878.18	46.3	166	154	V	5.27	10.96	56.3	64	-7.7	AV

18 GHz – 26.5 GHz, Wi-Fi Worst Case Scan at 1 Meter



8 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2 - Emission Bandwidth

8.1 Applicable Standards

According to ECFR §15.247(a) (2) and ISEDC RSS-247 §5.2, systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

8.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2020-04-29	1 year
-	RF cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

8.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Zhao Zhao on 2020-07-15 in RF site.

8.5 Test Results

Antenna 1

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	13245.0	7590	≥500
Middle	2437	13008.6	8133	≥500
High	2462	13341.7	8585	≥500
802.11g mode				
Low	2412	16409.0	16335	≥500
Middle	2437	16433.4	15761	≥500
High	2462	16351.9	15749	≥500
802.11n HT20 mode				
Low	2412	17555.3	17171	≥500
Middle	2437	17566.5	15721	≥500
High	2462	17541.1	16930	≥500
802.11n HT40 mode				
Low	2422	35959.5	35723	≥500
Middle	2437	36083.9	35141	≥500
High	2452	35850.7	35113	≥500
802.11n HT20 STBC				
Low	2412	17827.3	17590	≥500
Middle	2437	17769.7	17588	≥500
High	2462	17822.0	16956	≥500
802.11n HT40 STBC				
Low	2422	36406.2	36016	≥500
Middle	2437	36359.2	35224	≥500
High	2452	36429.2	35770	≥500

Antenna 2

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	13074.0	8583	≥500
Middle	2437	13026.6	8089	≥500
High	2462	13064.1	8127	≥500
802.11g mode				
Low	2412	16372.9	16322	≥500
Middle	2437	16376.2	15920	≥500
High	2462	16355.0	16013	≥500
802.11n HT20 mode				
Low	2412	17528.5	16863	≥500
Middle	2437	17563.7	15956	≥500
High	2462	17533.3	16973	≥500
802.11n HT40 mode				
Low	2422	35960.6	35137	≥500
Middle	2437	35974.2	35127	≥500
High	2452	35842.7	35117	≥500
802.11n HT20 STBC				
Low	2412	17898.2	17582	≥500
Middle	2437	17857.5	17600	≥500
High	2462	17895.7	16396	≥500
802.11n HT40 STBC				
Low	2422	36504.0	36235	≥500
Middle	2437	36521.6	35783	≥500
High	2452	36468.2	35750	≥500

Antenna 3

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	13678.0	9558	≥500
Middle	2437	13272.8	8149	≥500
High	2462	13202.8	8108	≥500
802.11g mode				
Low	2412	16399.0	16299	≥500
Middle	2437	16405.9	15461	≥500
High	2462	16340.7	15455	≥500
802.11n HT20 mode				
Low	2412	17573.7	16778	≥500
Middle	2437	17610.9	16575	≥500
High	2462	17573.5	16357	≥500
802.11n HT40 mode				
Low	2422	35983.5	36335	≥500
Middle	2437	36048.9	35104	≥500
High	2452	35791.1	35213	≥500
802.11n HT20 STBC				
Low	2412	17941.7	17574	≥500
Middle	2437	17831.8	17589	≥500
High	2462	17885.2	16378	≥500
802.11n HT40 STBC				
Low	2422	36475.8	35783	≥500
Middle	2437	36479.5	35178	≥500
High	2452	36477.6	35762	≥500

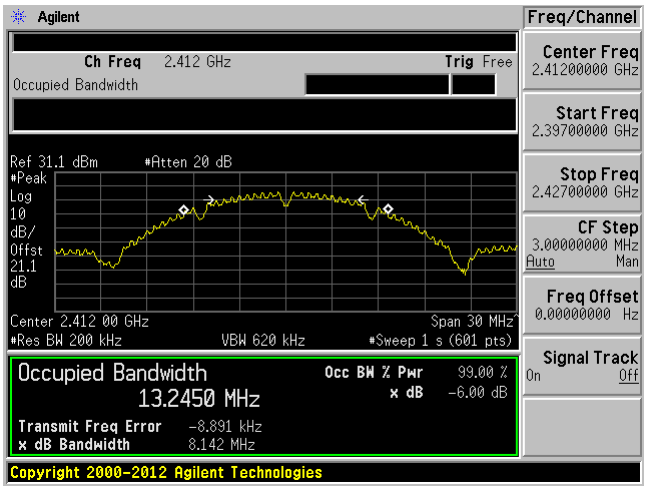
Please refer to the Plots below for test results from antenna port 1.

Antenna 1

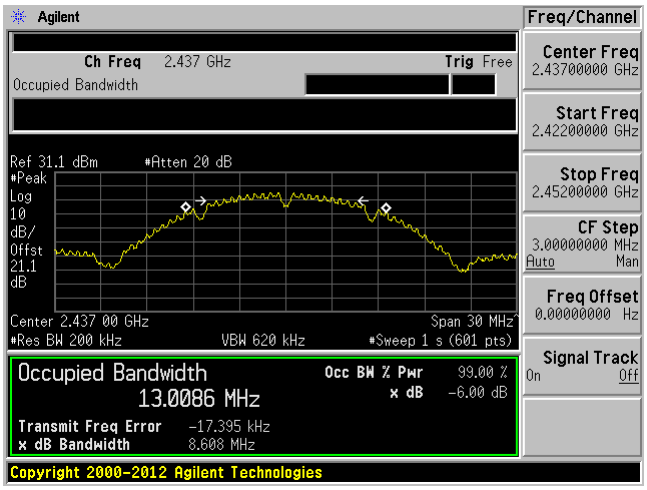
99% OBW

802.11b mode

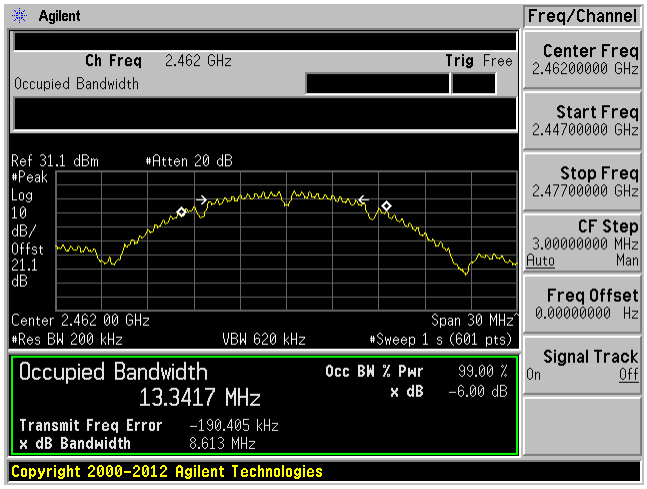
Low Channel 2412 MHz



Middle Channel 2437 MHz

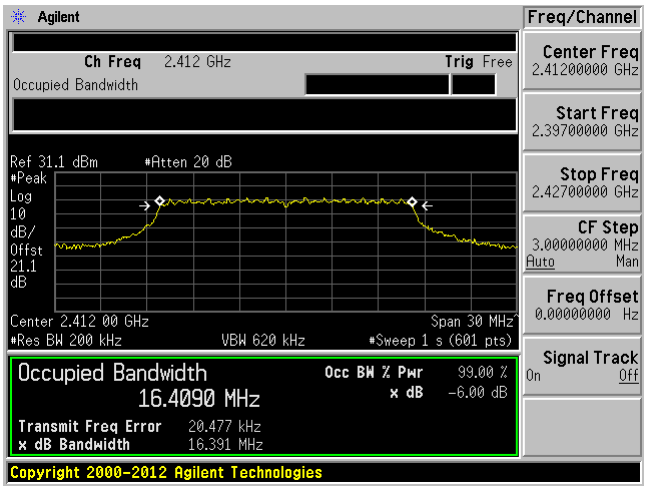


High Channel 2462 MHz

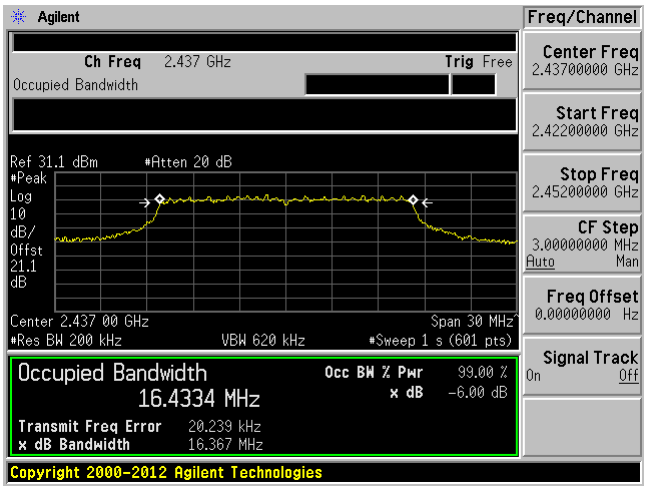


802.11g mode

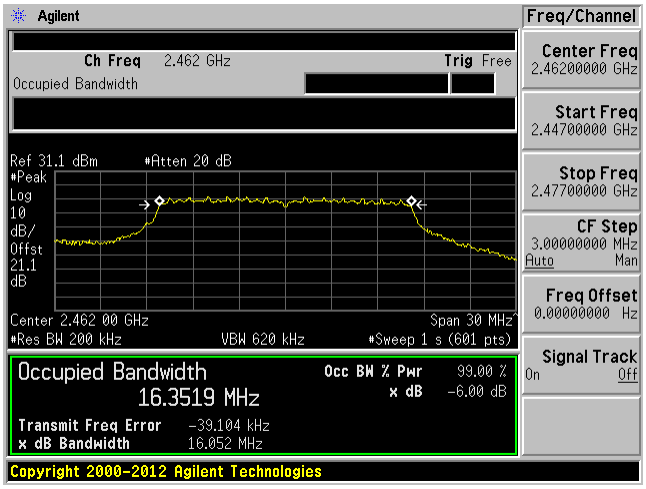
Low Channel 2412 MHz



Middle Channel 2437 MHz

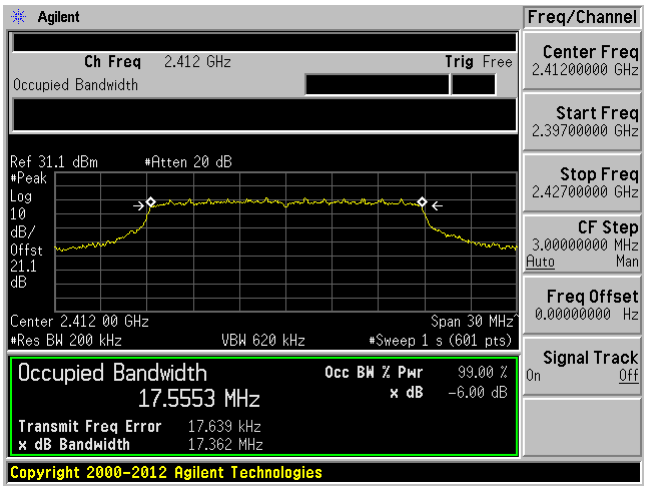


High Channel 2462 MHz

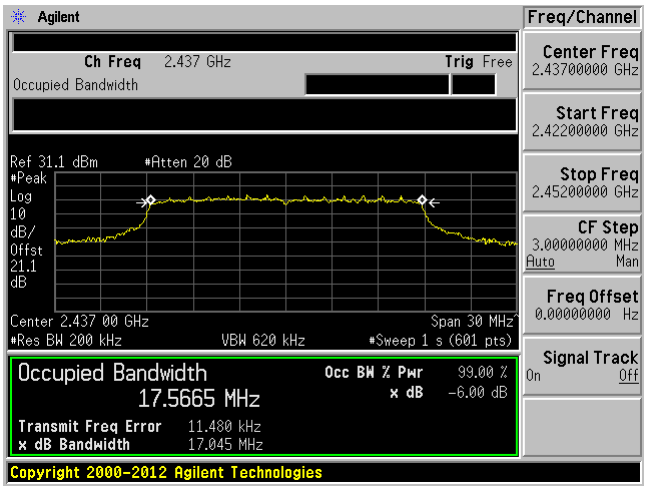


802.11n HT20 mode

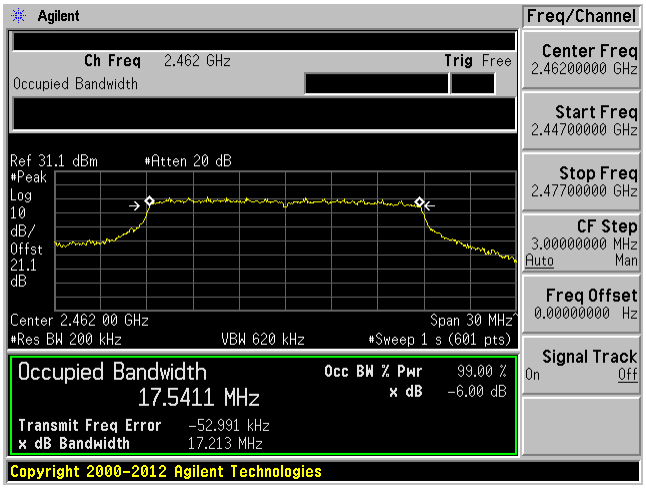
Low Channel 2412 MHz



Middle Channel 2437 MHz

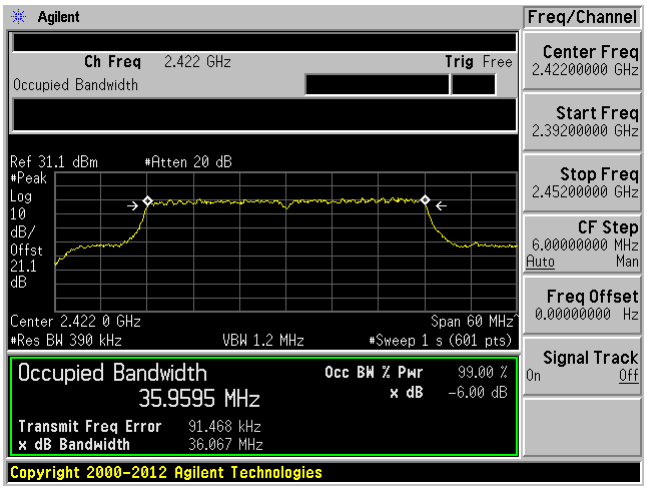


High Channel 2462 MHz

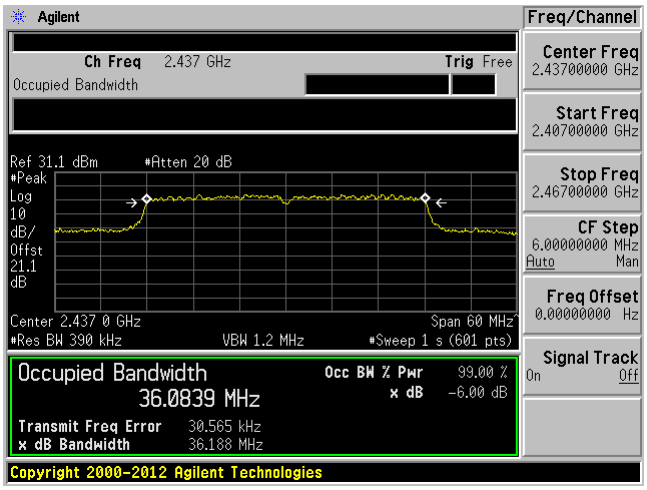


802.11n HT40 mode

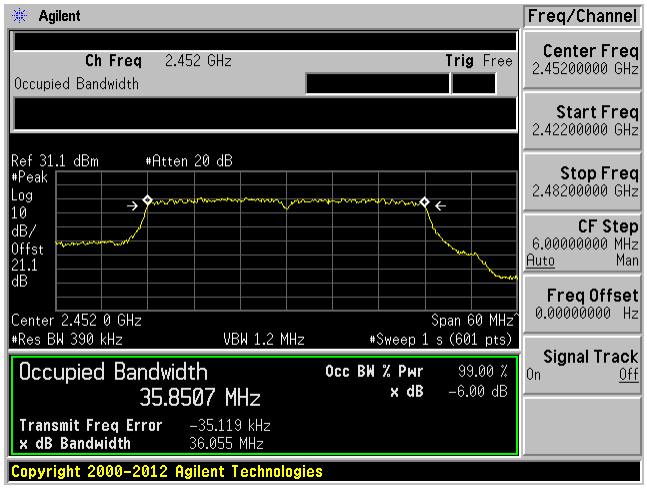
Low Channel 2422 MHz



Middle Channel 2437 MHz

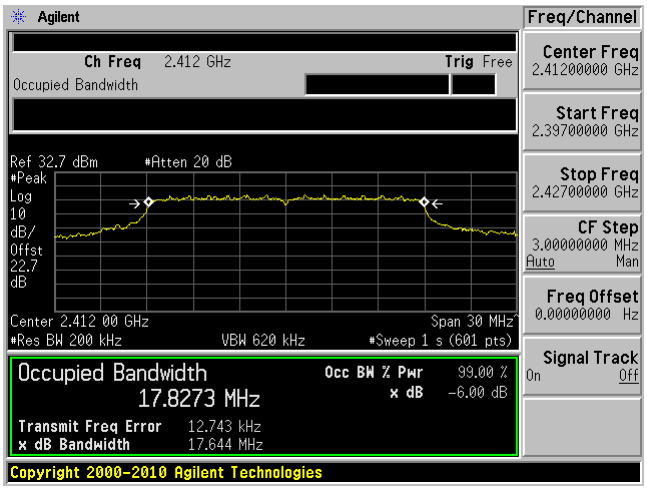


High Channel 2452 MHz

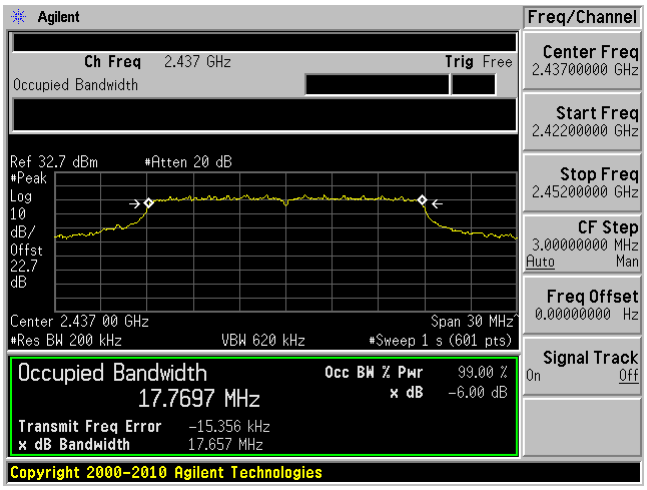


802.11n HT20 STBC

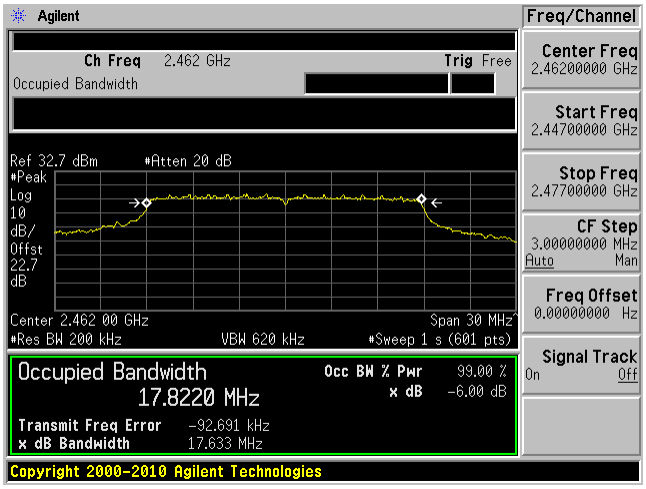
Low Channel 2412 MHz



Middle Channel 2437 MHz

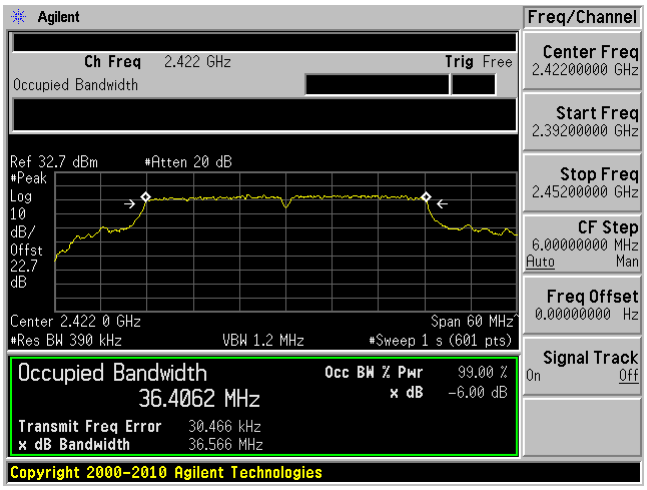


High Channel 2462 MHz

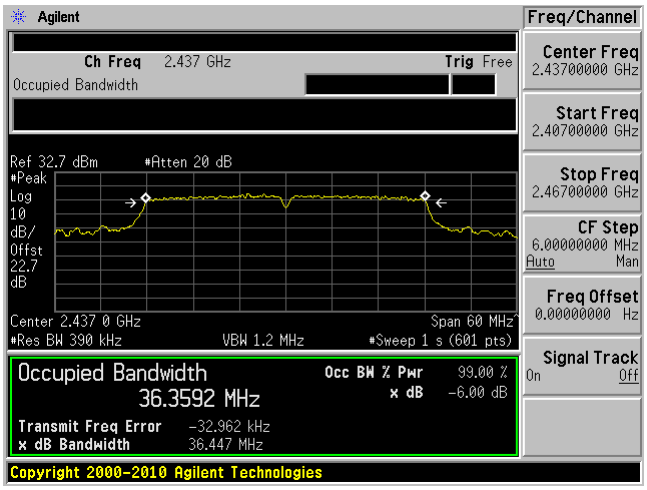


802.11n HT40 STBC

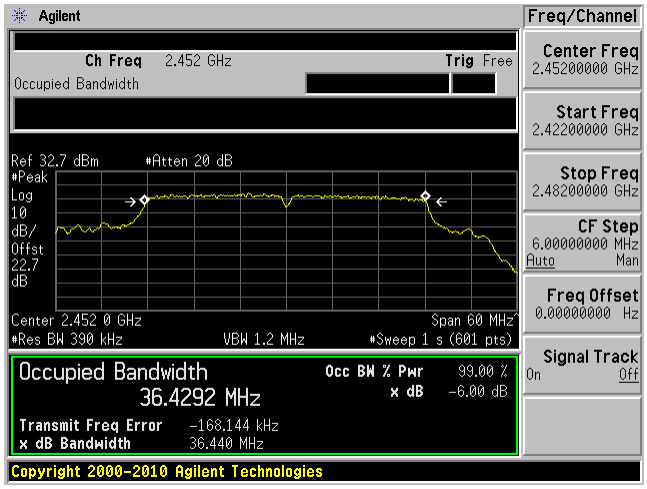
Low Channel 2422 MHz



Middle Channel 2437 MHz



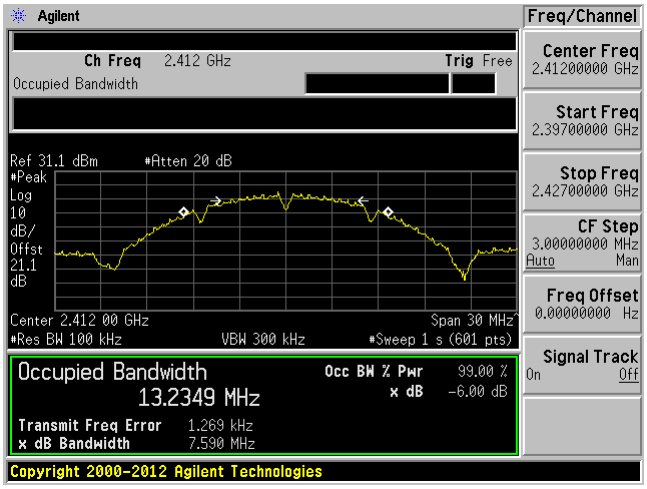
High Channel 2452 MHz



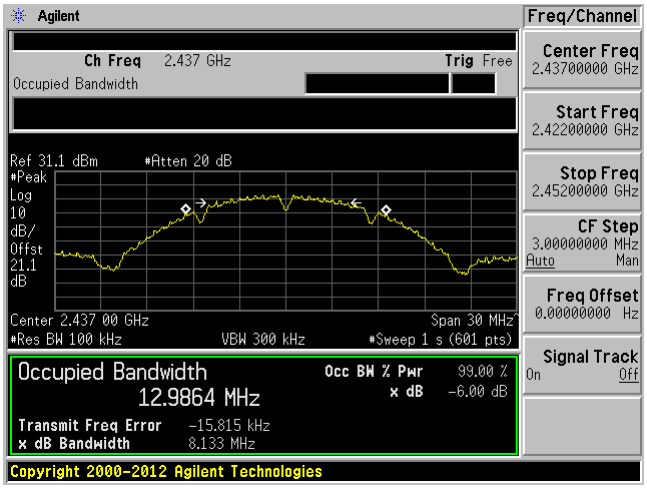
6 dB OBW

802.11b mode

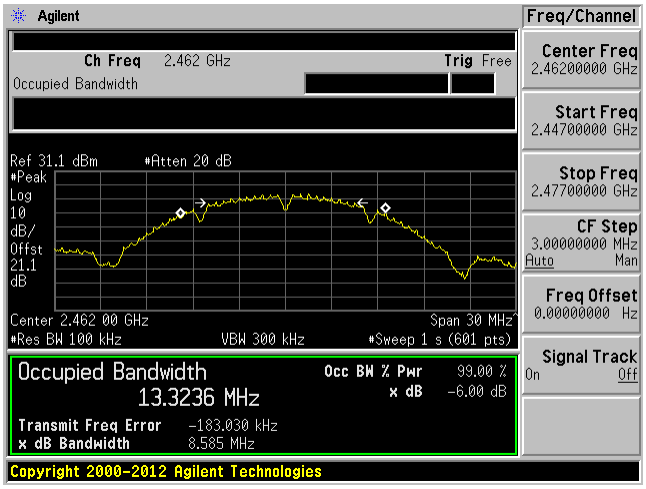
Low Channel 2412 MHz



Middle Channel 2437 MHz

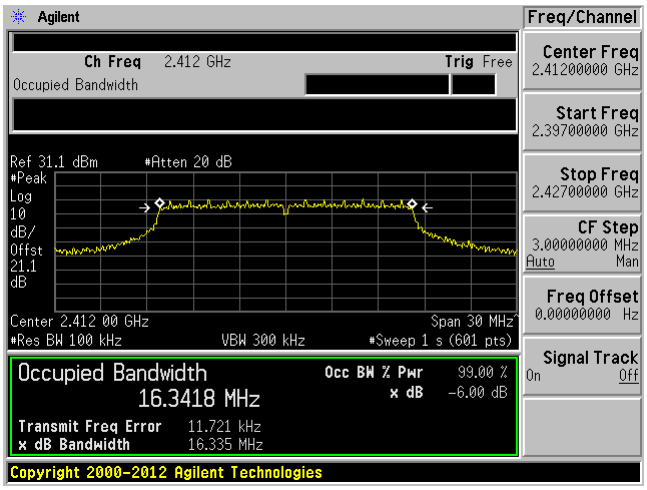


High Channel 2462 MHz

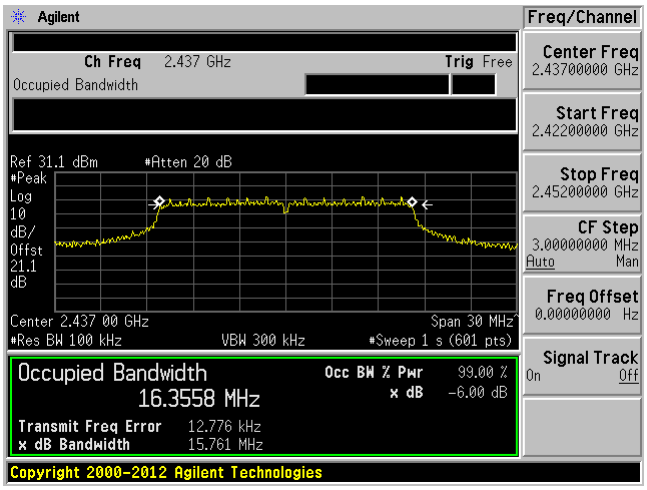


802.11g mode

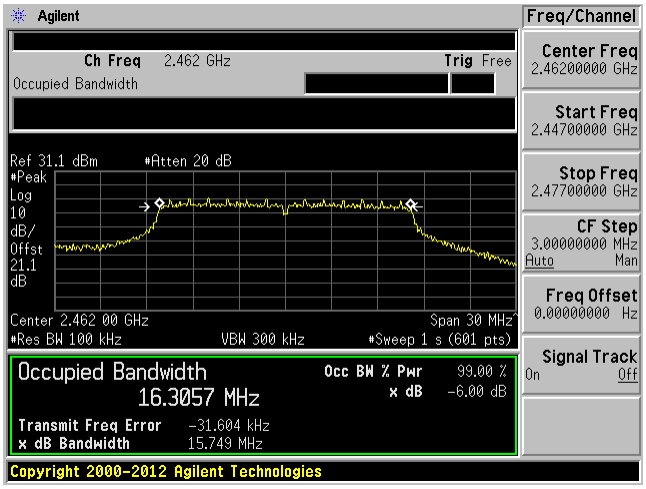
Low Channel 2412 MHz



Middle Channel 2437 MHz

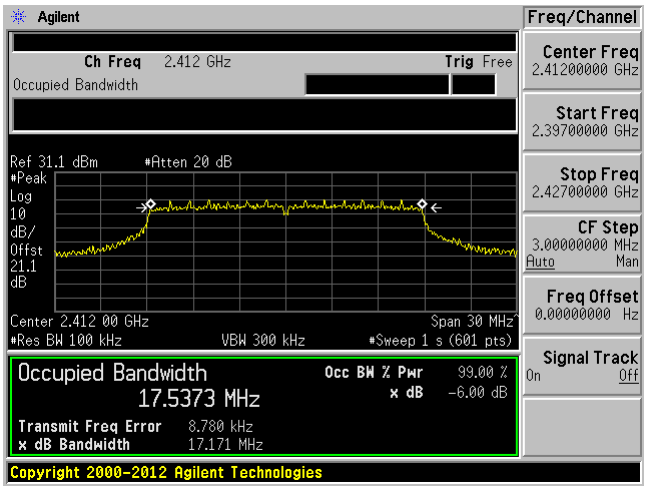


High Channel 2462 MHz

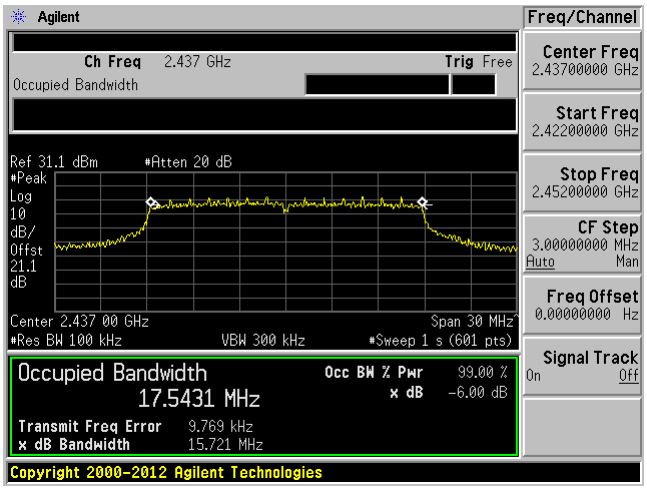


802.11n HT20 mode

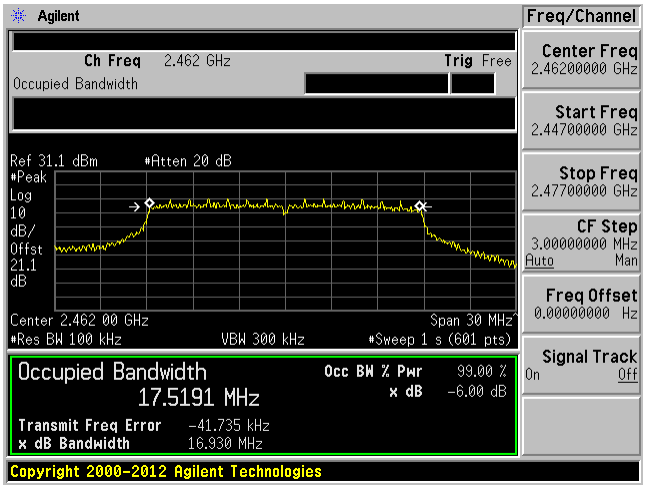
Low Channel 2412 MHz



Middle Channel 2437 MHz

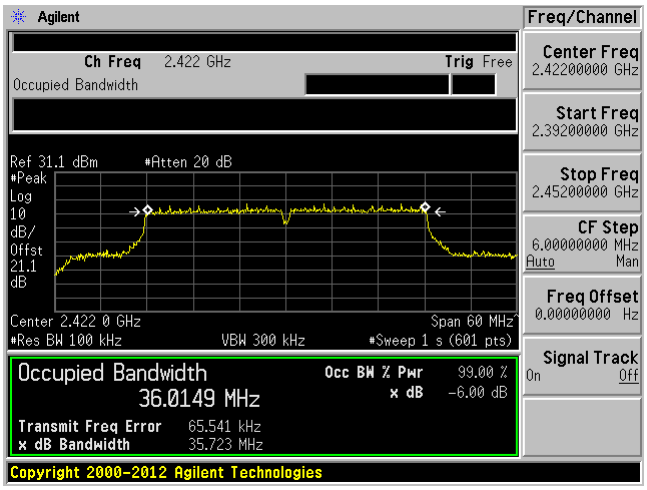


High Channel 2462 MHz

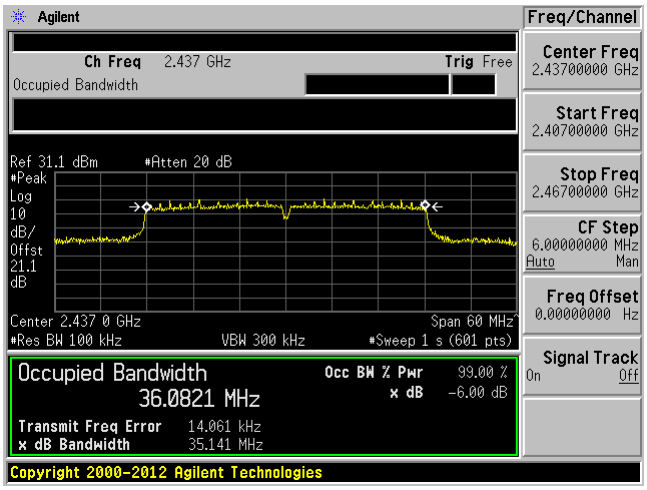


802.11n HT40 mode

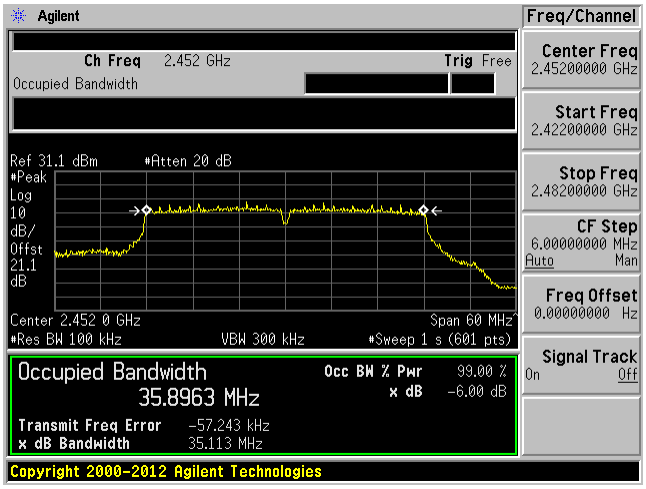
Low Channel 2422 MHz



Middle Channel 2437 MHz

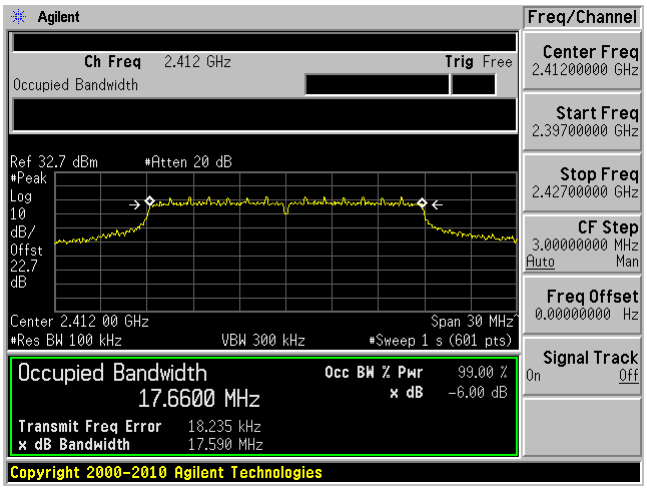


High Channel 2452 MHz

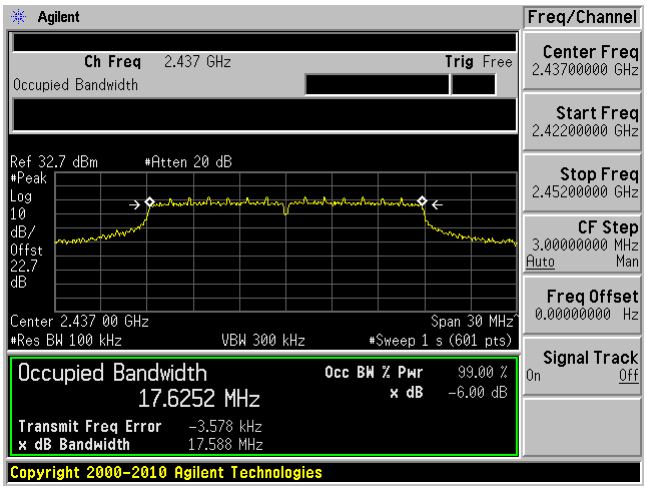


802.11n HT20 STBC

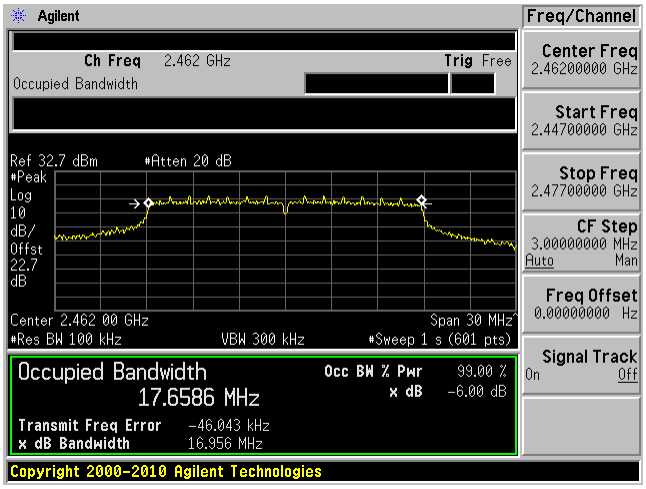
Low Channel 2412 MHz



Middle Channel 2437 MHz

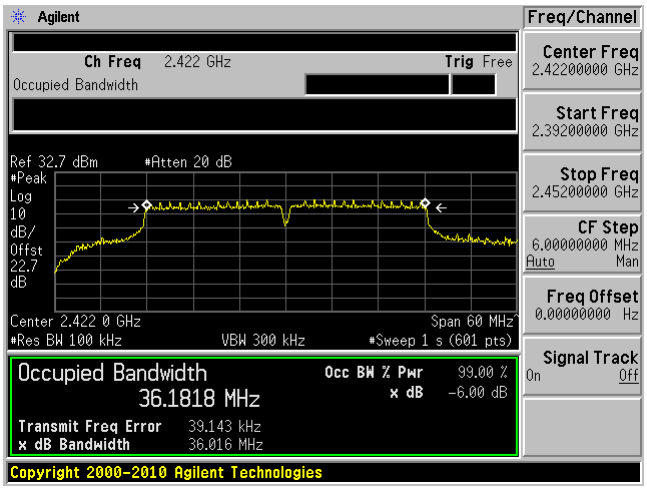


High Channel 2462 MHz

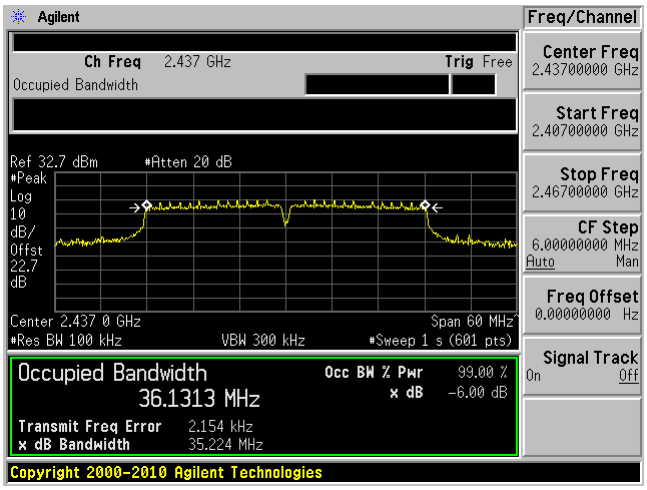


802.11n HT40 STBC

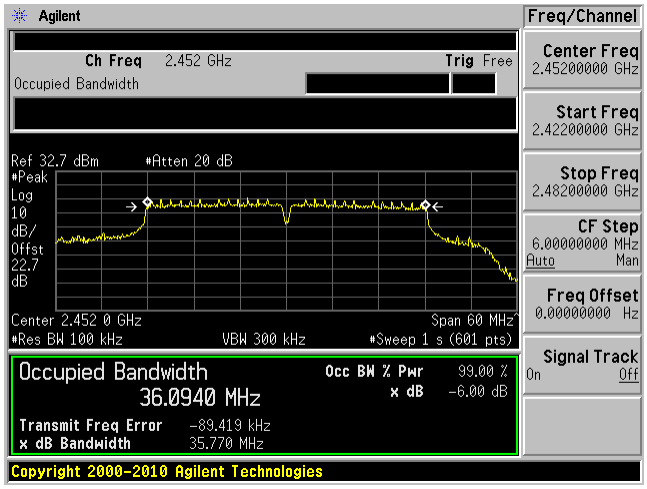
Low Channel 2422 MHz



Middle Channel 2437 MHz



High Channel 2452 MHz



9 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 (4) - Output Power Measurement

9.1 Applicable Standards

According to ECFR §15.247(b) (3) and ISEDC RSS-247 §5.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS- Lindgren	Power Sensor	7002-006	160097	2018-12-31	2 years
-	RF Cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

9.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Zhao Zhao on 2020-07-13 and 2020-07-28 at RF site.

9.5 Test Results

Average Output Power

Channel	Frequency (MHz)	Conducted Average Power (dBm)			Total Power (dBm)	Limit (dBm)
		Ant 1	Ant 2	Ant 3	Total	
802.11b mode						
Low	2412	25.16	25.31	25.17	-	30
Middle	2437	24.52	24.83	24.67	-	30
High	2462	24.62	24.86	24.56	-	30
802.11g mode						
Low	2412	22.34	21.91	21.82	-	30
Middle	2437	23.71	24.09	23.59	-	30
High	2462	21.89	21.75	21.57	-	30
802.11n HT20 mode						
Low	2412	20.55	20.35	20.29	25.16	26.23
Middle	2437	20.15	20.14	19.92	24.84	26.23
High	2462	20.09	20.23	20.09	24.91	26.23
802.11n HT40 mode						
Low	2422	20.58	20.32	20.17	25.13	26.23
Middle	2437	20.94	20.77	19.94	25.34	26.23
High	2452	20.72	21.05	20.88	25.66	26.23
802.11n HT20 STBC						
Low	2412	23.08	23.26	23.11	27.92	30
Middle	2437	24.83	24.68	24.74	29.52	30
High	2462	24.66	24.56	24.69	29.41	30
802.11n HT40 STBC						
Low	2422	23.36	23.07	23.25	28.00	30
Middle	2437	25.14	25.01	25.06	29.84	30
High	2452	25.01	24.84	24.95	29.71	30

Note: Duty Cycle correction factor has already been added to the measurement.

According to ECFR §15.247(b) (4) and ISEDC RSS-247 §5.4 f , the directional gain for 3 antennas is 9.77 dBi in total, the limit for HT20 and HT40 mode should be 26.23 dBm=30 dBm –(9.77 dBi- 6 dBi) for 802.11n HT20/40 modes. The directional gain for 3 antennas is 5 dBi for STBC mode. Therefore, no limit reduction is required.

10 FCC §15.247(d) and ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges

10.1 Applicable Standards

According to ECFR §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

According to ISEDC RSS-247 §5.5.In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2020-04-29	1 year
-	RF cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 Octomber 2018) "A2LA Policy on Metrological Traceability".*

10.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

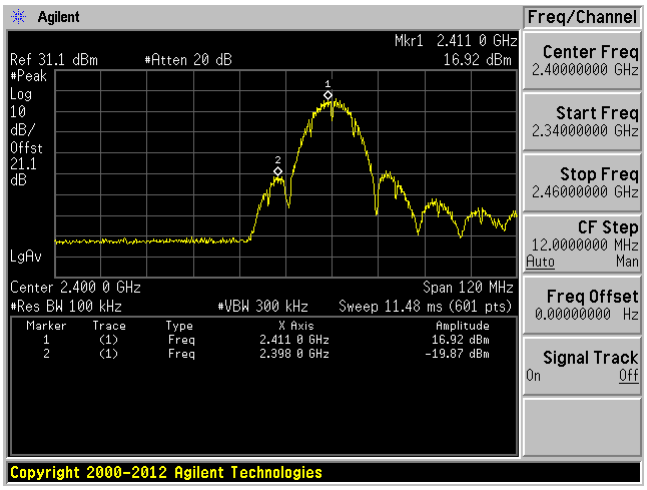
The testing was performed by Zhao Zhao on 2020-07-15 and 2020-07-28 at RF site.

10.5 Test Results

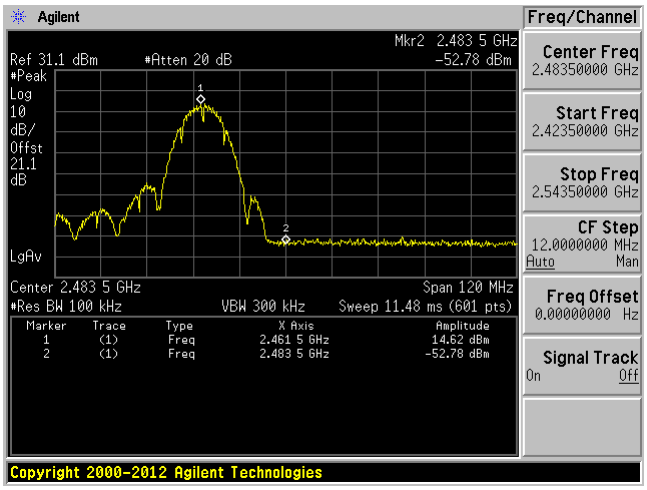
Antenna 1

802.11b mode

Low Channel 2412 MHz

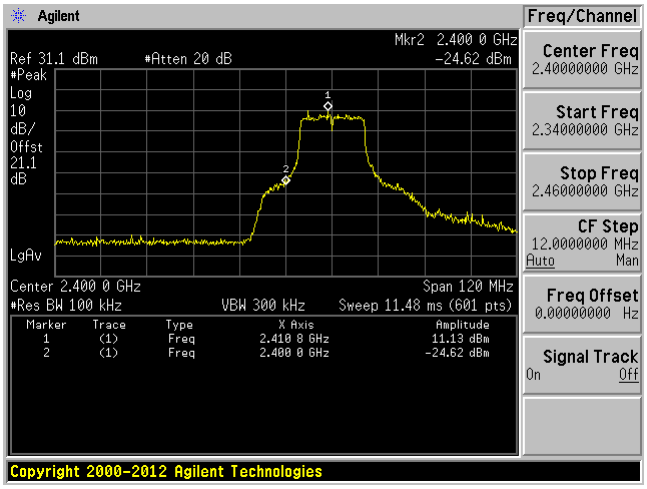


High Channel 2462 MHz

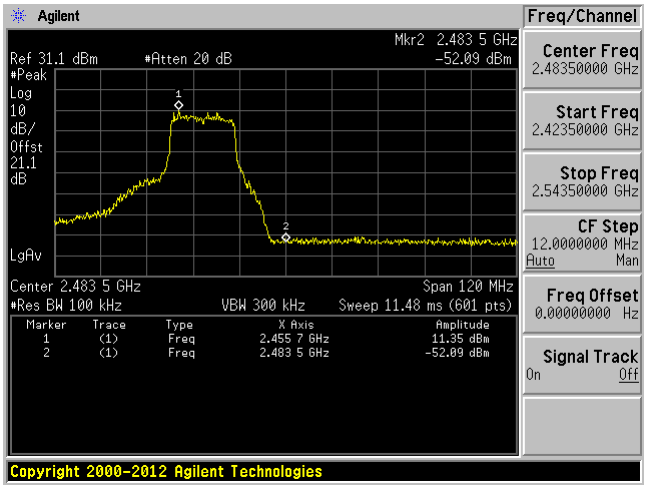


802.11g mode

Low Channel 2412 MHz

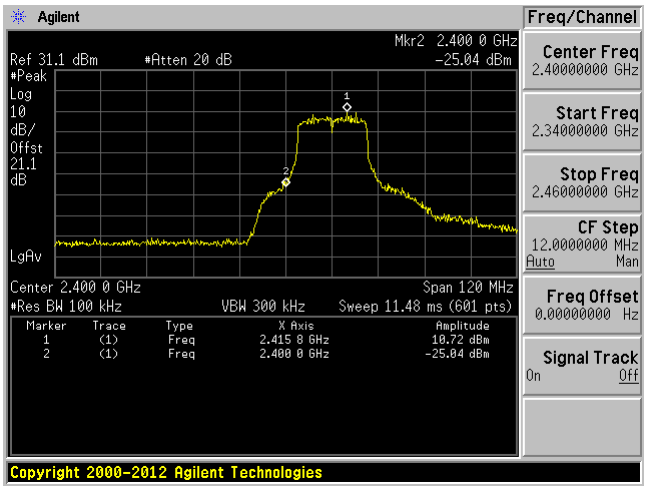


High Channel 2462 MHz

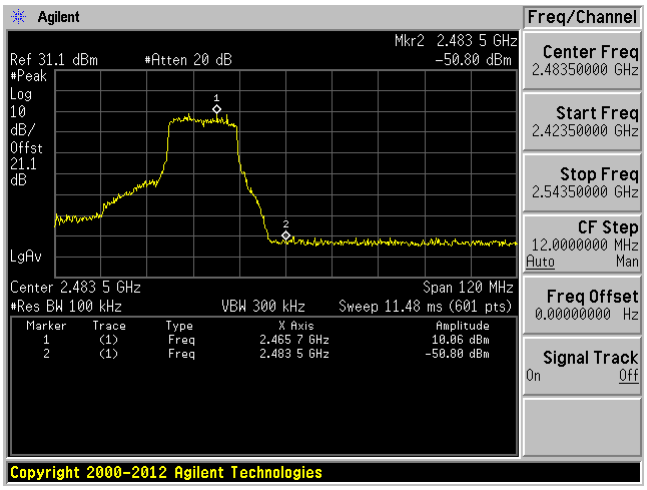


802.11n HT20 mode

Low Channel 2412 MHz

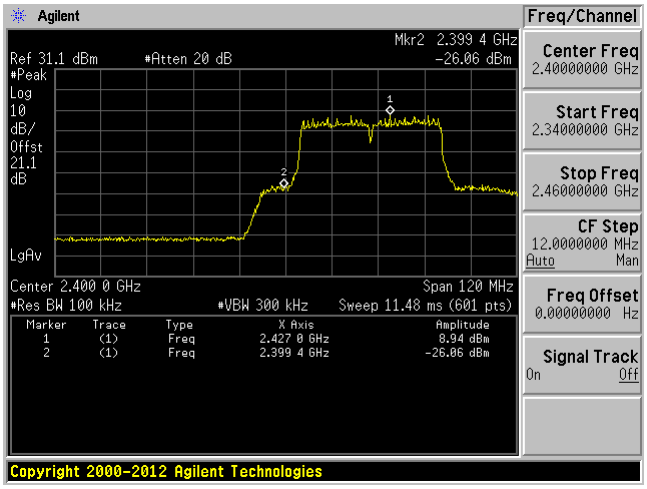


High Channel 2462 MHz

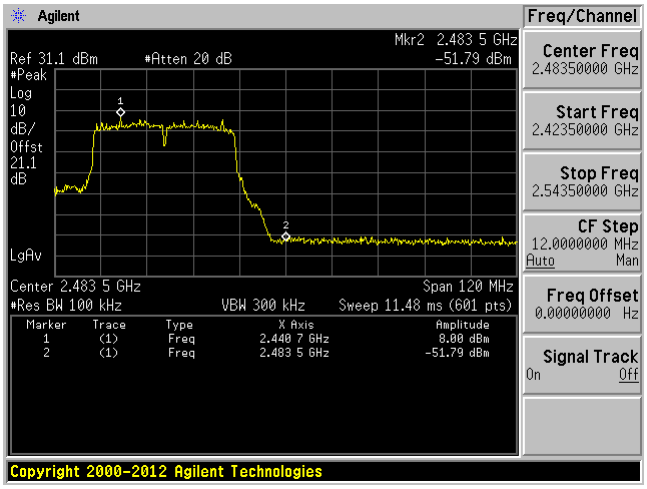


802.11n HT40 mode

Low Channel 2422 MHz

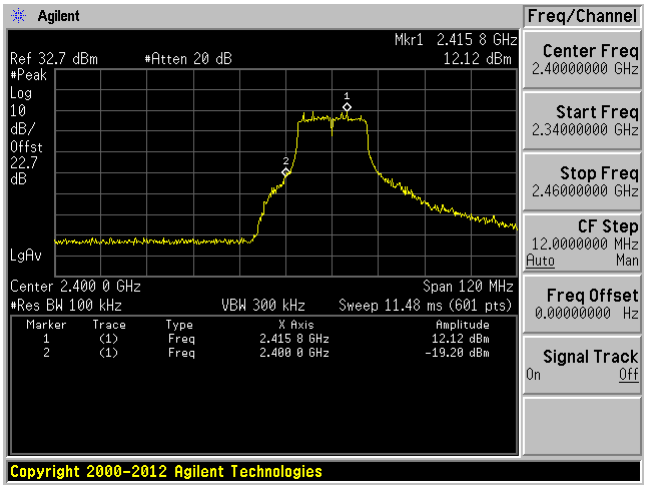


High Channel 2452 MHz

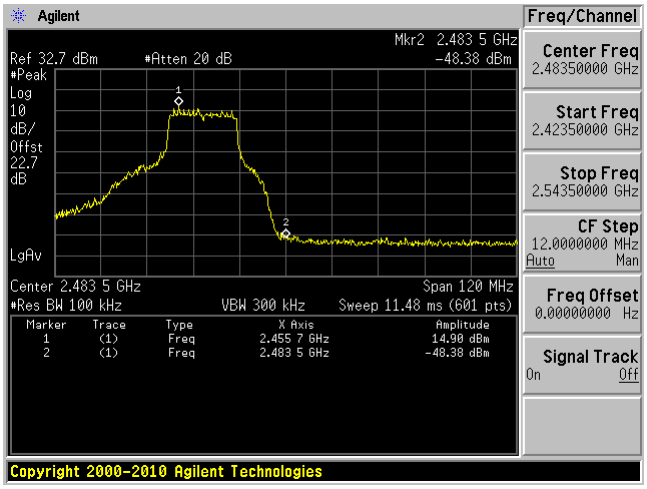


802.11n HT20 STBC

Low Channel 2412 MHz

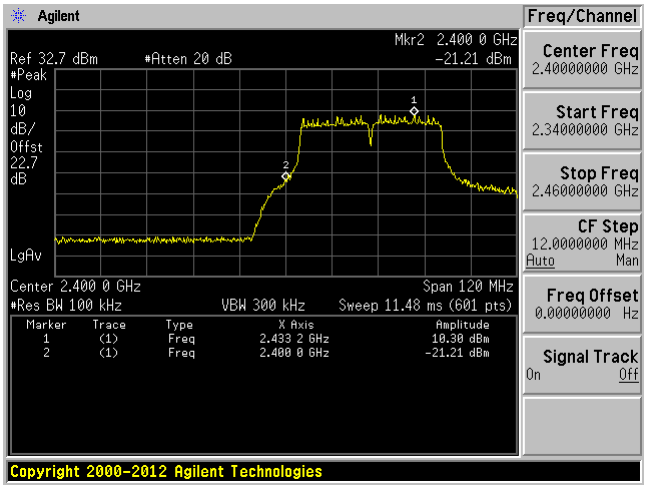


High Channel 2462 MHz

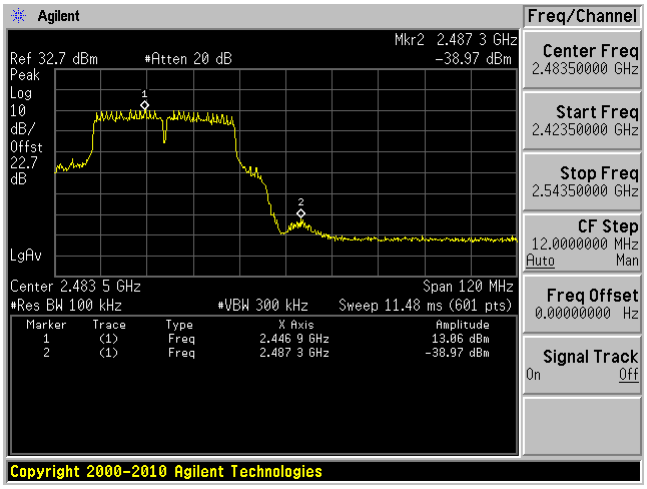


802.11n HT40 STBC

Low Channel 2422 MHz



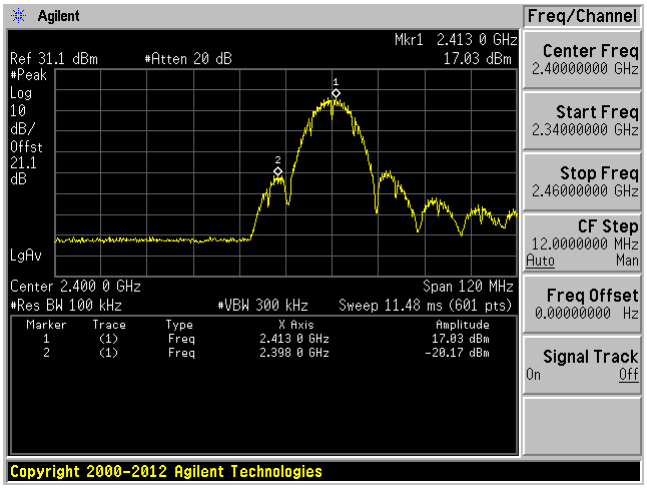
High Channel 2452 MHz



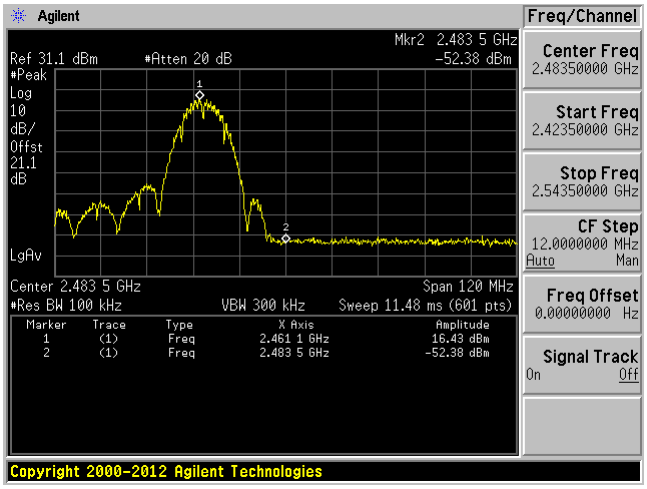
Antenna 2

802.11b mode

Low Channel 2412 MHz

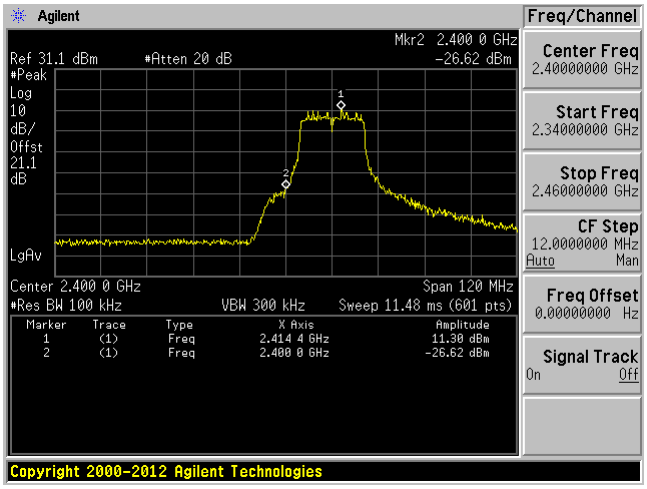


High Channel 2462 MHz

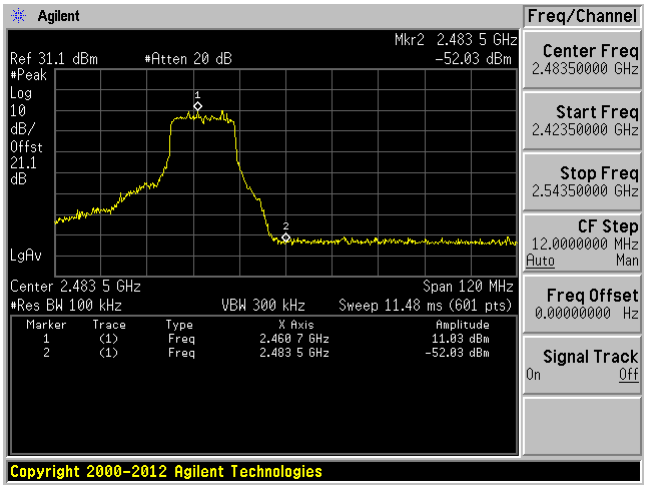


802.11g mode

Low Channel 2412 MHz

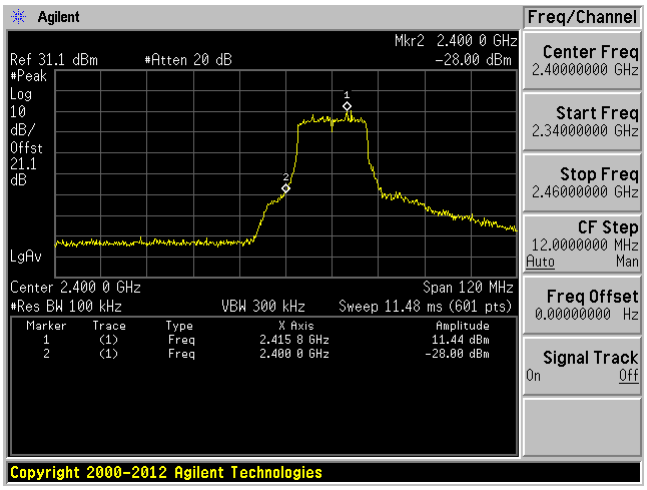


High Channel 2462 MHz

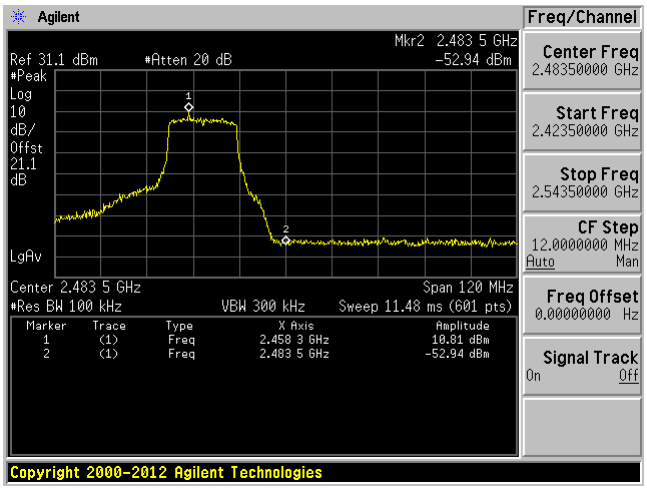


802.11n HT20 mode

Low Channel 2412 MHz

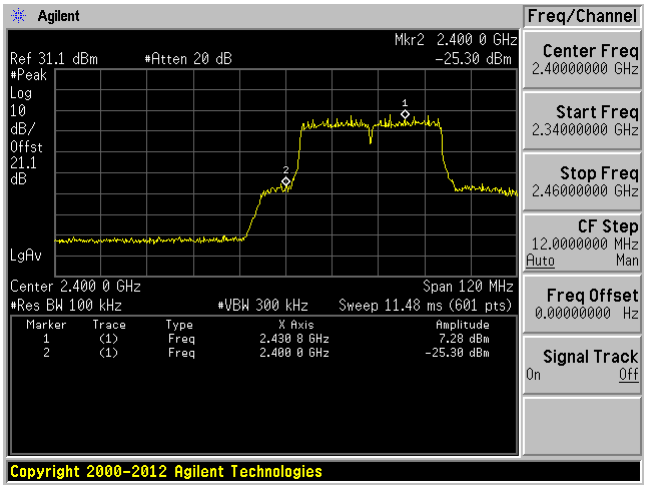


High Channel 2462 MHz

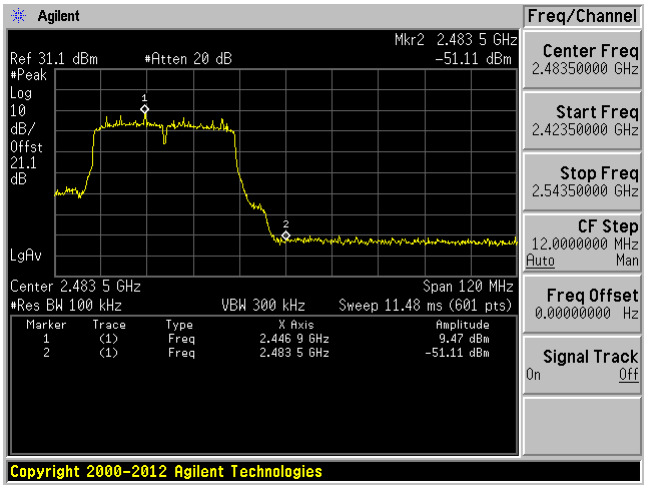


802.11n HT40 mode

Low Channel 2422 MHz

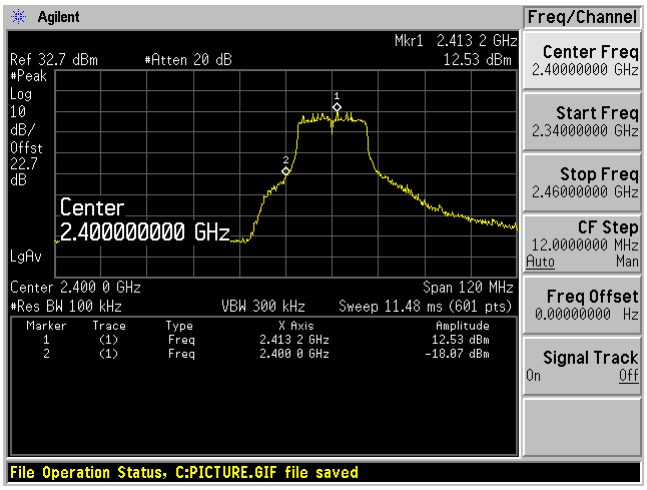


High Channel 2452 MHz

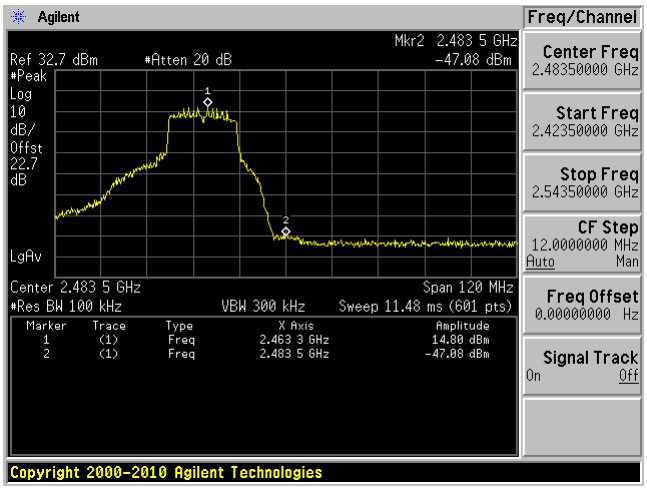


802.11n HT20 STBC

Low Channel 2412 MHz

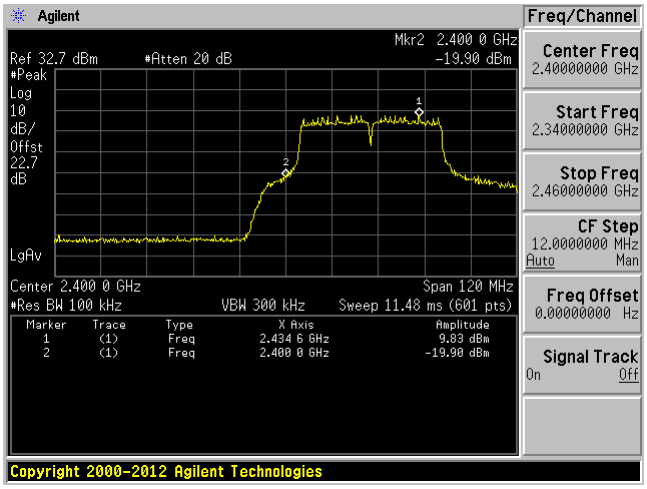


High Channel 2462 MHz

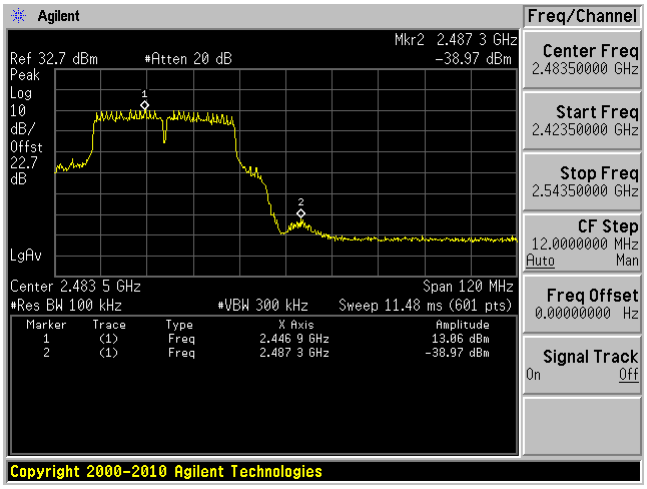


802.11n HT40 STBC

Low Channel 2422 MHz



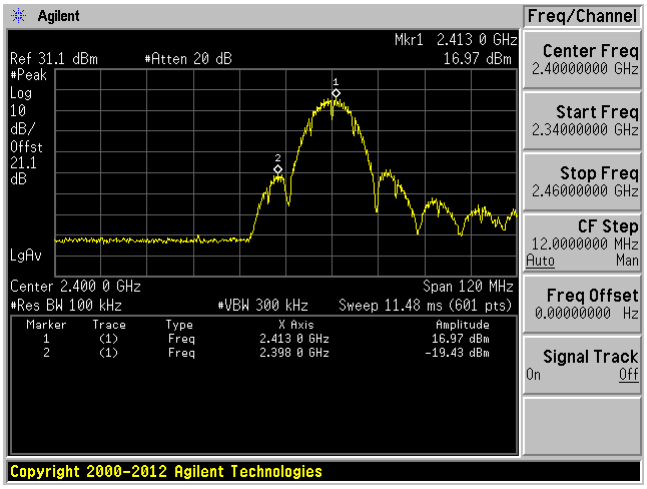
High Channel 2452 MHz



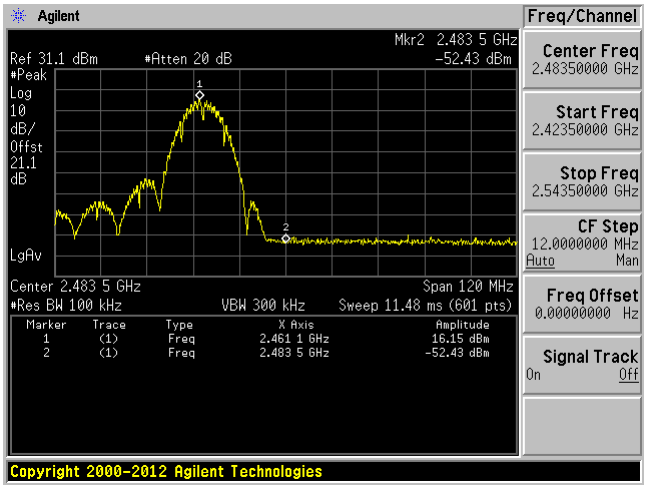
Antenna 3

802.11b mode

Low Channel 2412 MHz

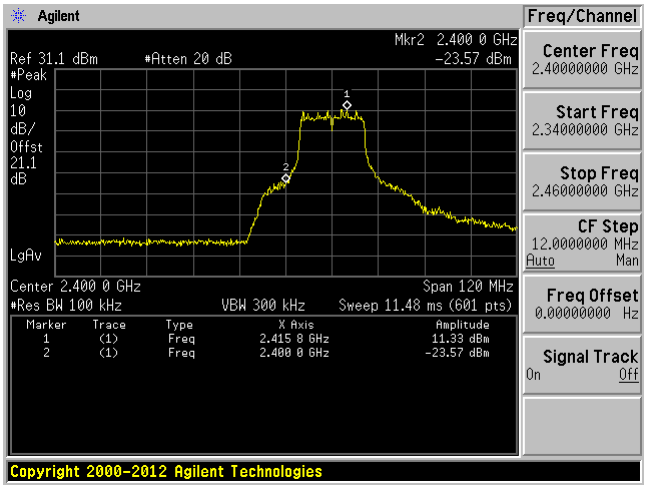


High Channel 2462 MHz

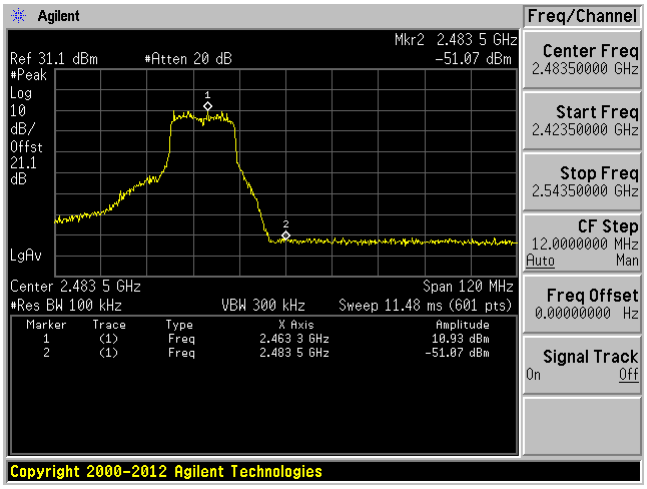


802.11g mode

Low Channel 2412 MHz

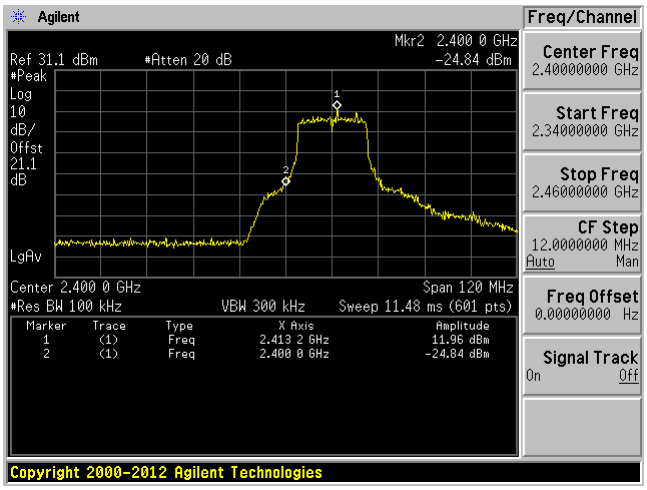


High Channel 2462 MHz

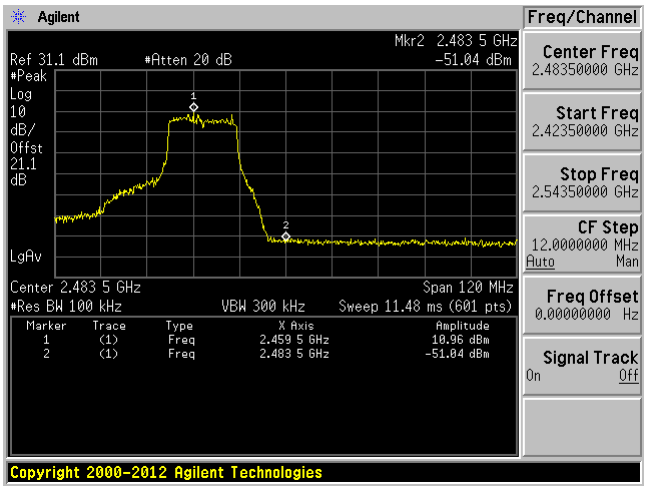


802.11n HT20 mode

Low Channel 2412 MHz

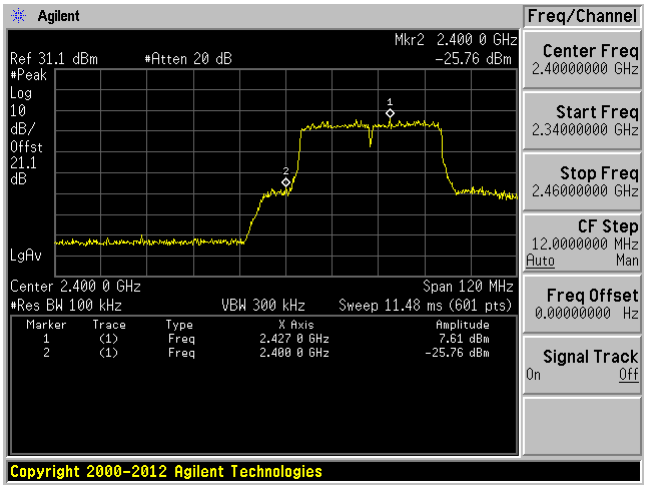


High Channel 2462 MHz

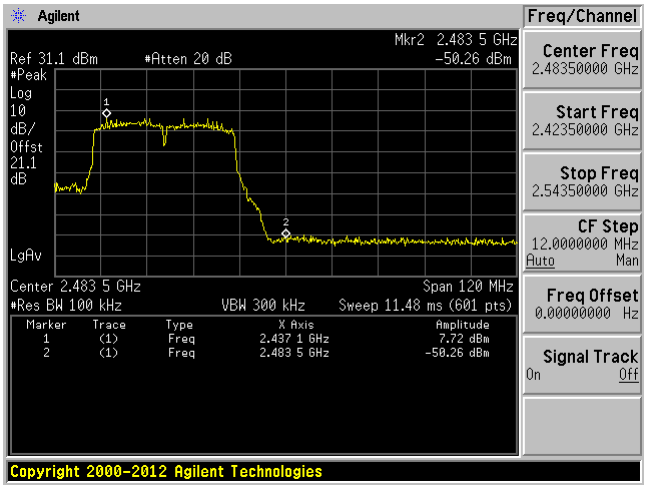


802.11n HT40 mode

Low Channel 2422 MHz

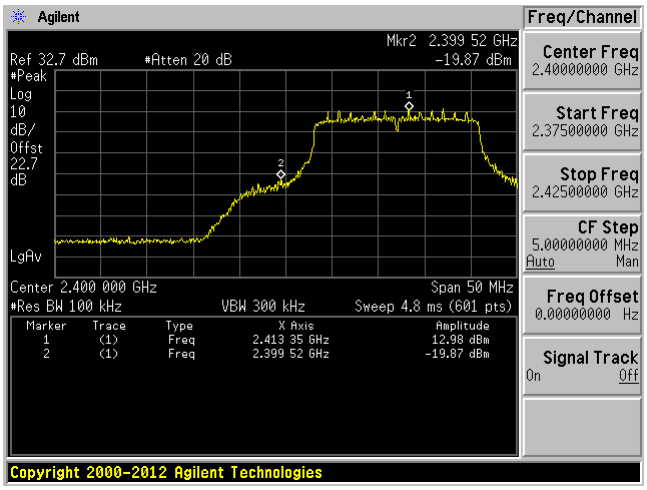


High Channel 2452 MHz

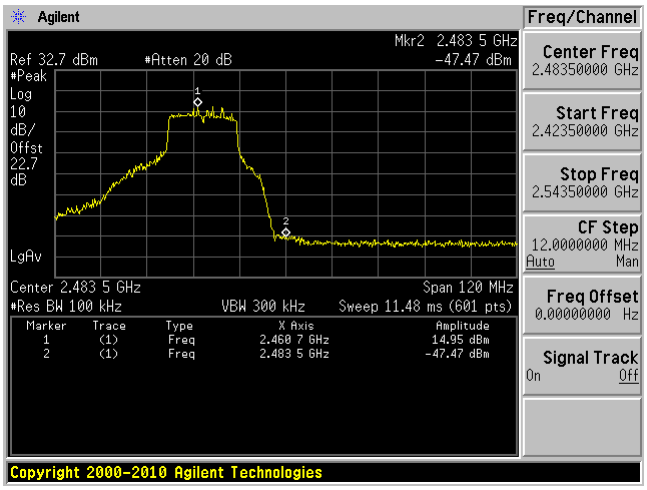


802.11n HT20 STBC

Low Channel 2412 MHz

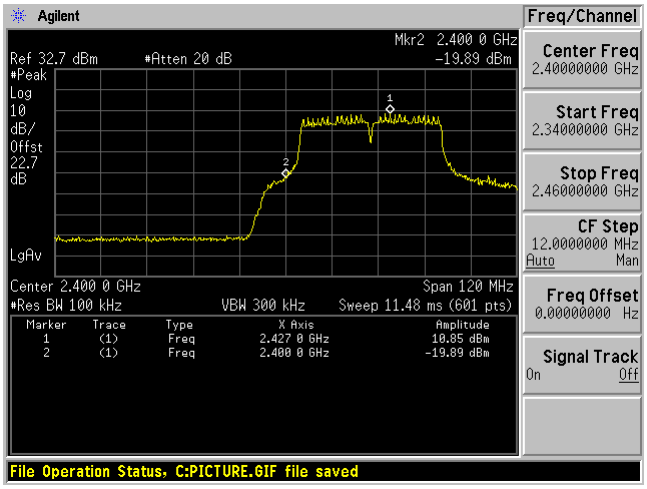


High Channel 2462 MHz

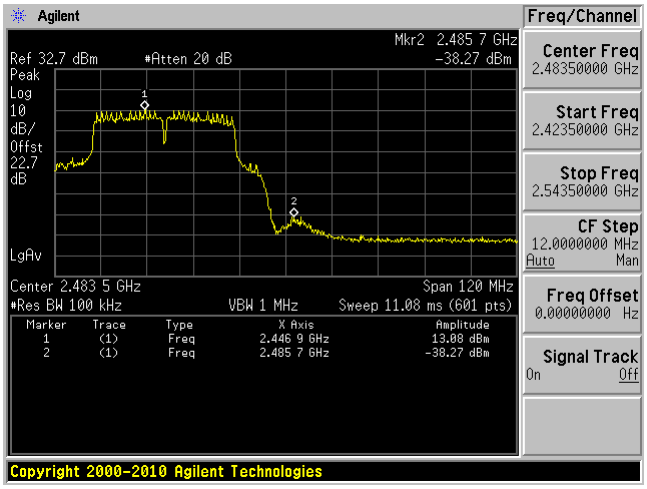


802.11n HT40 STBC

Low Channel 2422 MHz



High Channel 2452 MHz



11 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) - Power Spectral Density

11.1 Applicable Standards

According to ECFR §15.247(e) and RSS-247 §5.2 (2) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

11.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2020-04-29	1 year
-	RF cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

11.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Zhao Zhao on 2020-07-15 and 2020-07-28 at RF site.

11.5 Test Results

Channel	Frequency (MHz)	Conducted PSD (dBm/3kHz)			Total PSD (dBm/3kHz)	Limit (dBm/3kHz)
		Ant 1	Ant 2	Ant 3		
802.11b mode						
Low	2412	1.44	-0.61	-0.77	-	8
Middle	2437	-1.64	-0.08	-0.23	-	8
High	2462	-1.37	2.88	-2.28	-	8
802.11g mode						
Low	2412	-5.21	-4.84	-5.53	-	8
Middle	2437	-3.94	-3.34	-3.62	-	8
High	2462	-6.13	-4.71	-6.30	-	8
802.11 HT20 mode						
Low	2412	-6.33	-6.72	-7.02	-1.91	4.23
Middle	2437	-7.47	-7.40	-7.64	-2.73	4.23
High	2462	-7.00	-7.03	-7.78	-2.48	4.23
802.11 HT40 mode						
Low	2422	-7.54	-9.05	-7.05	-3.03	4.23
Middle	2437	-8.88	-7.88	-8.53	-3.64	4.23
High	2452	-8.06	-8.73	-8.26	-3.57	4.23
802.11 HT20 STBC						
Low	2412	-3.30	-2.77	-2.22	2.03	8
Middle	2437	-0.66	-1.11	-0.96	3.87	8
High	2462	-0.51	-1.26	-1.23	3.79	8
802.11 HT40 STBC						
Low	2422	-4.97	-5.19	-4.55	-0.12	8
Middle	2437	-2.43	-2.26	-3.18	2.17	8
High	2452	-4.23	-2.90	-2.60	1.58	8

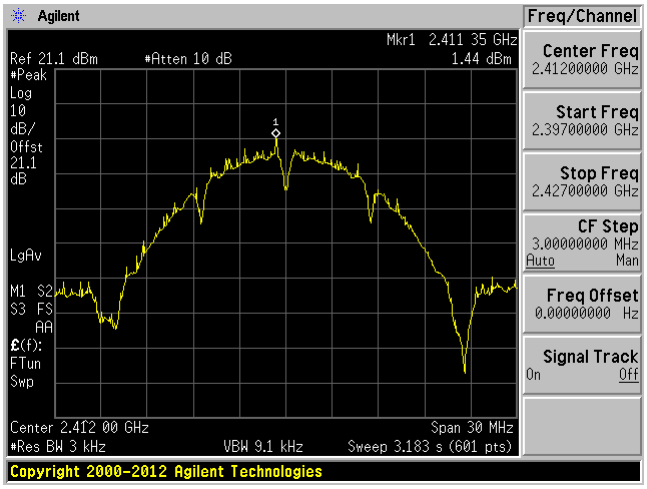
Please refer to plots below for detailed test results

Note: According to ECFR §15.247(e) and ISEDC RSS-247 §5.4 f , since the directional gain for 3 antennas is 9.77 dBi in total, the limit for HT20 and HT40 mode should be 4.23 dBm/3 kHz=8 dBm /3 kHz–(9.77 dBi- 6 dBi). The directional gain for 3 antennas is 5 dBi for STBC mode. Therefore, no limit reduction is required.

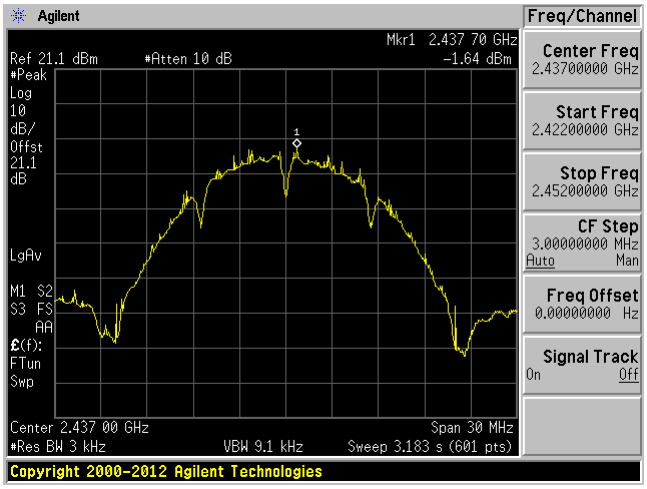
Antenna 1

802.11b mode

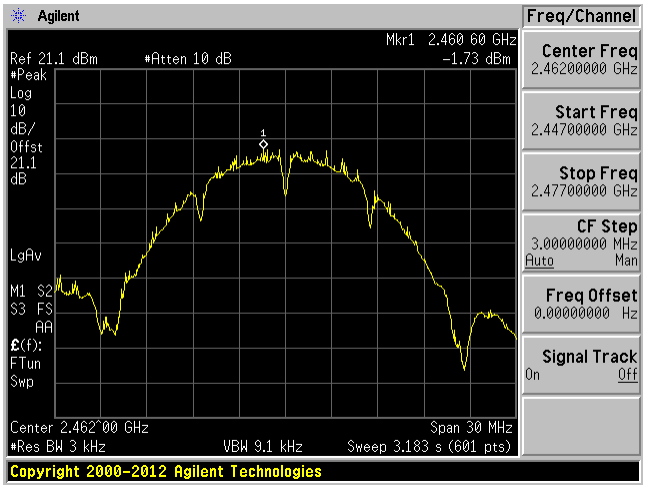
Low Channel 2412 MHz



Middle Channel 2437 MHz

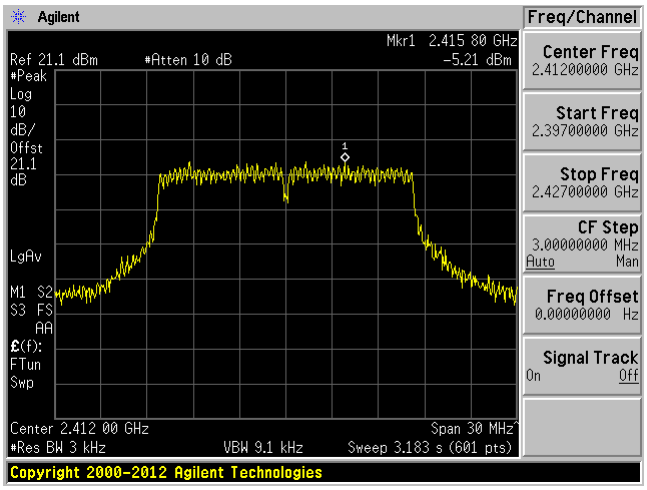


High Channel 2462 MHz

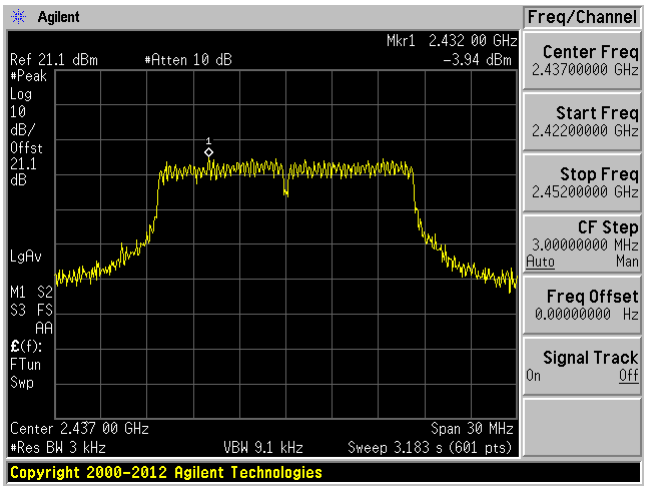


802.11g mode

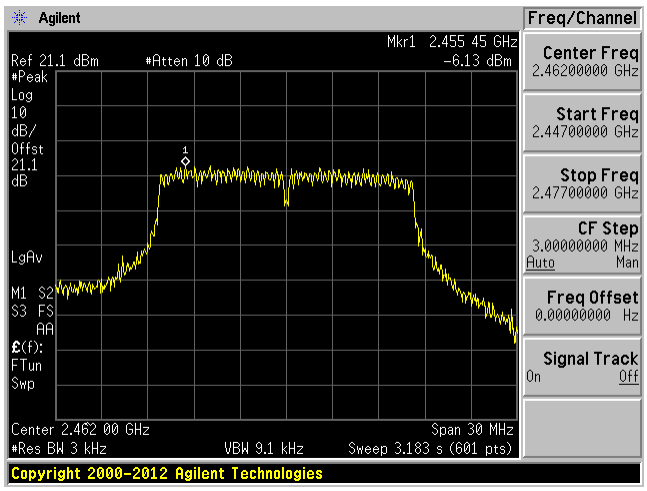
Low Channel 2412 MHz



Middle Channel 2437 MHz

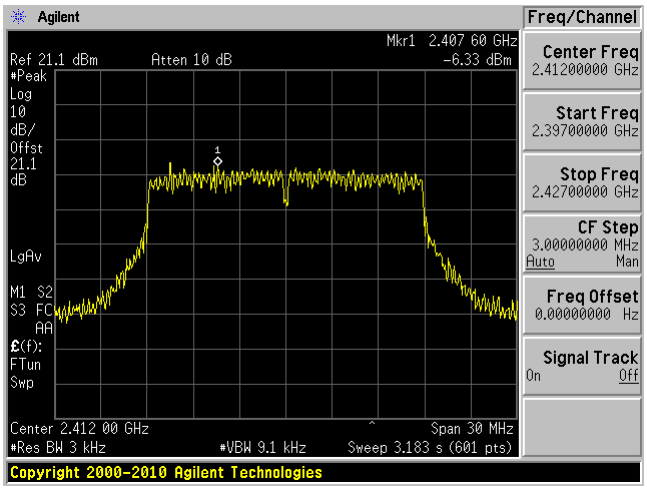


High Channel 2462 MHz

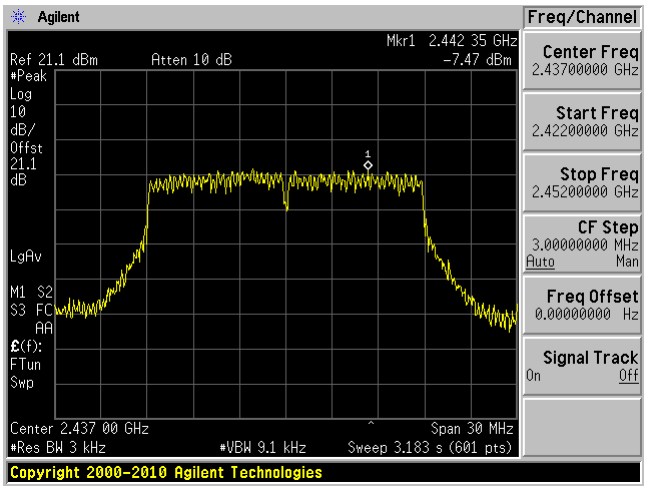


802.11n HT20 mode

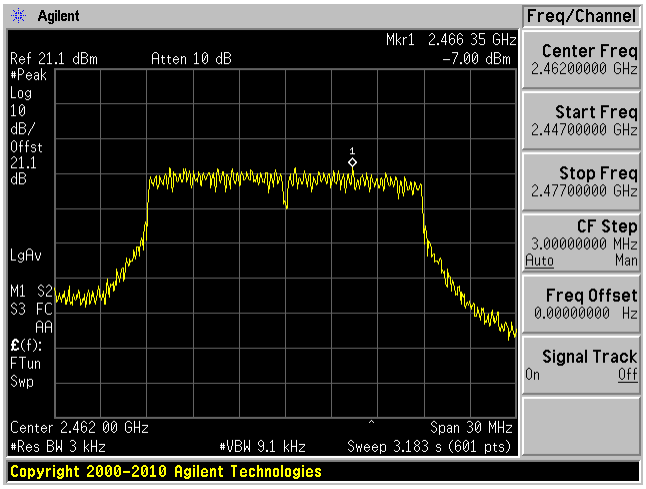
Low Channel 2412 MHz



Middle Channel 2437 MHz

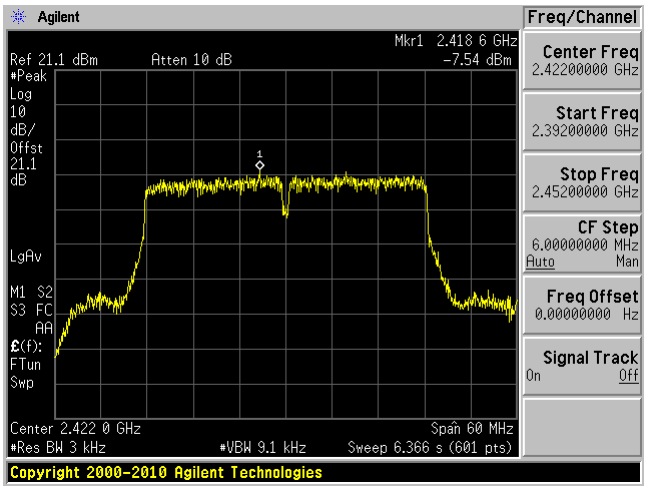


High Channel 2462 MHz

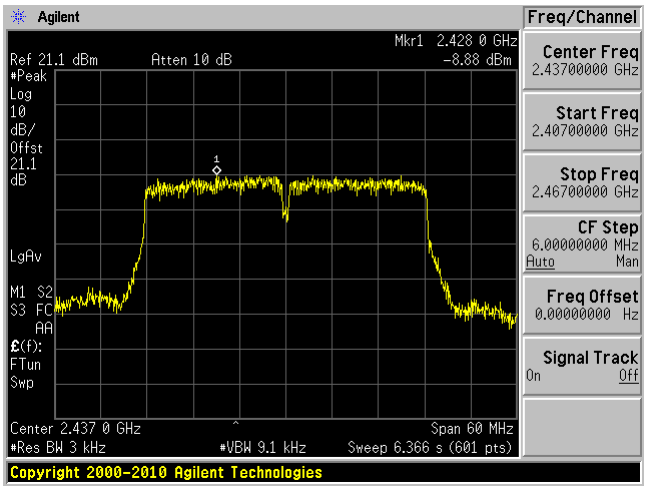


802.11n HT40 mode

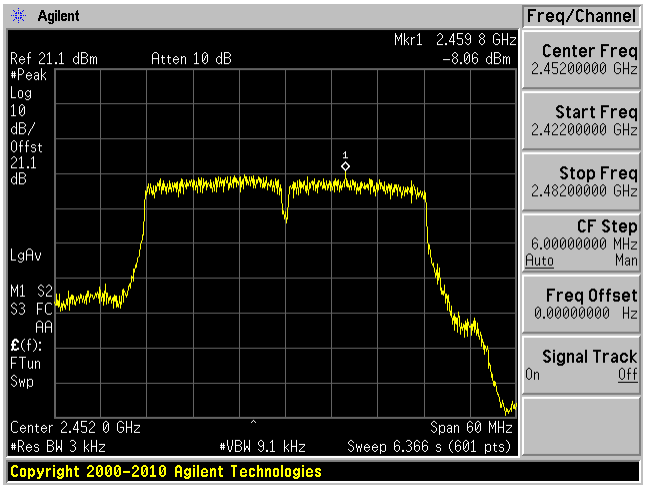
Low Channel 2422 MHz



Middle Channel 2437 MHz

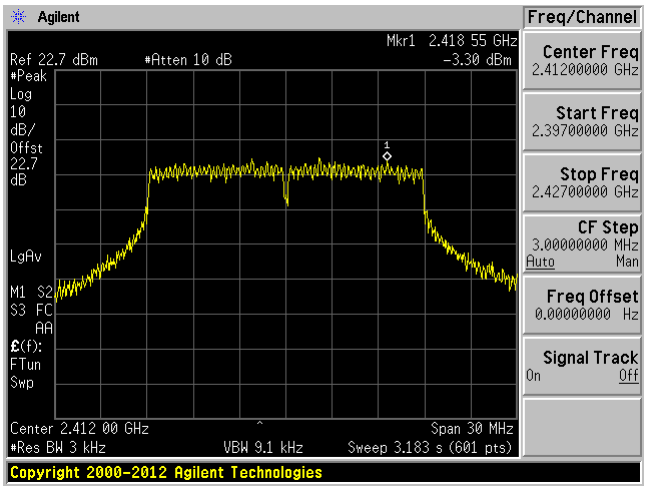


High Channel 2452 MHz

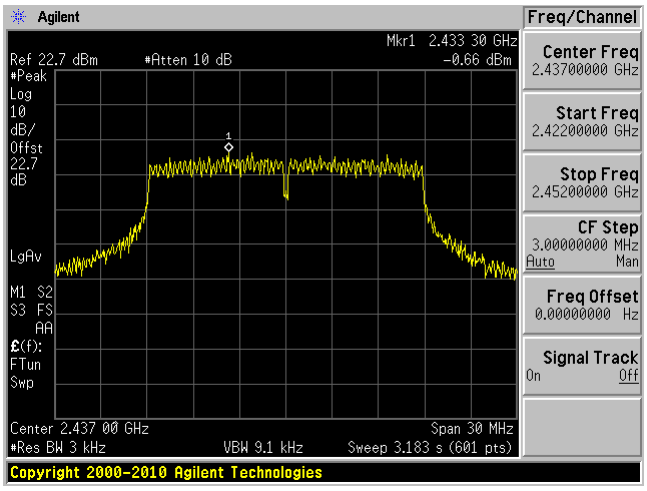


802.11n HT20 STBC

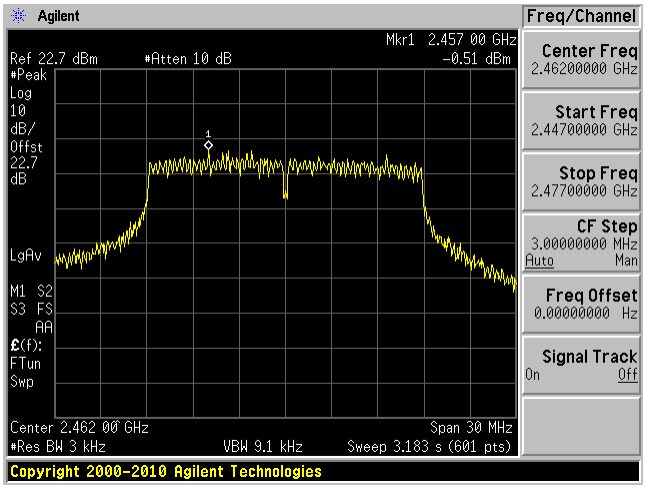
Low Channel 2412 MHz



Middle Channel 2437 MHz

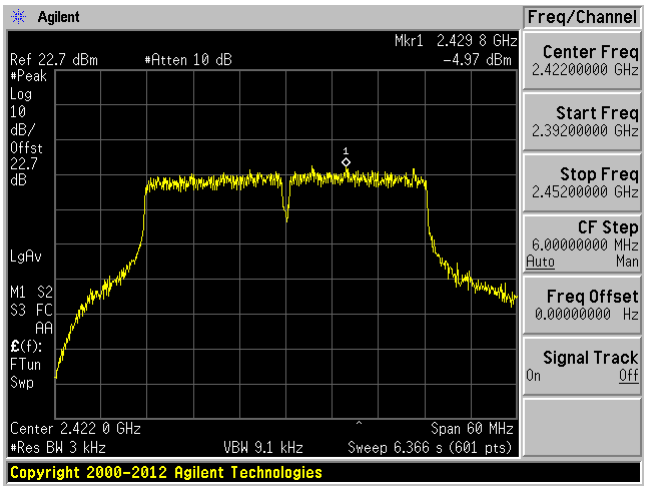


High Channel 2462 MHz

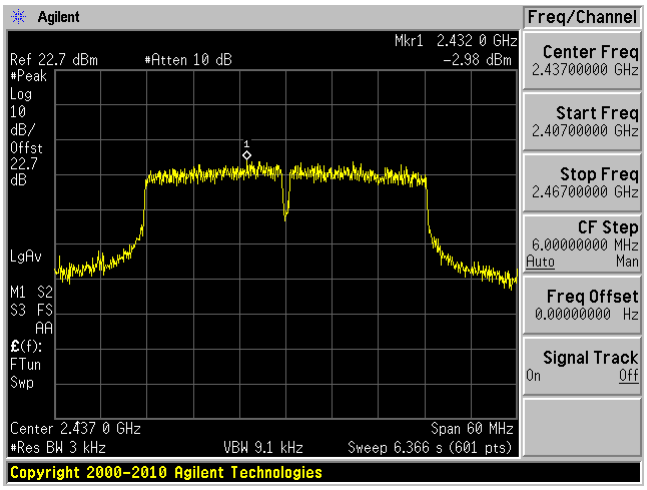


802.11n HT40 STBC

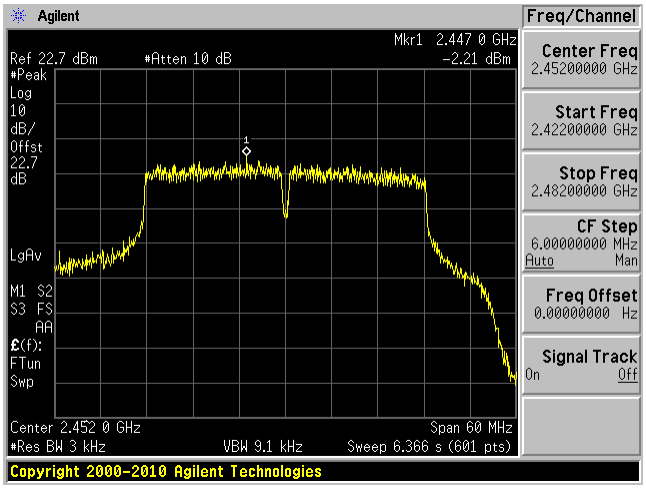
Low Channel 2422 MHz



Middle Channel 2437 MHz



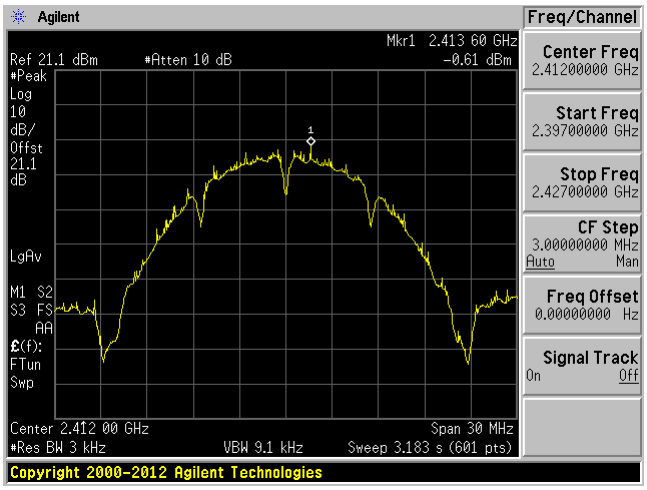
High Channel 2452 MHz



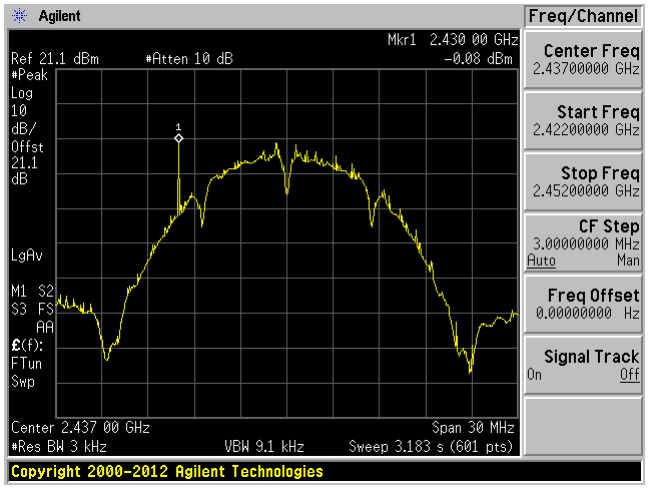
Antenna 2

802.11b mode

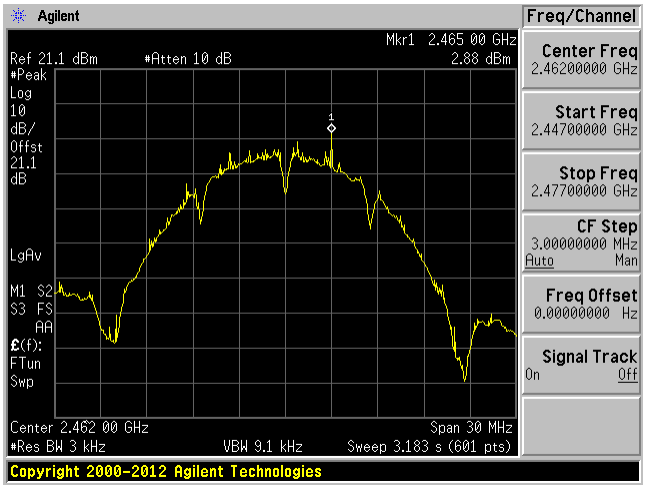
Low Channel 2412 MHz



Middle Channel 2437 MHz

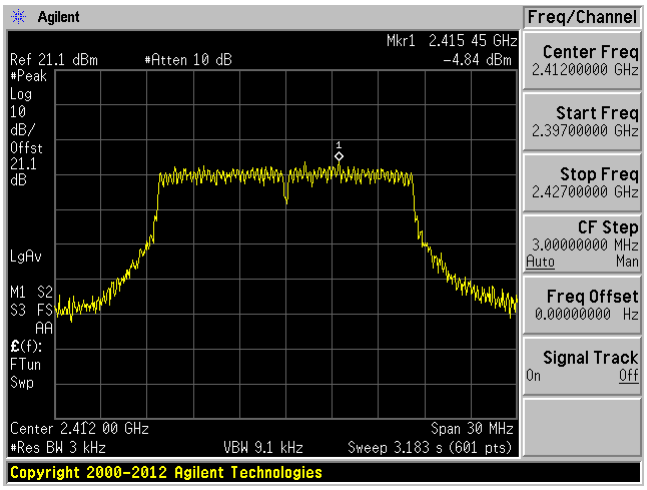


High Channel 2462 MHz

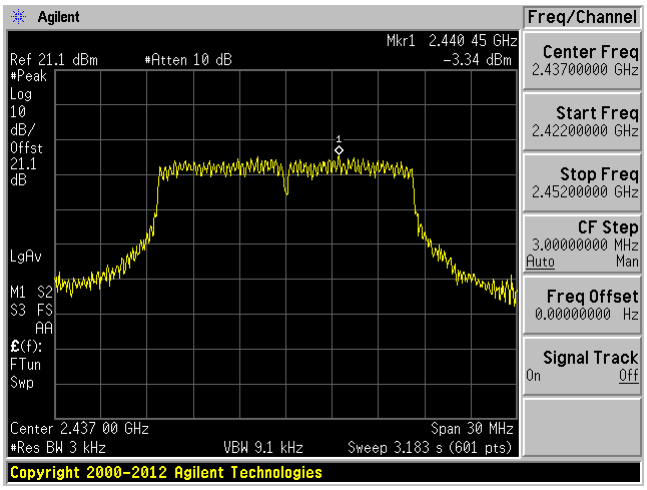


802.11g mode

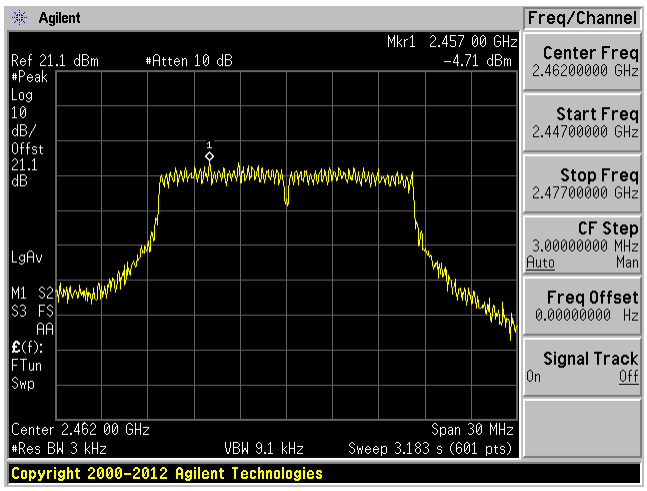
Low Channel 2412 MHz



Middle Channel 2437 MHz

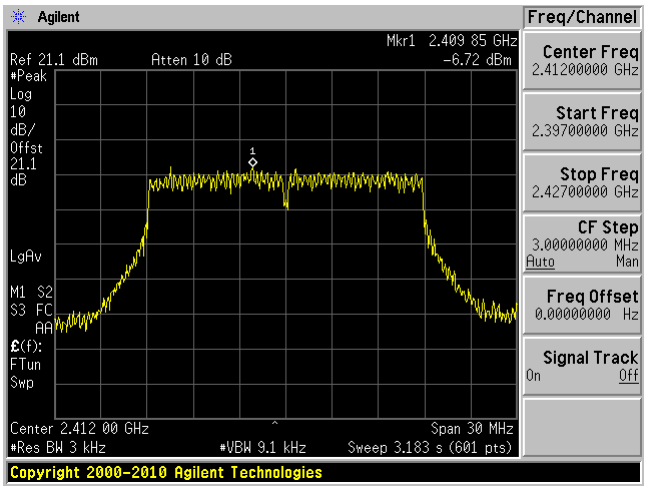


High Channel 2462 MHz

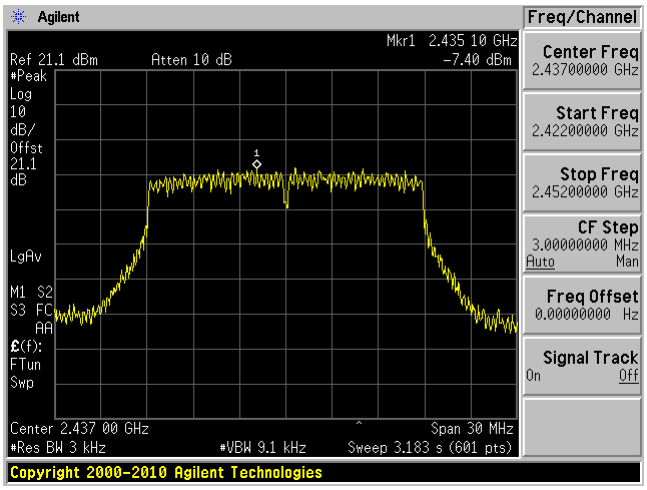


802.11n HT20 mode

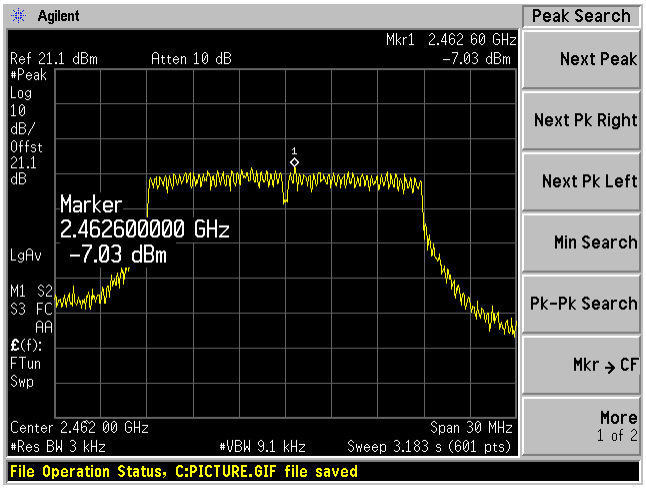
Low Channel 2412 MHz



Middle Channel 2437 MHz

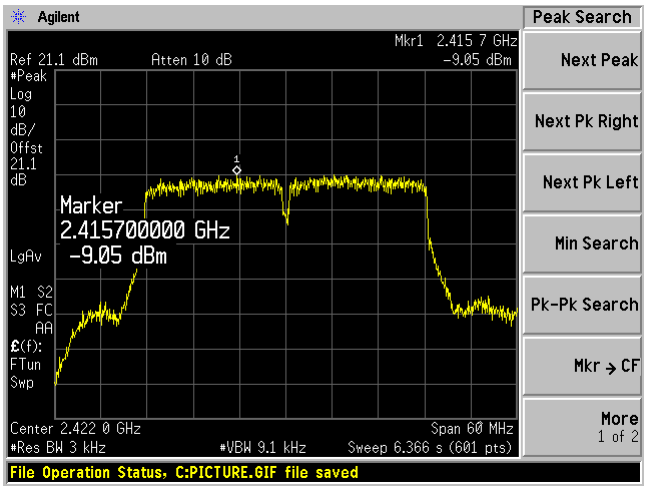


High Channel 2462 MHz

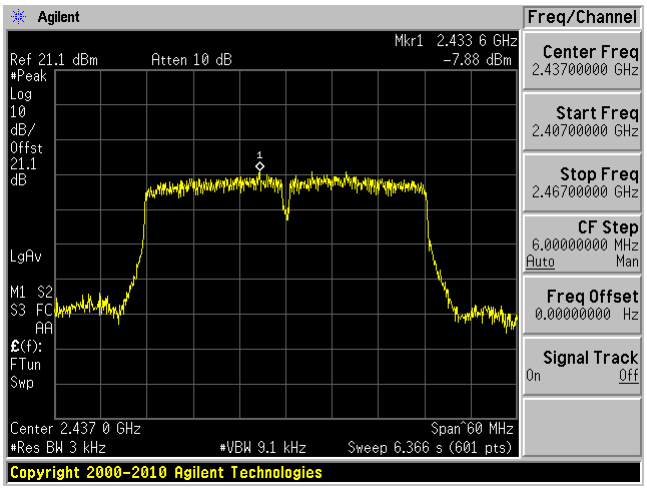


802.11n HT40 mode

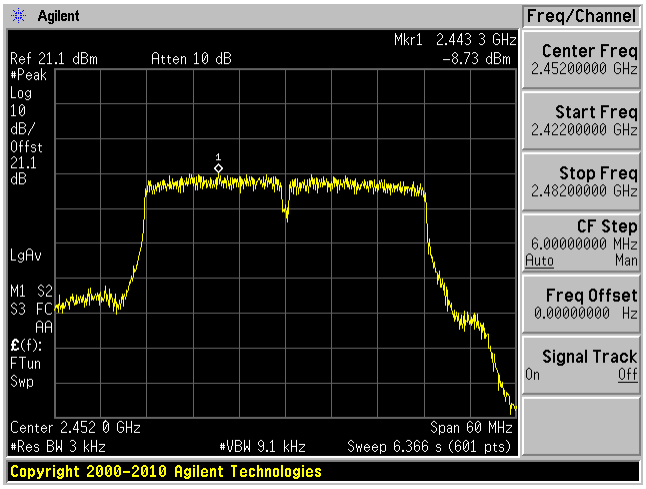
Low Channel 2422 MHz



Middle Channel 2437 MHz

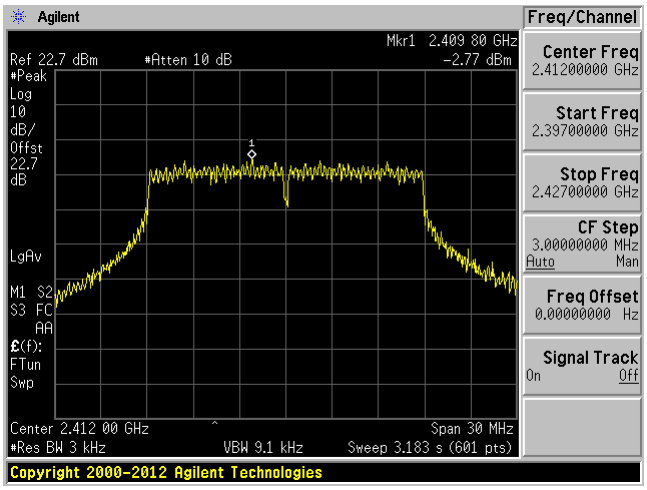


High Channel 2452 MHz

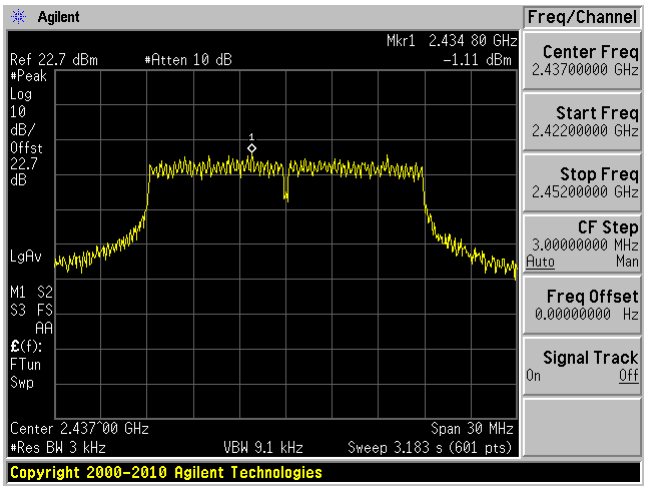


802.11n HT20 STBC

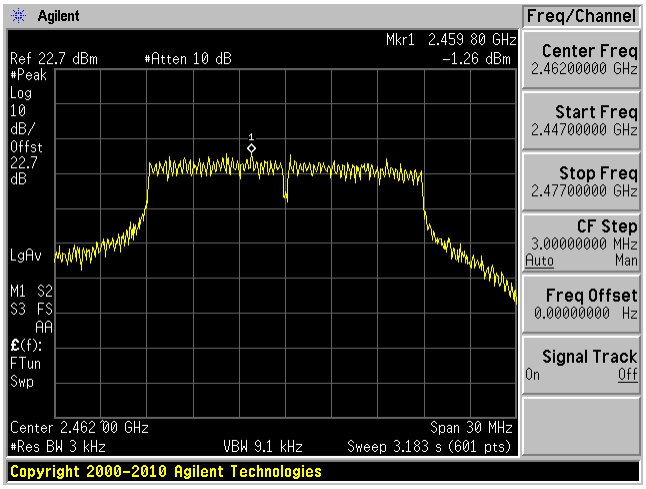
Low Channel 2412 MHz



Middle Channel 2437 MHz

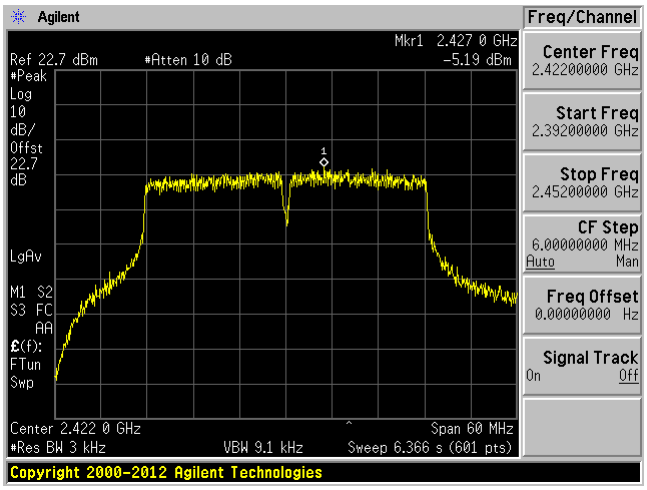


High Channel 2462 MHz

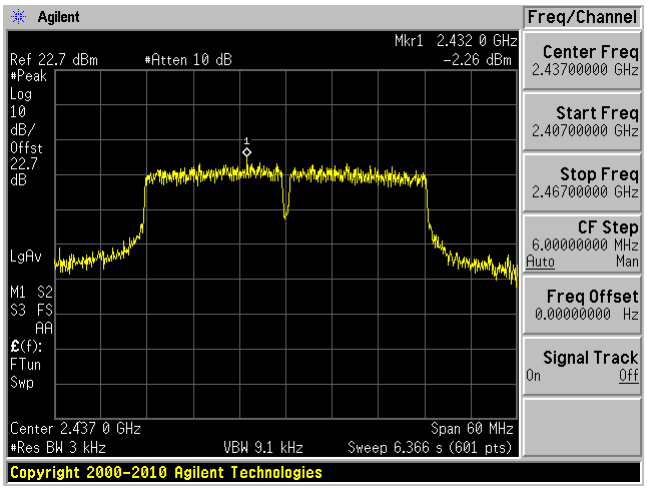


802.11n HT40 STBC

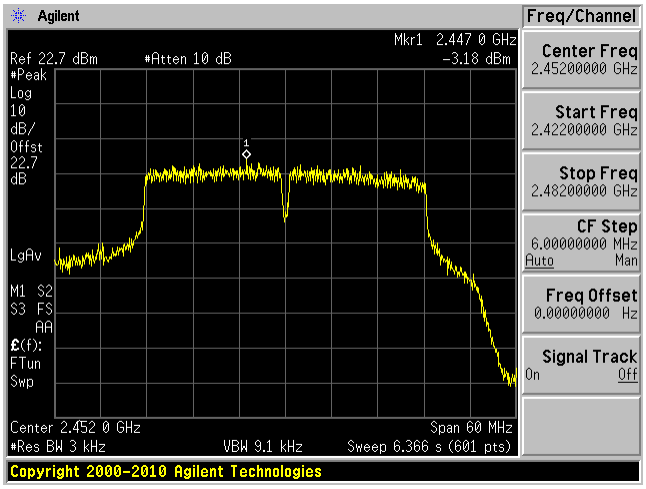
Low Channel 2422 MHz



Middle Channel 2437 MHz



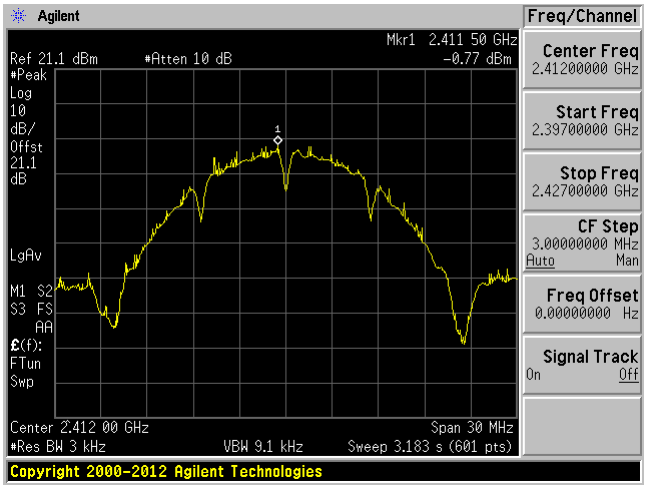
High Channel 2452 MHz



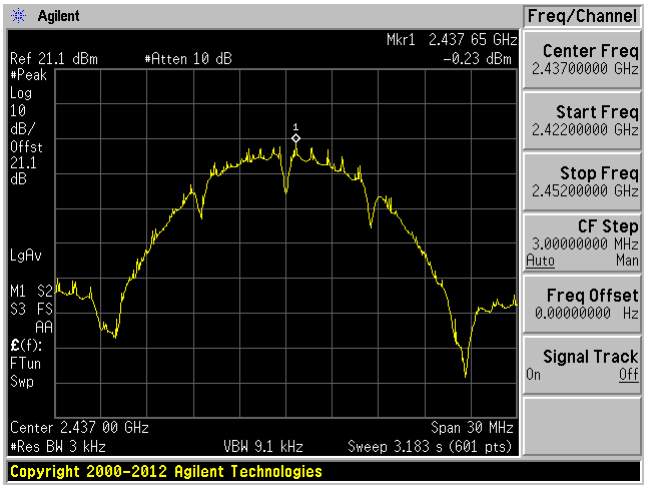
Antenna 3

802.11b mode

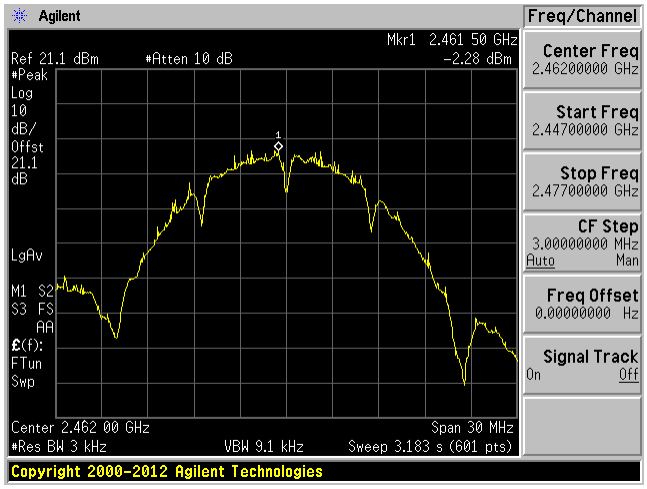
Low Channel 2412 MHz



Middle Channel 2437 MHz

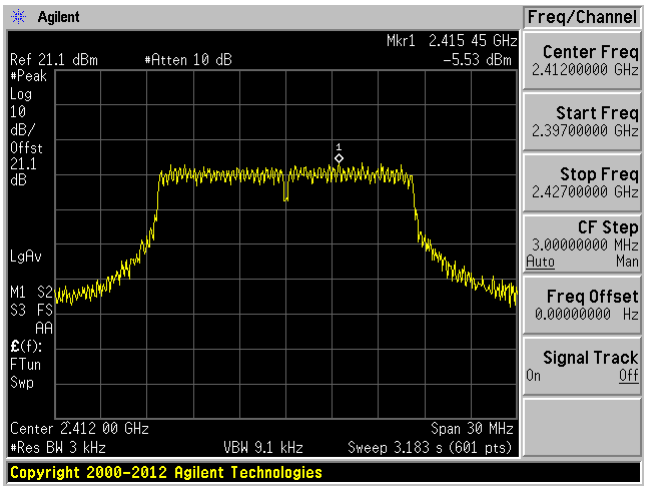


High Channel 2462 MHz

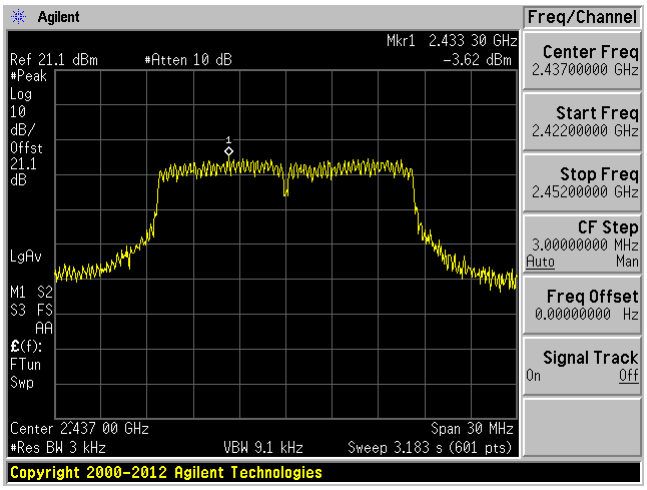


802.11g mode

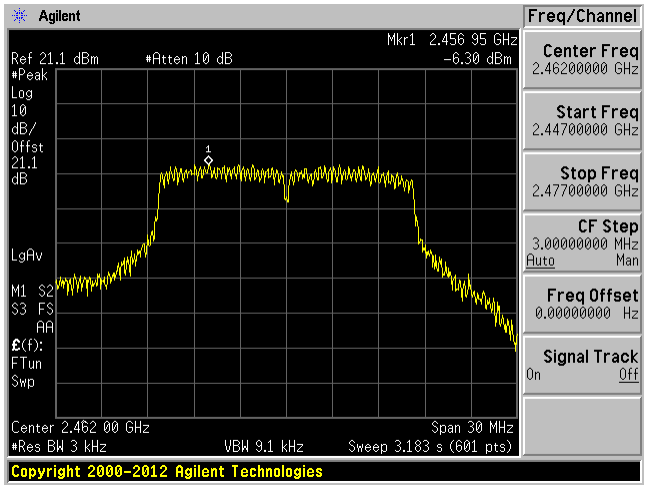
Low Channel 2412 MHz



Middle Channel 2437 MHz

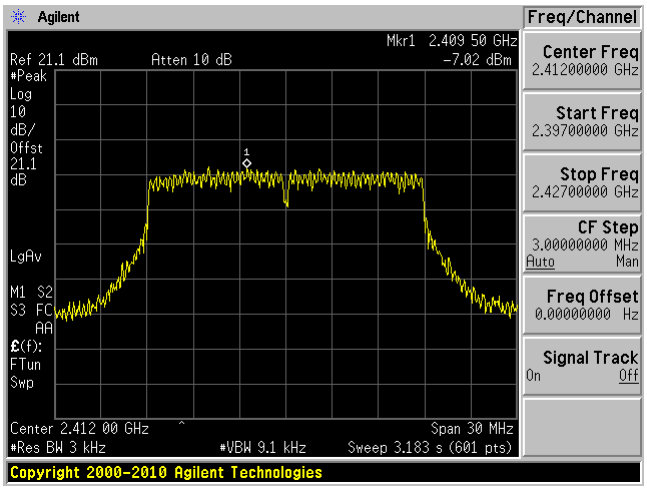


High Channel 2462 MHz

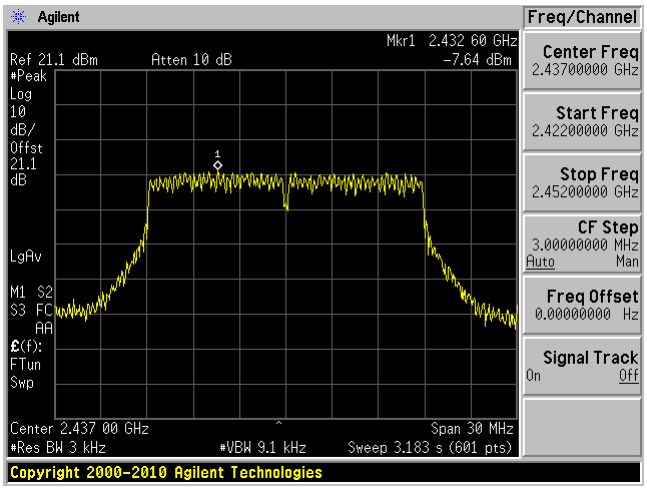


802.11 HT20 mode

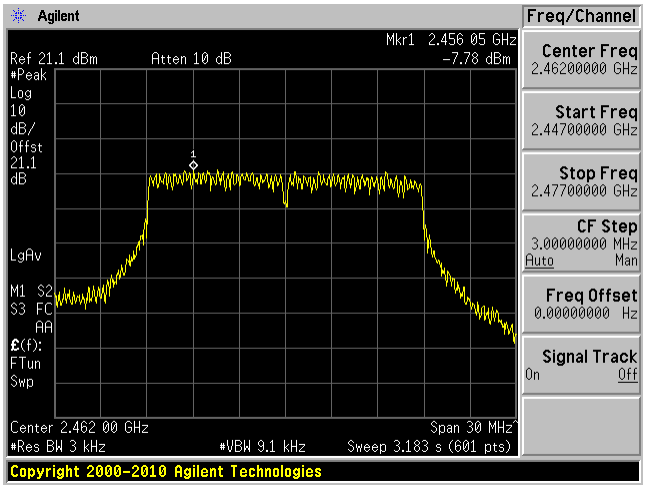
Low Channel 2412 MHz



Middle Channel 2437 MHz

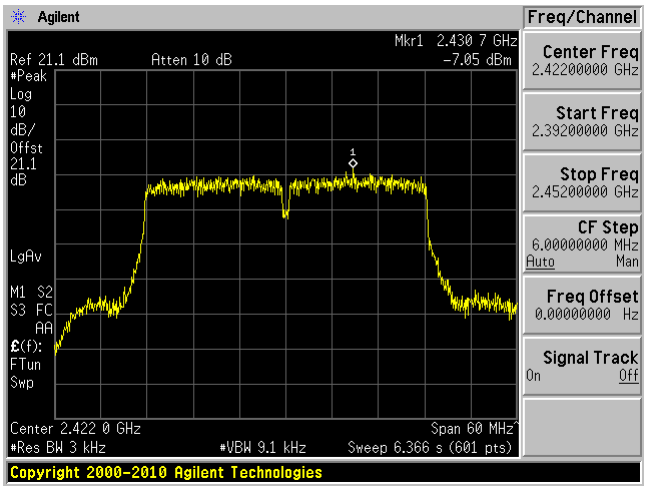


High Channel 2462 MHz

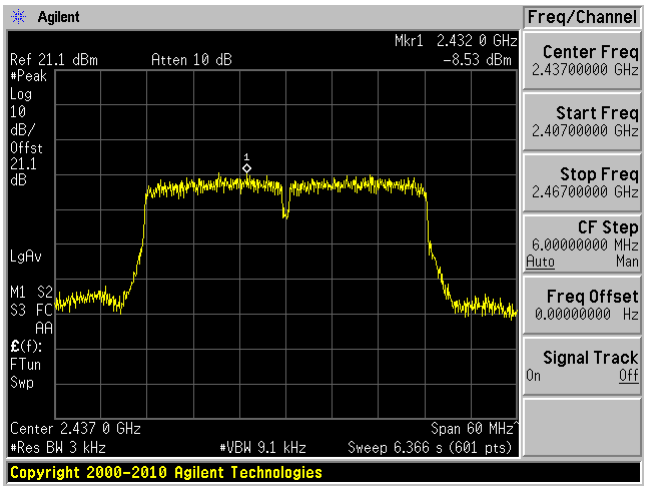


802.11 HT40 mode

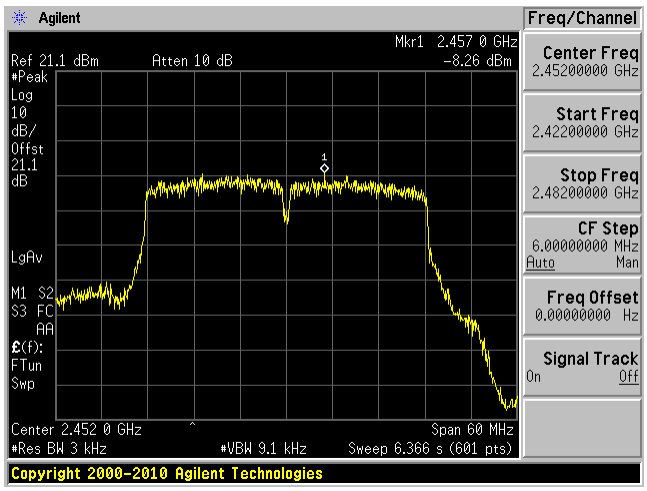
Low Channel 2422 MHz



Middle Channel 2437 MHz

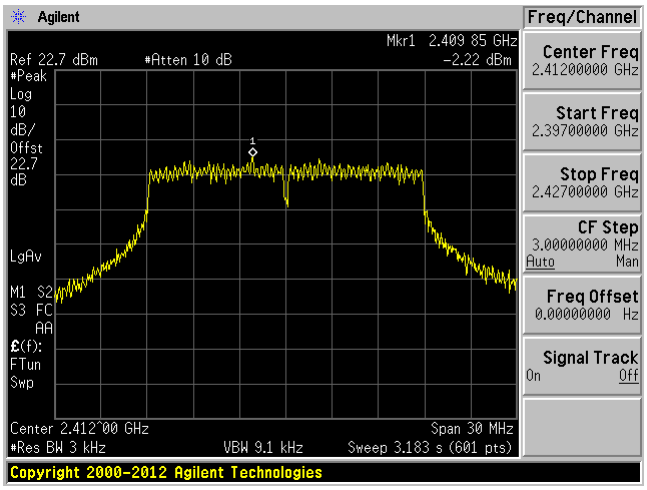


High Channel 2452 MHz

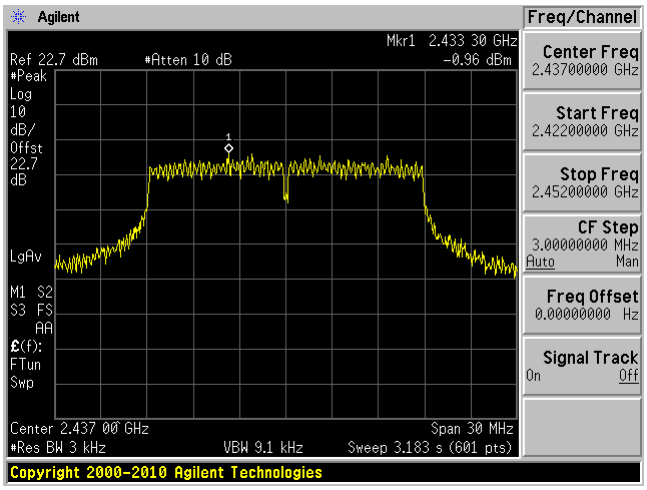


802.11n HT20 STBC

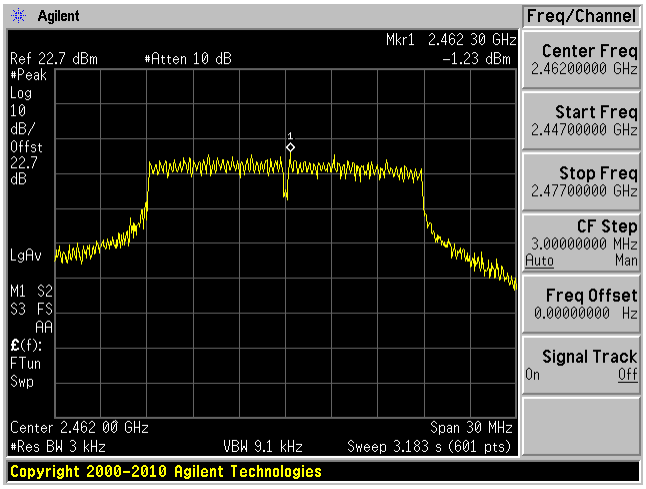
Low Channel 2412 MHz



Middle Channel 2437 MHz

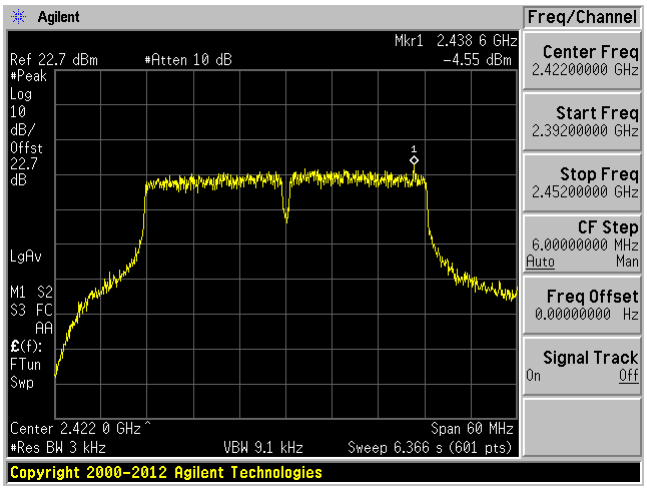


High Channel 2462 MHz

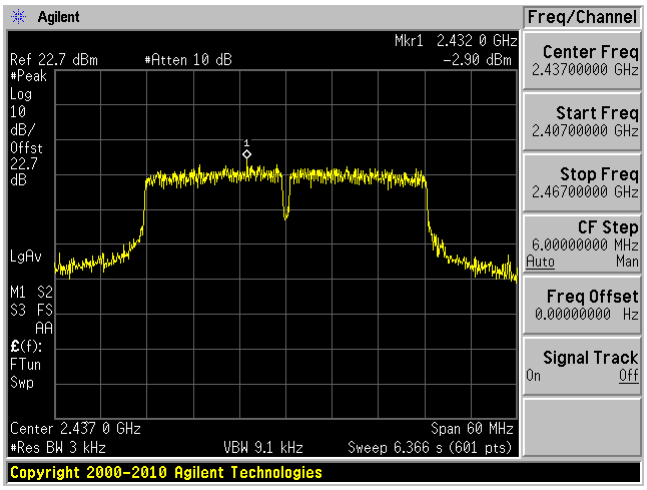


802.11n HT40 STBC

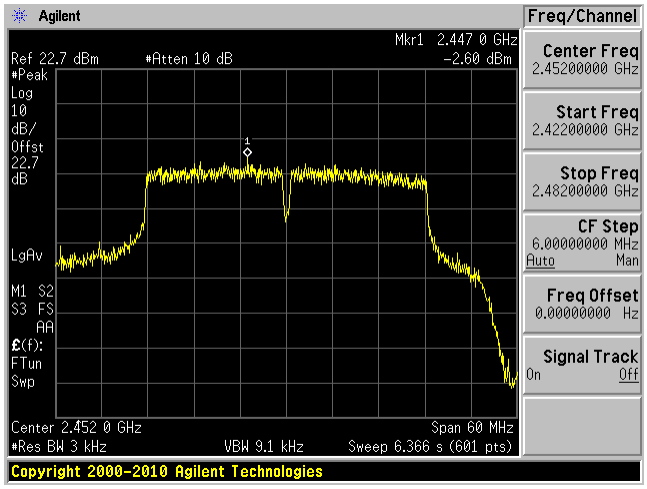
Low Channel 2422 MHz



Middle Channel 2437 MHz



High Channel 2452 MHz



12 FCC §15.247(d) & ISEDC RSS-247 §5.5, RSS-GEN §8.9 - Spurious Emissions at Antenna Terminals

12.1 Applicable Standards

For ECFR §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

12.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2020-04-29	1 year
-	RF cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

12.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

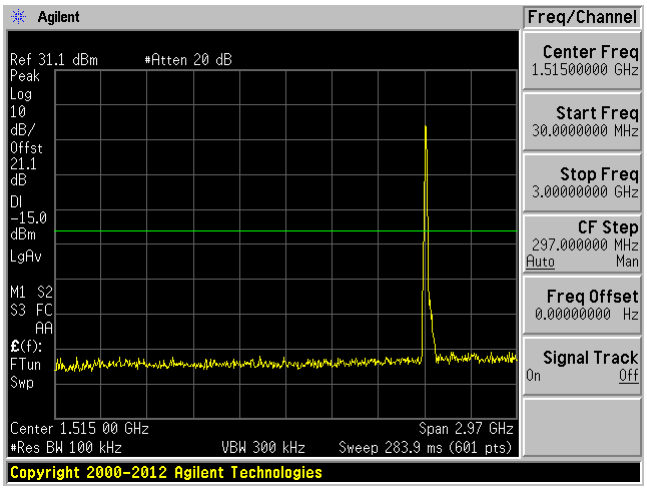
The testing was performed by Zhao Zhao on 2020-07-15 and 2020-07-28 at RF site.

12.5 Test Results

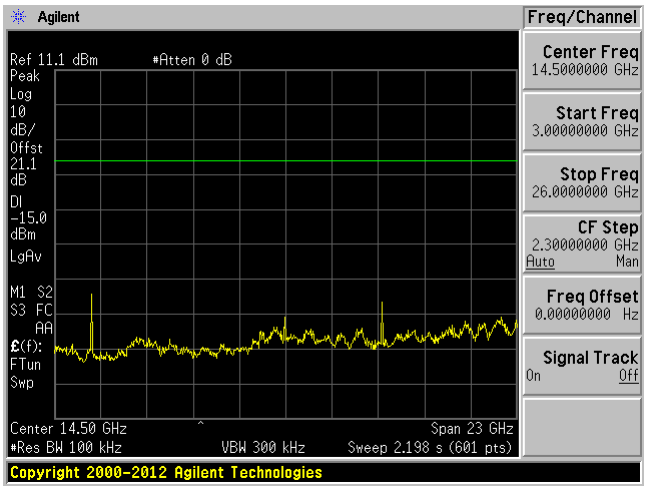
Please refer to plots below for details

Antenna 1
802.11b mode

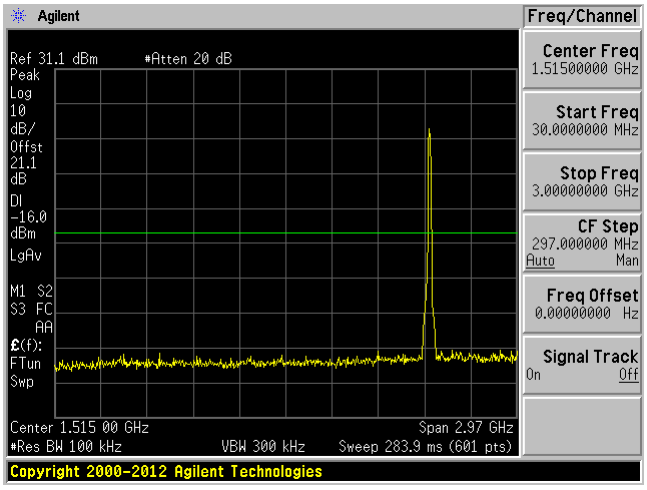
Low Channel 30MHz – 3 GHz



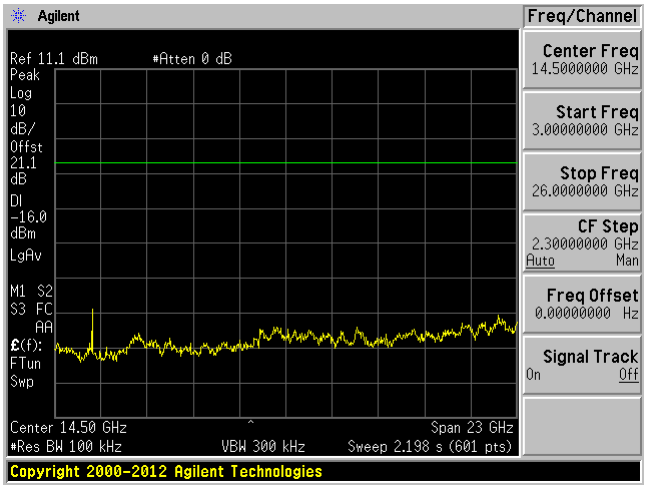
Low Channel 3 GHz – 26 GHz



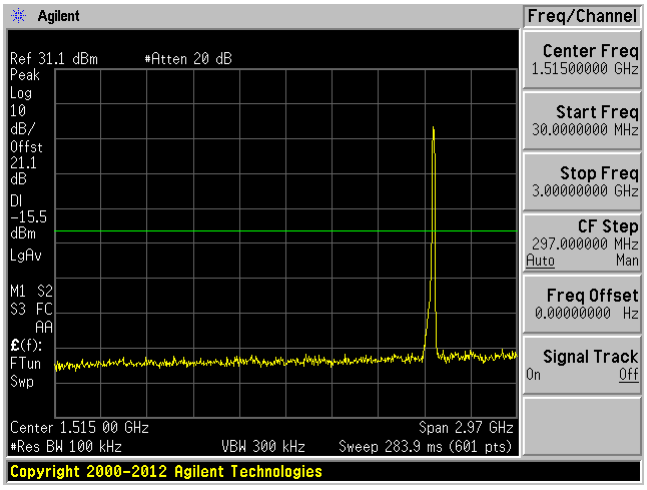
Middle Channel 30 MHz – 3 GHz



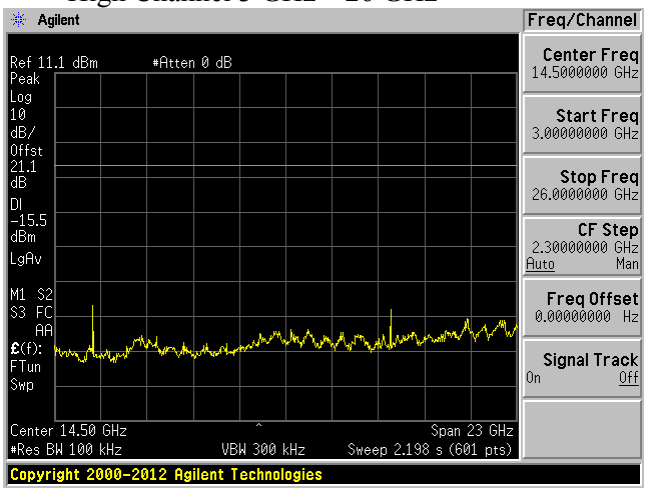
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

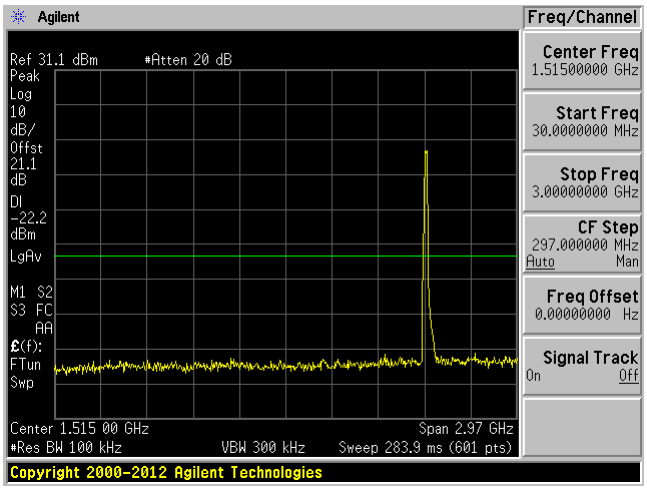


High Channel 3 GHz – 26 GHz

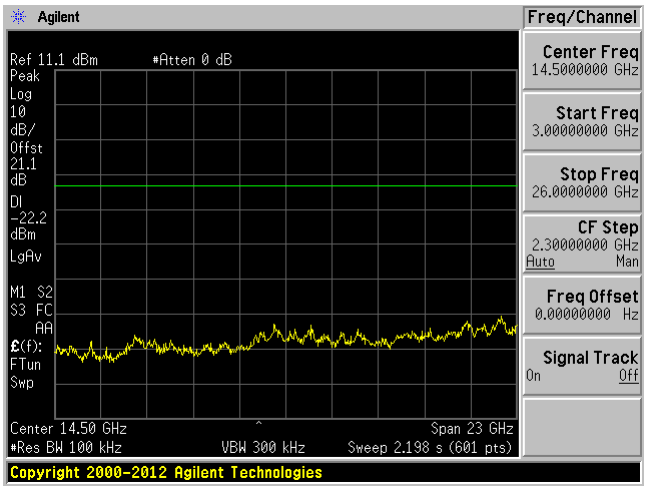


802.11g mode

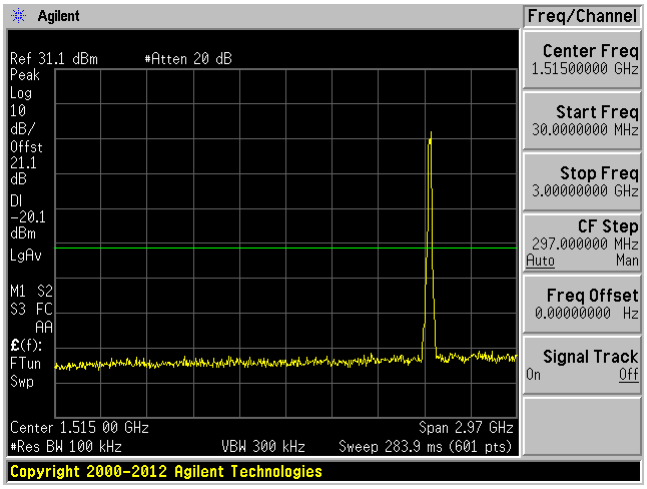
Low Channel 30 MHz – 3 GHz



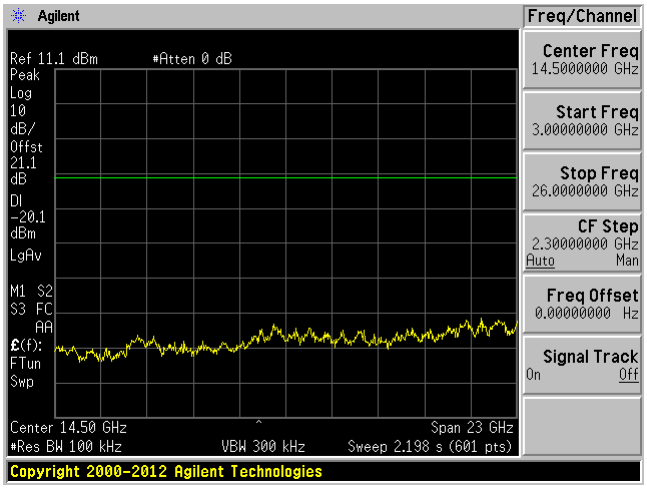
Low Channel 3 GHz – 26 GHz



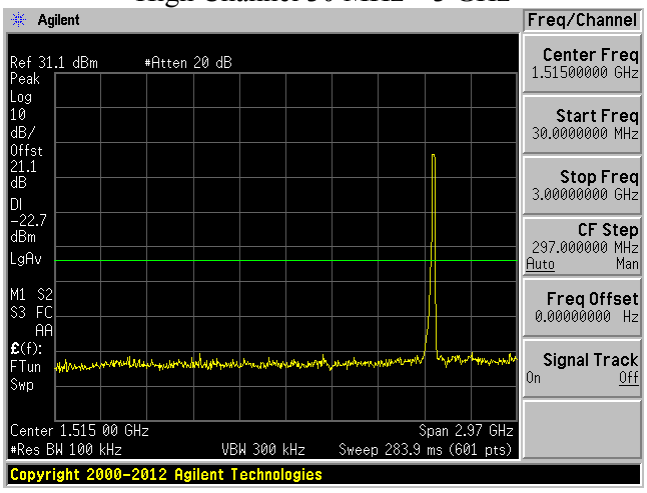
Middle Channel 30 MHz – 3 GHz



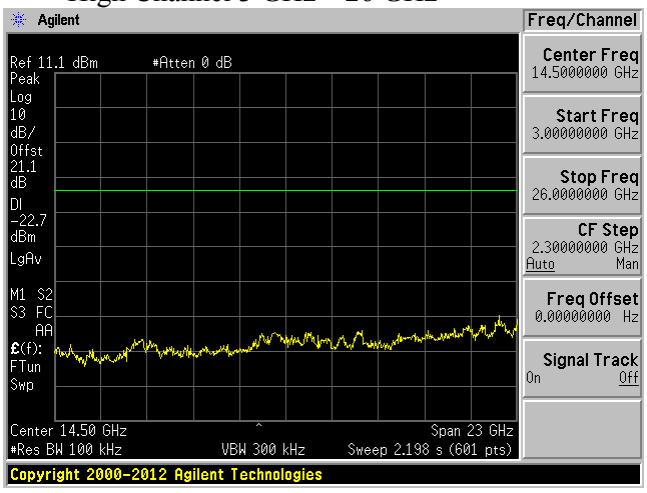
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

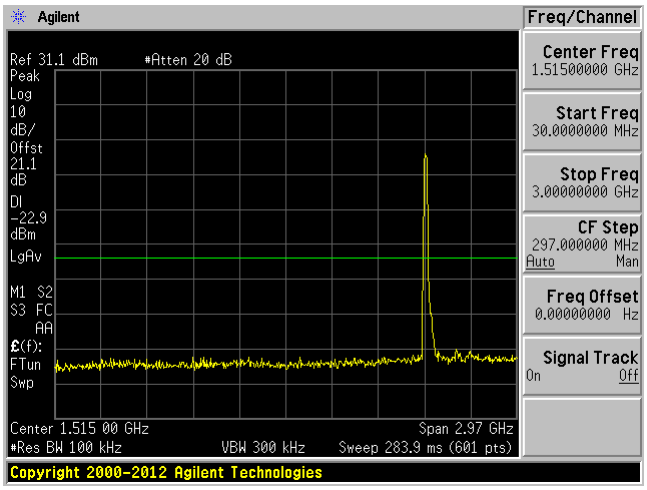


High Channel 3 GHz – 26 GHz

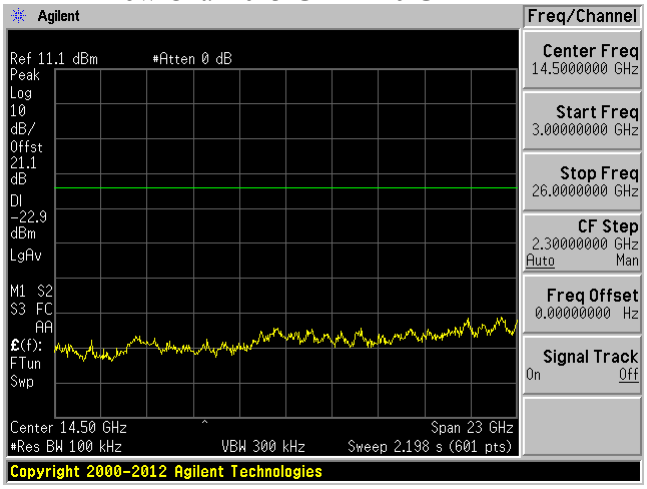


802.11 HT20 mode

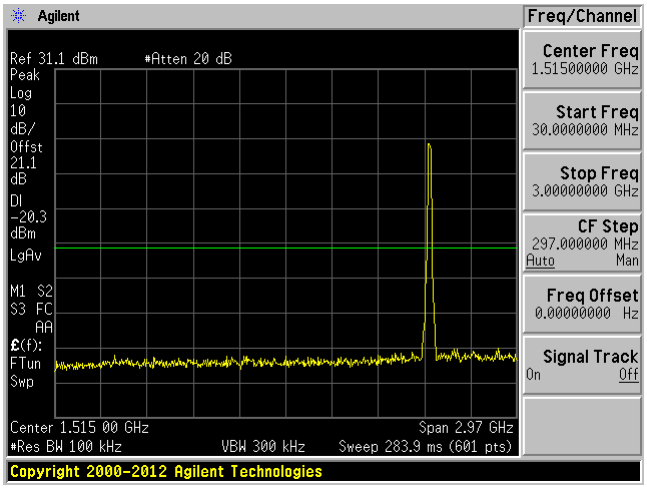
Low Channel 30 MHz – 3 GHz



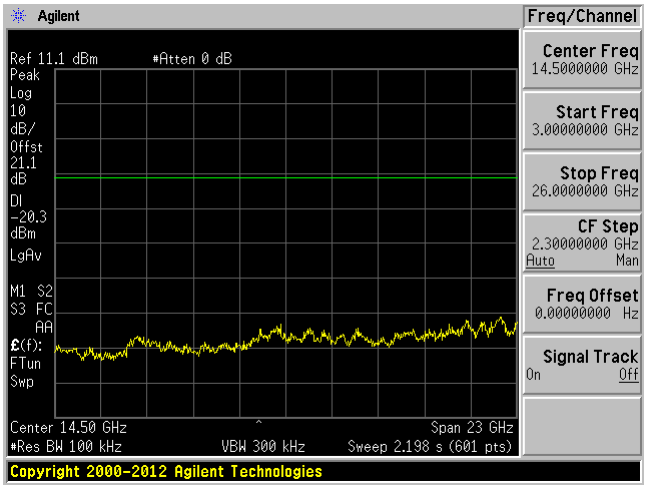
Low Channel 3 GHz – 26 GHz



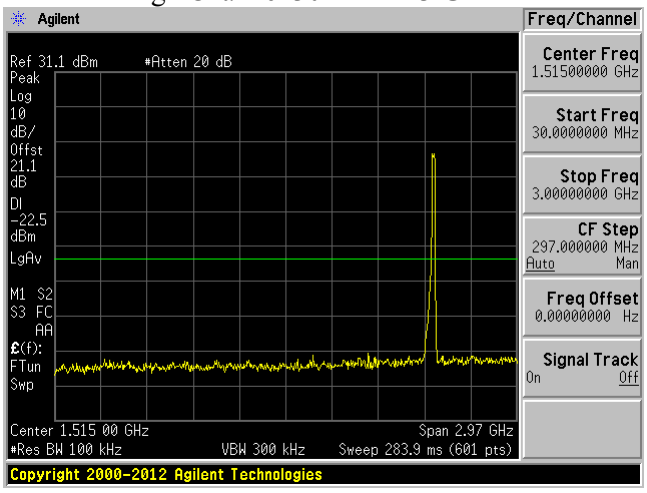
Middle Channel 30 MHz – 3 GHz



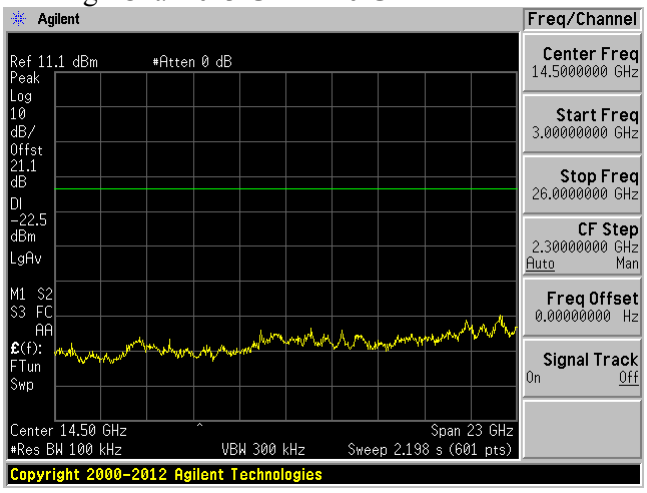
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

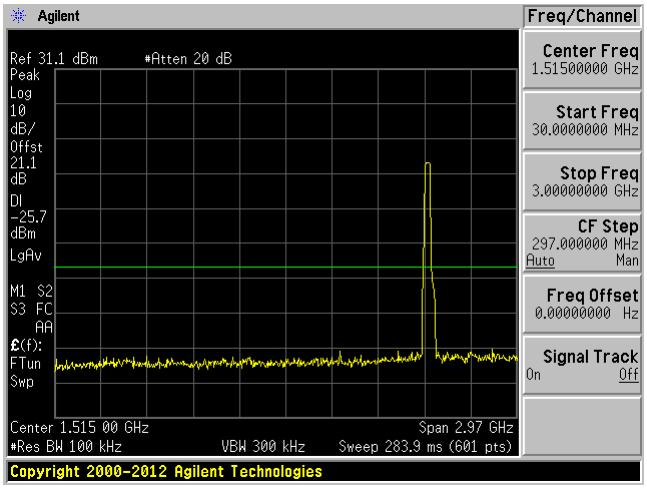


High Channel 3 GHz – 26 GHz

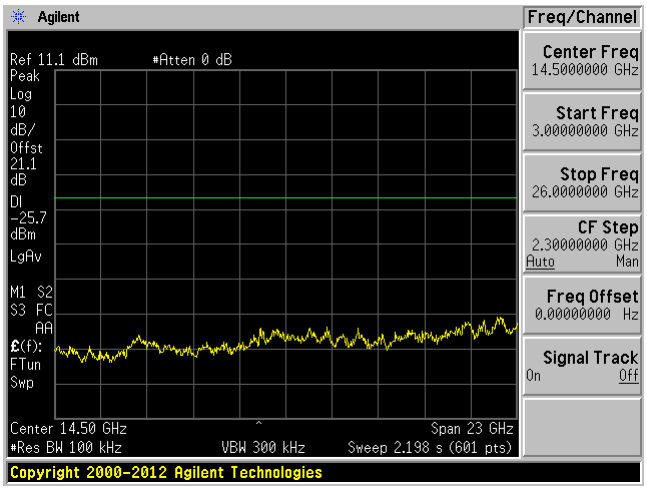


802.11 HT40 mode

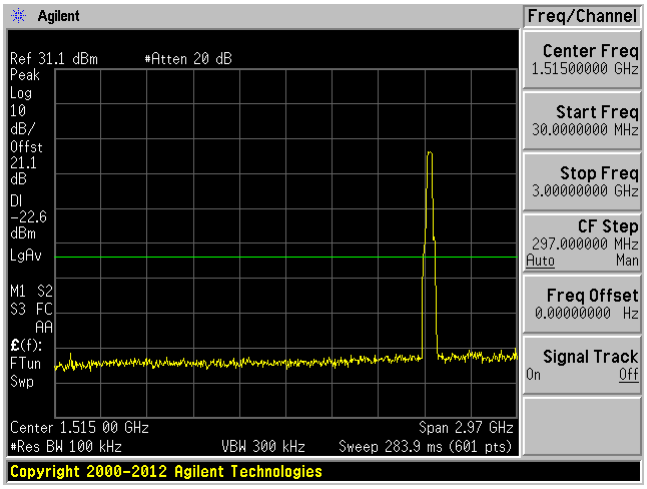
Low Channel 30 MHz – 3 GHz



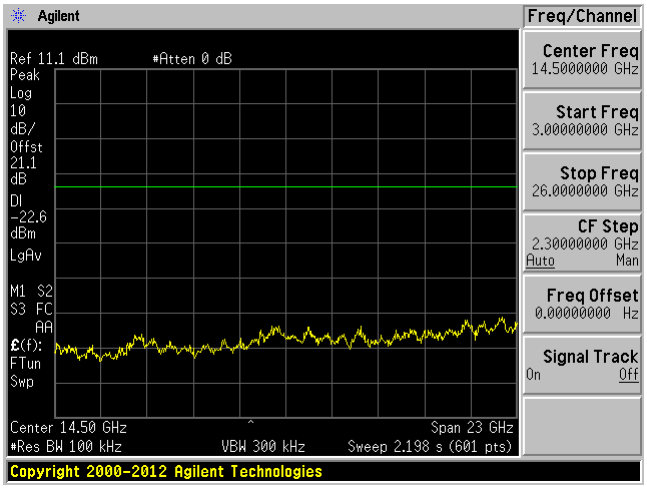
Low Channel 3 GHz – 26 GHz



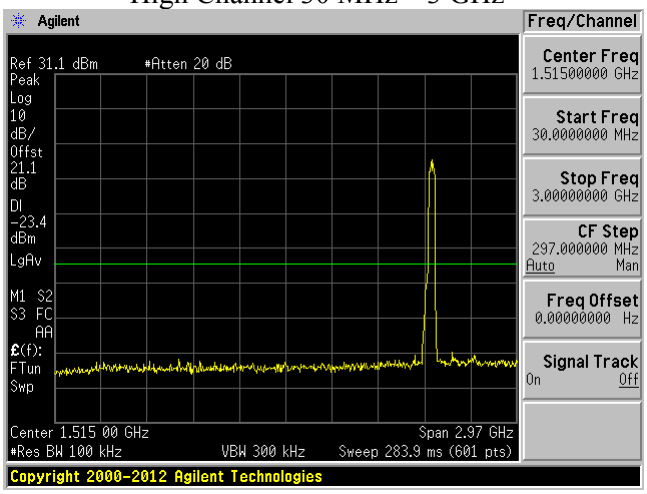
Middle Channel 30 MHz – 3 GHz



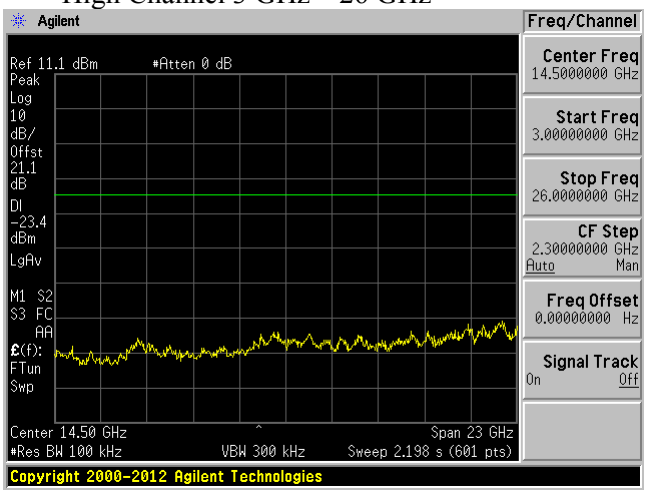
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

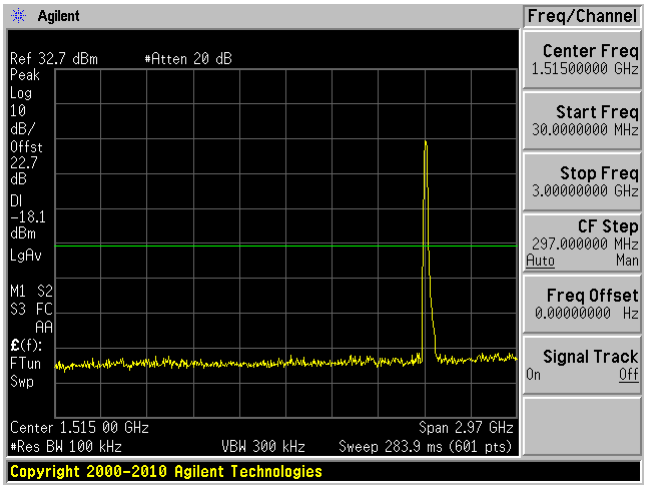


High Channel 3 GHz – 26 GHz

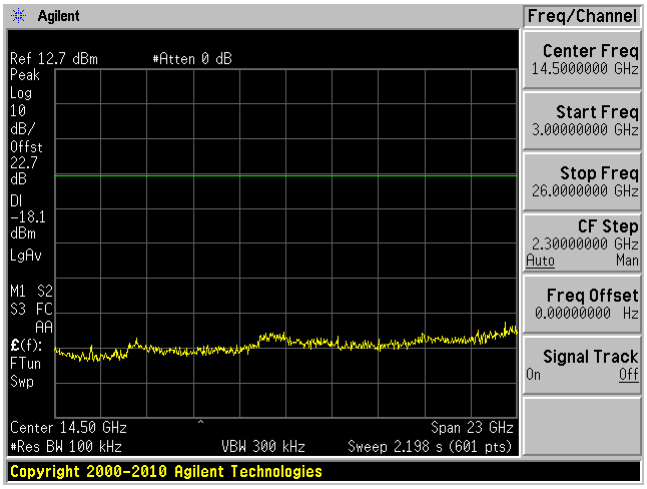


802.11 HT20 STBC

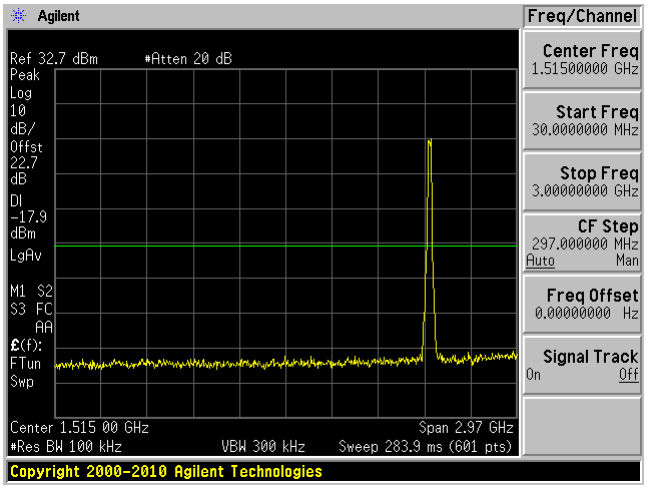
Low Channel 30 MHz – 3 GHz



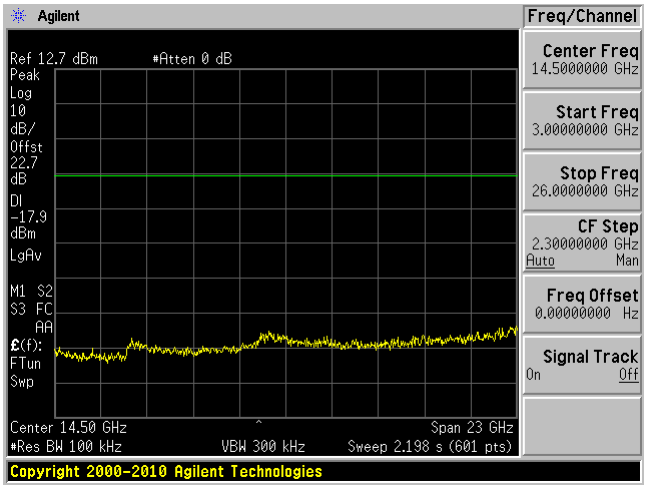
Low Channel 3 GHz – 26 GHz



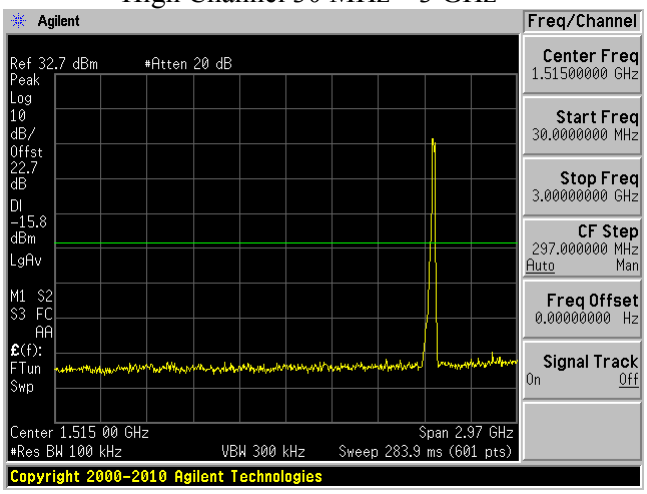
Middle Channel 30 MHz – 3 GHz



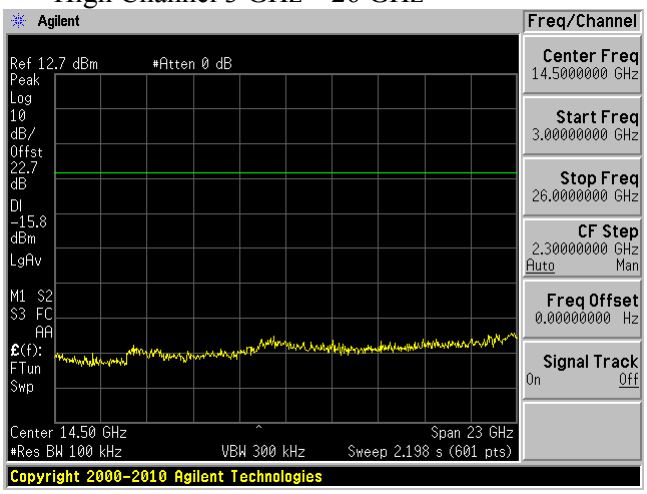
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

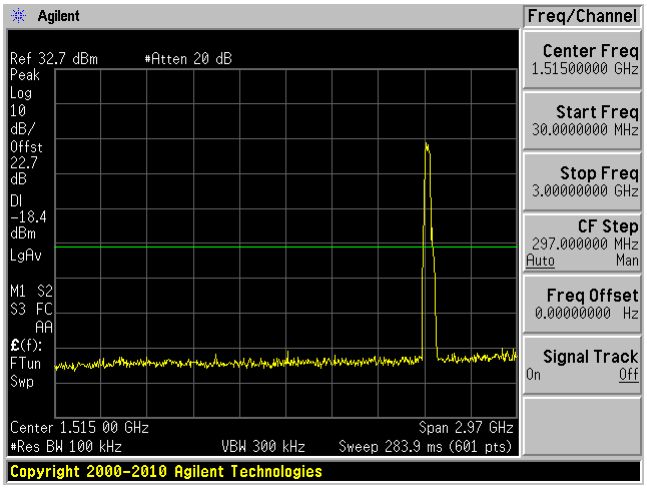


High Channel 3 GHz – 26 GHz

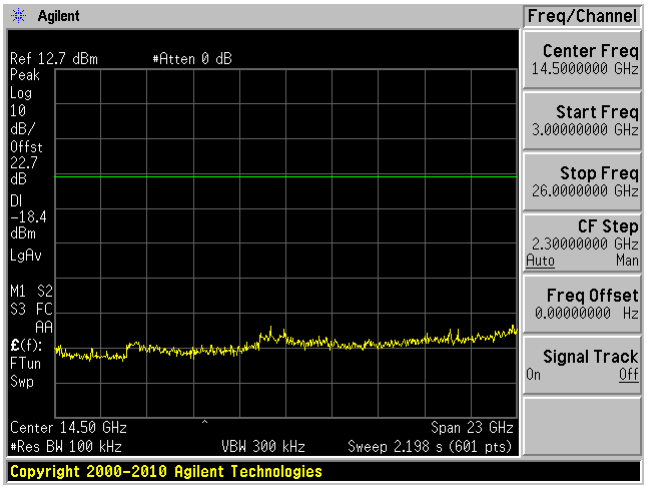


802.11 HT40 STBC

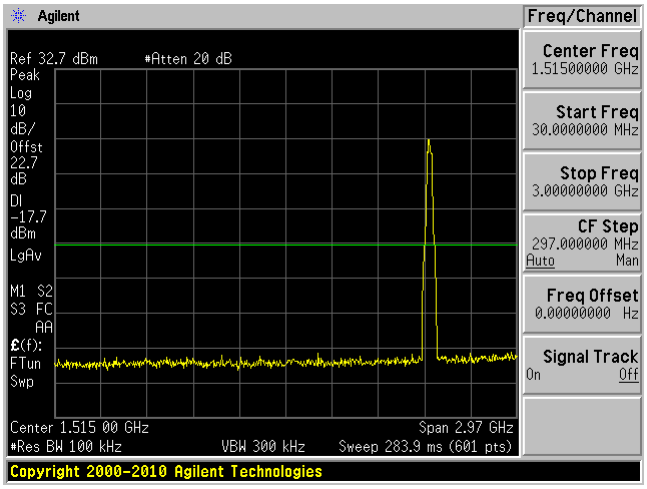
Low Channel 30 MHz – 3 GHz



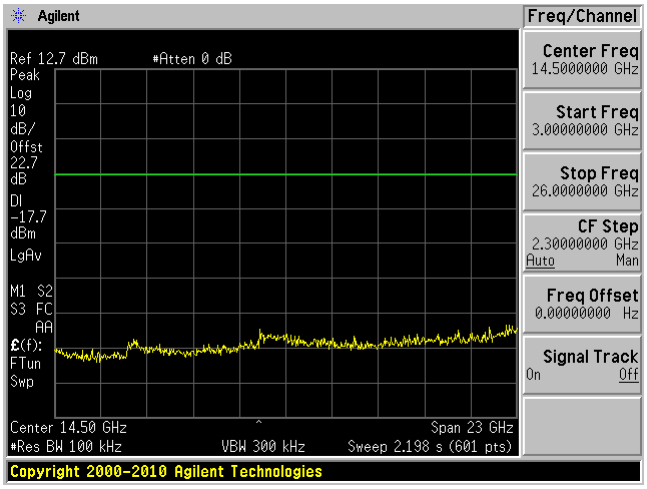
Low Channel 3 GHz – 26 GHz



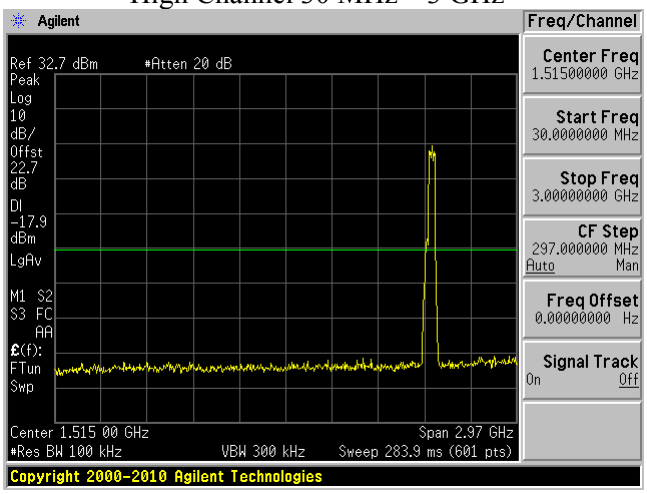
Middle Channel 30 MHz – 3 GHz



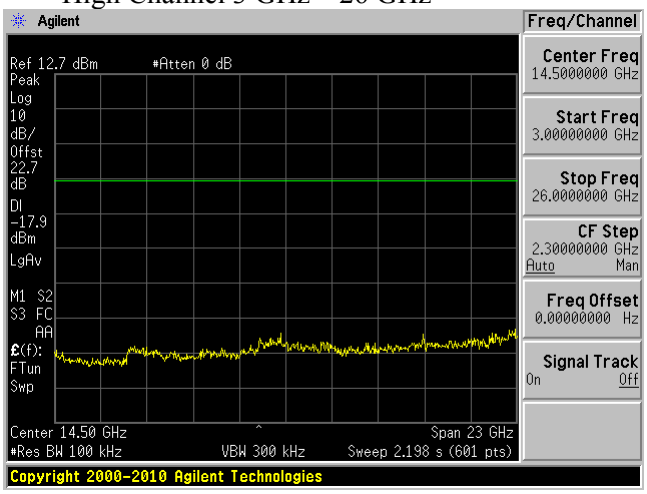
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

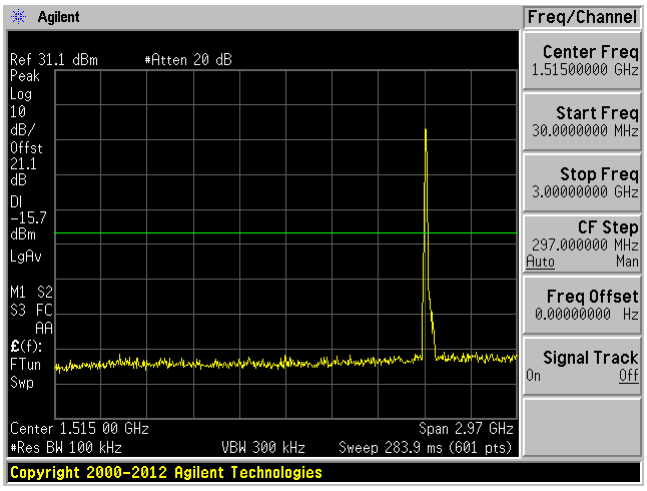


High Channel 3 GHz – 26 GHz

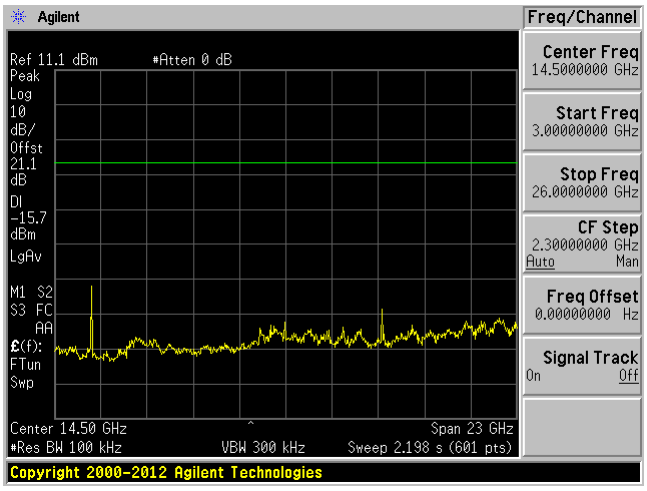


Antenna 2
802.11b mode

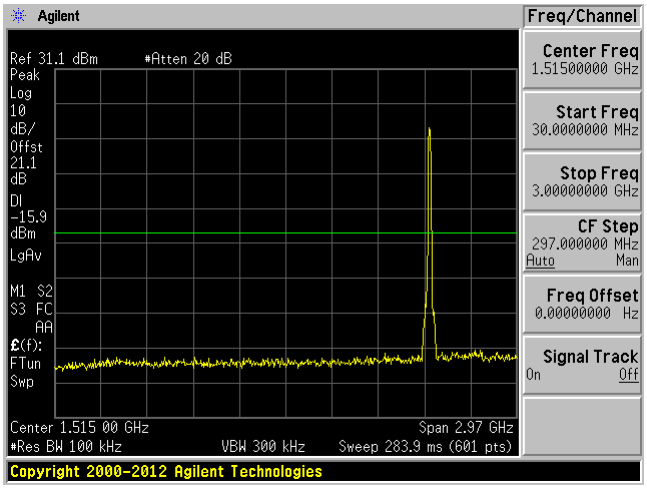
Low Channel 30MHz – 3 GHz



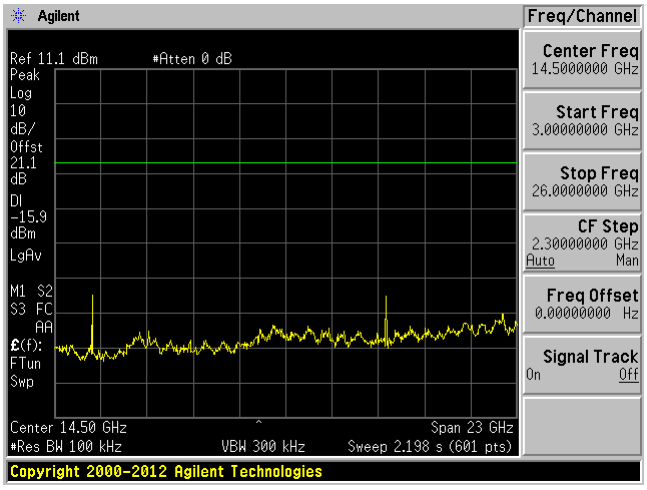
Low Channel 3 GHz – 26 GHz



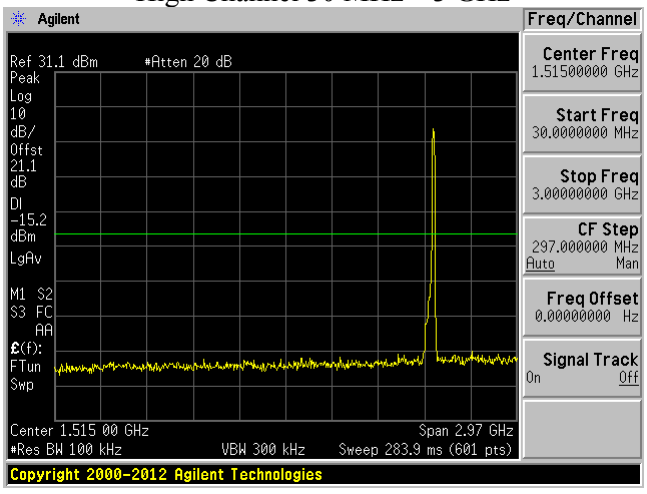
Middle Channel 30 MHz – 3 GHz



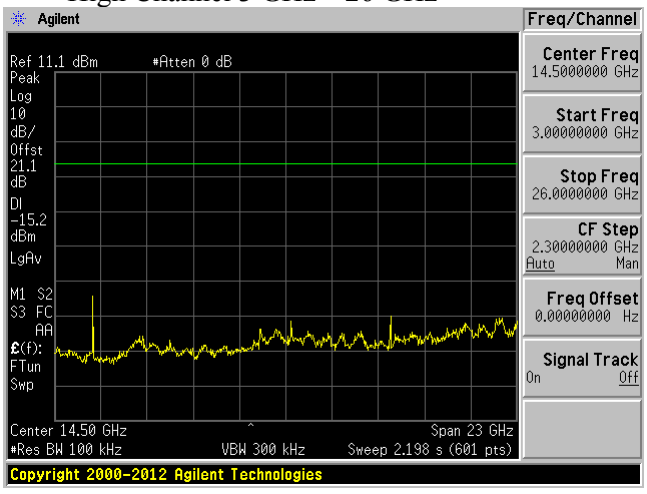
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

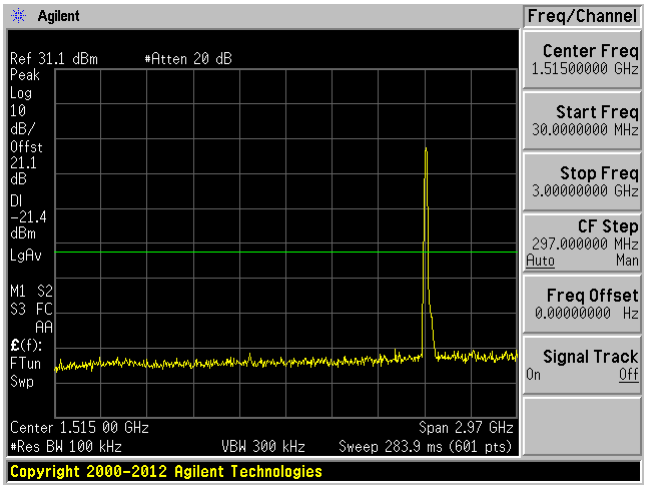


High Channel 3 GHz – 26 GHz

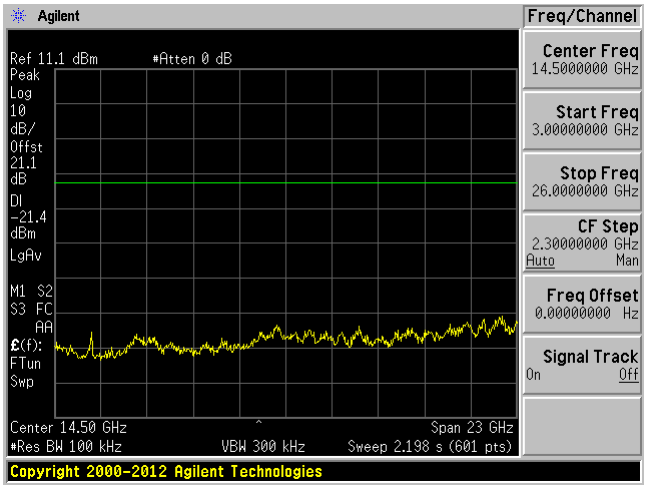


802.11g mode

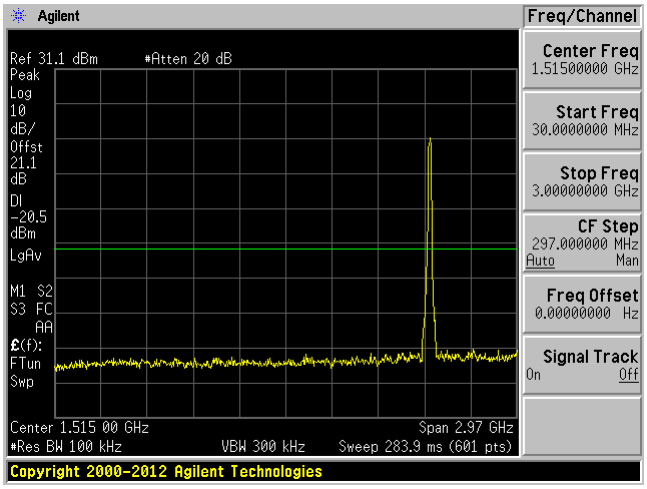
Low Channel 30 MHz – 3 GHz



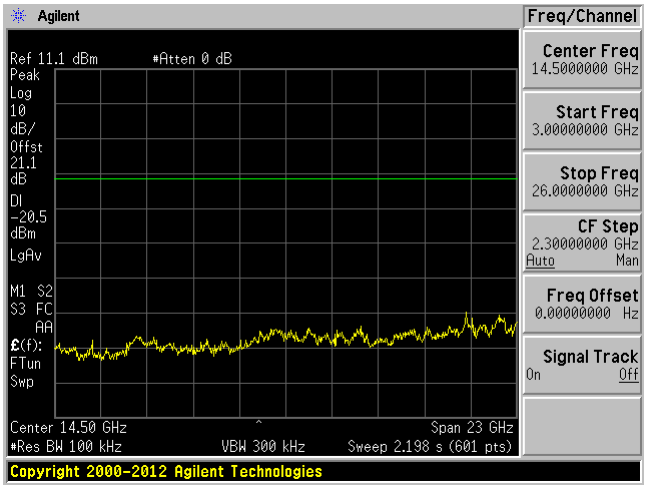
Low Channel 3 GHz – 26 GHz



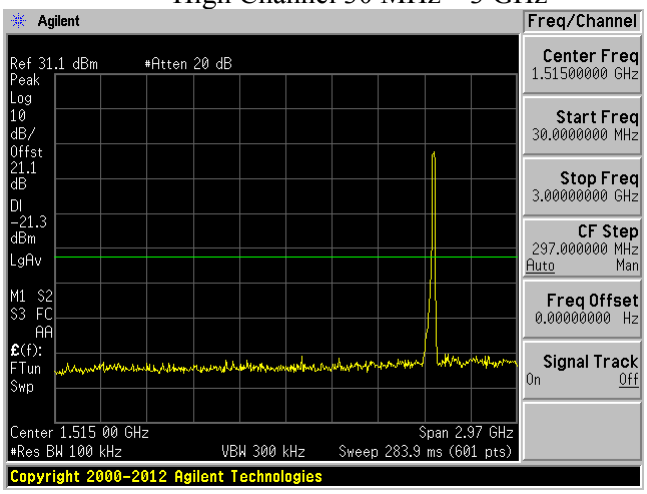
Middle Channel 30 MHz – 3 GHz



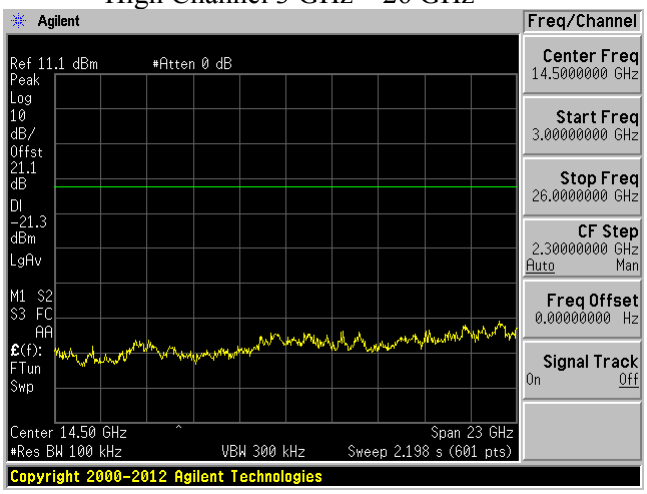
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

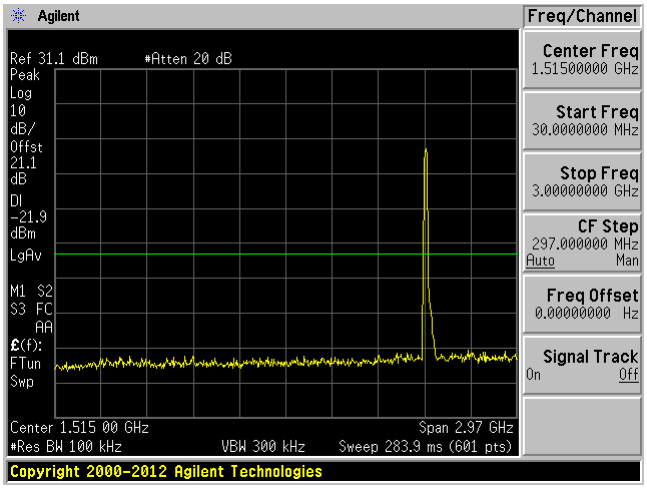


High Channel 3 GHz – 26 GHz

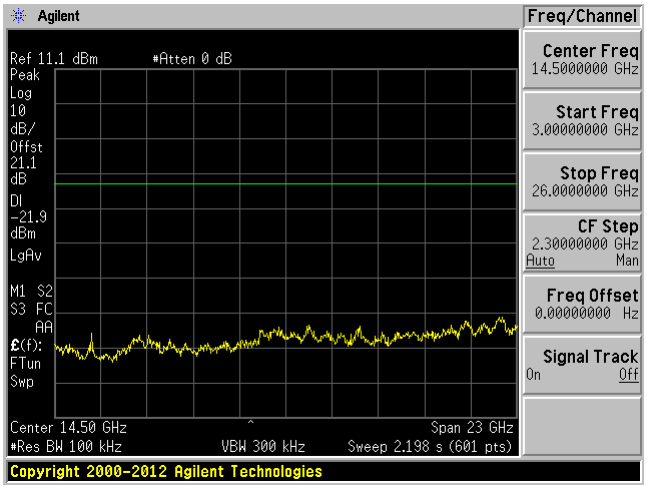


802.11 HT20 mode

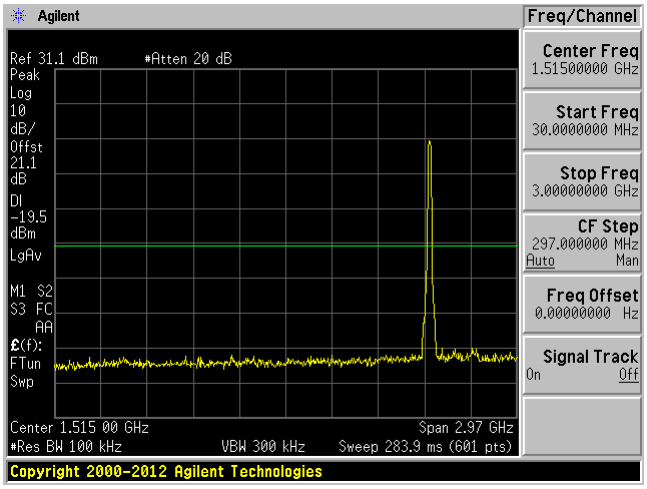
Low Channel 30 MHz – 3 GHz



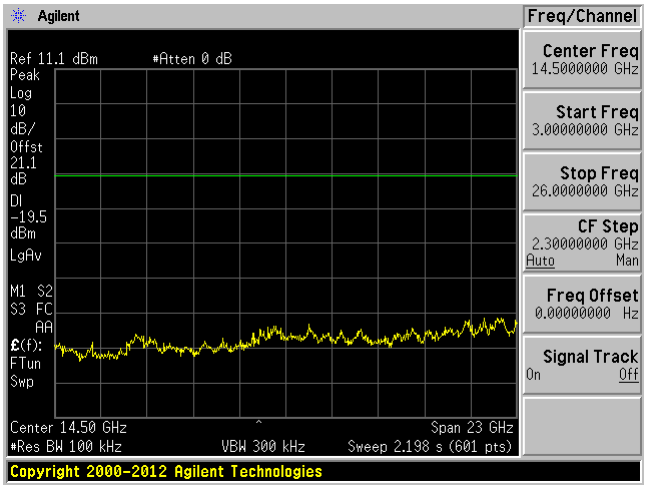
Low Channel 3 GHz – 26 GHz



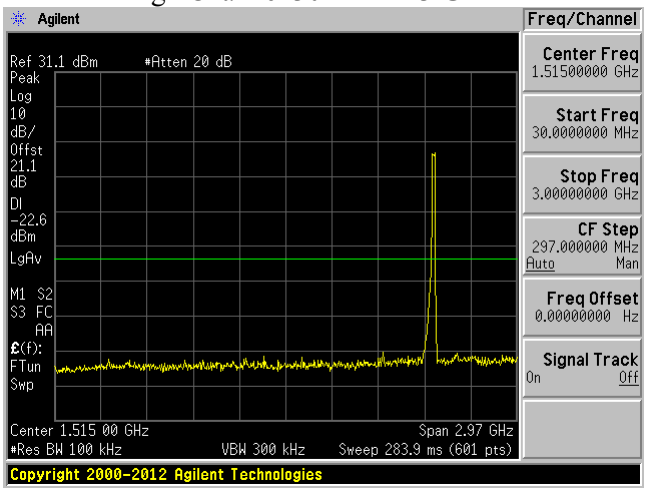
Middle Channel 30 MHz – 3 GHz



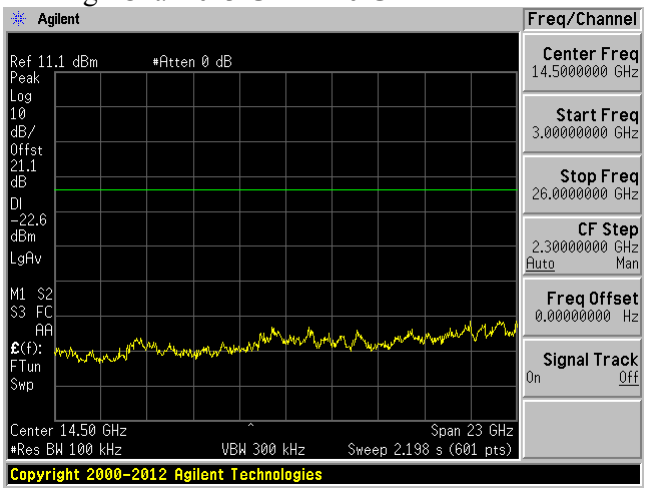
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

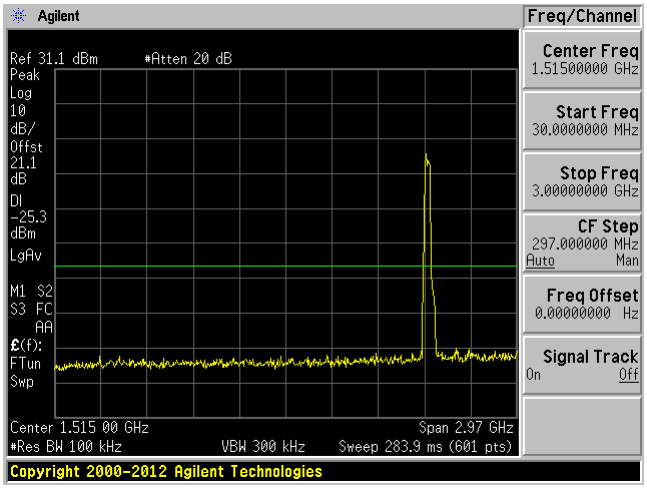


High Channel 3 GHz – 26 GHz

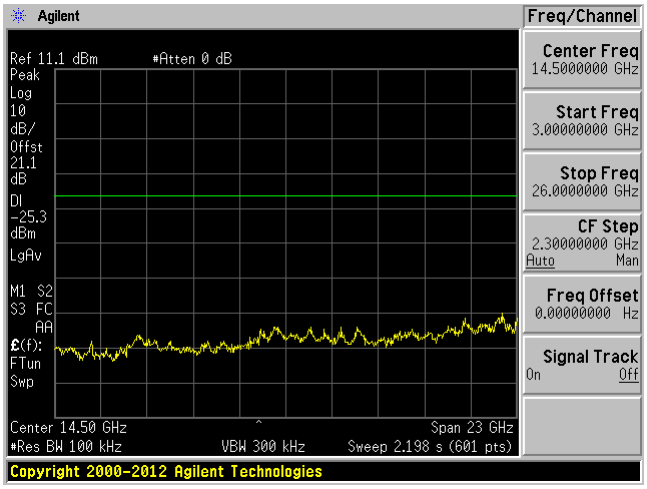


802.11 HT40 mode

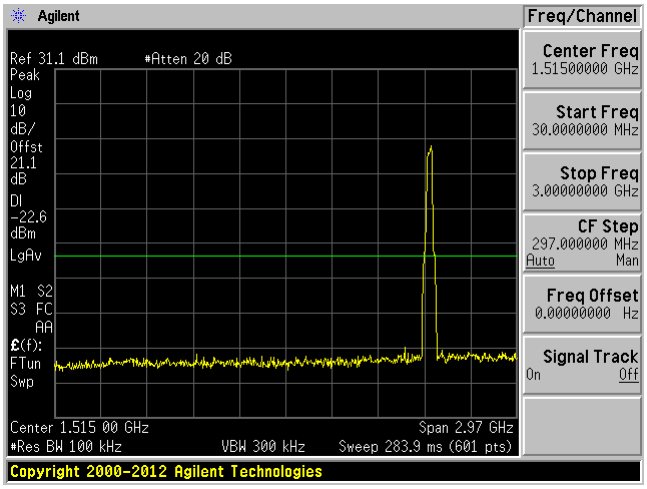
Low Channel 30 MHz – 3 GHz



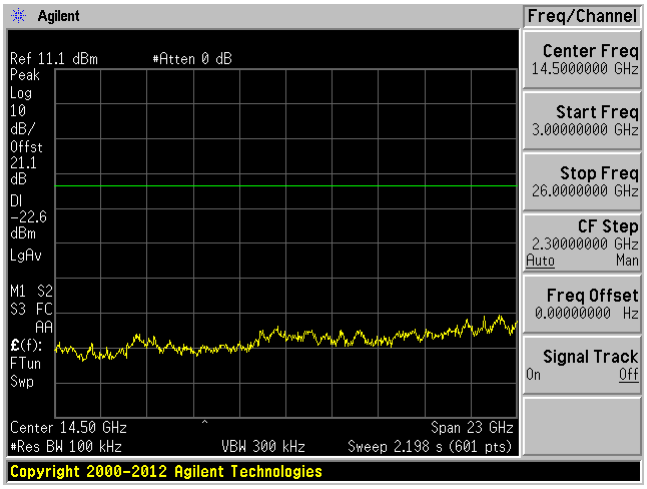
Low Channel 3 GHz – 26 GHz



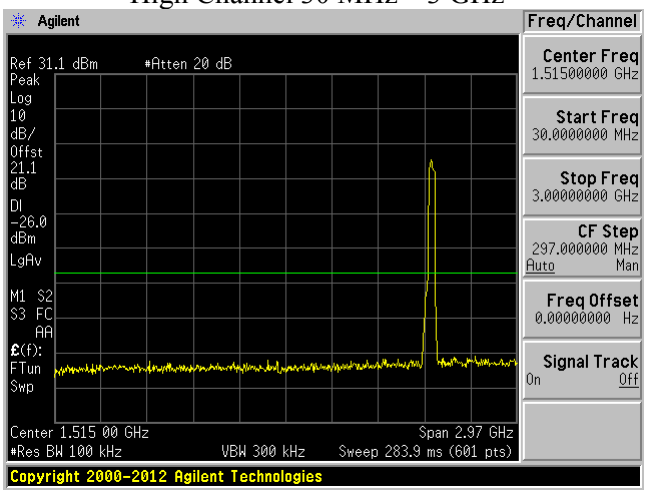
Middle Channel 30 MHz – 3 GHz



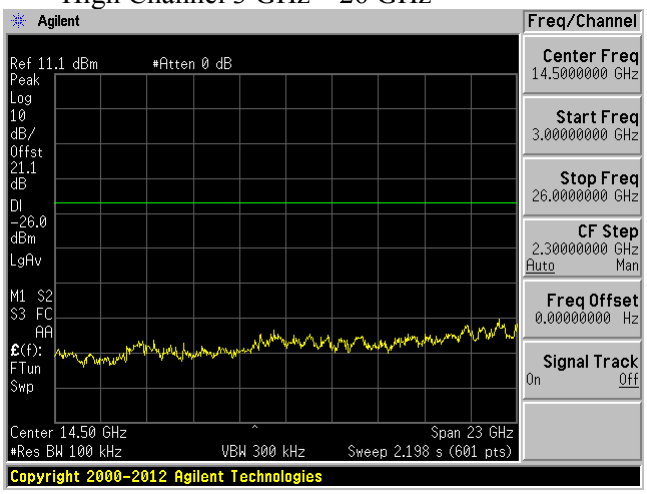
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

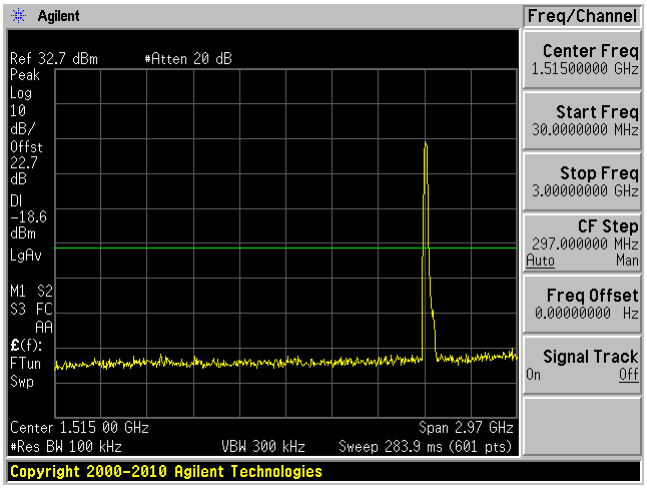


High Channel 3 GHz – 26 GHz

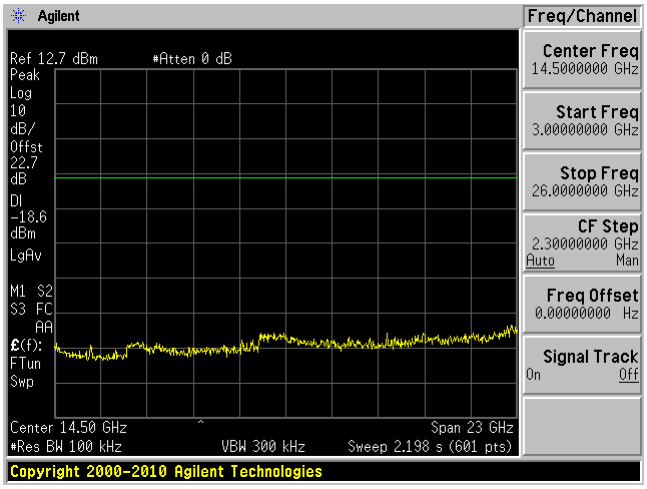


802.11 HT20 STBC

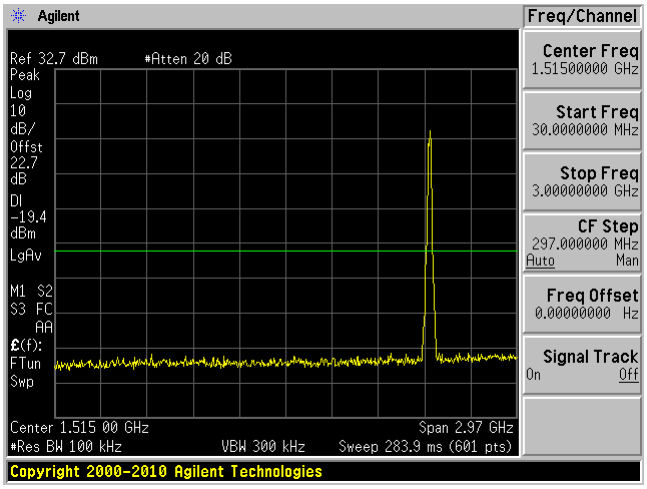
Low Channel 30 MHz – 3 GHz



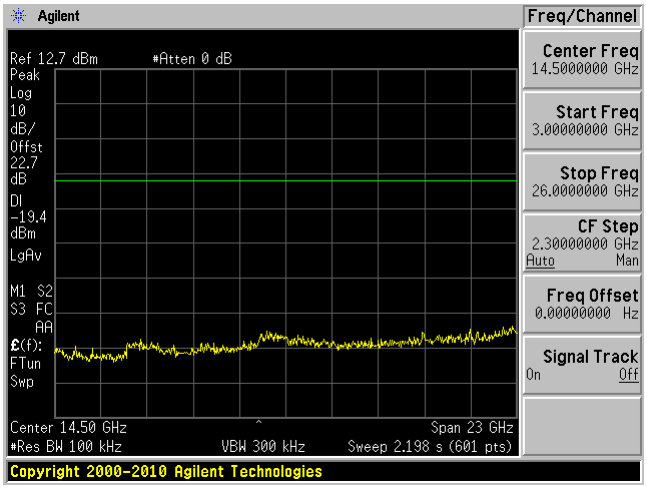
Low Channel 3 GHz – 26 GHz



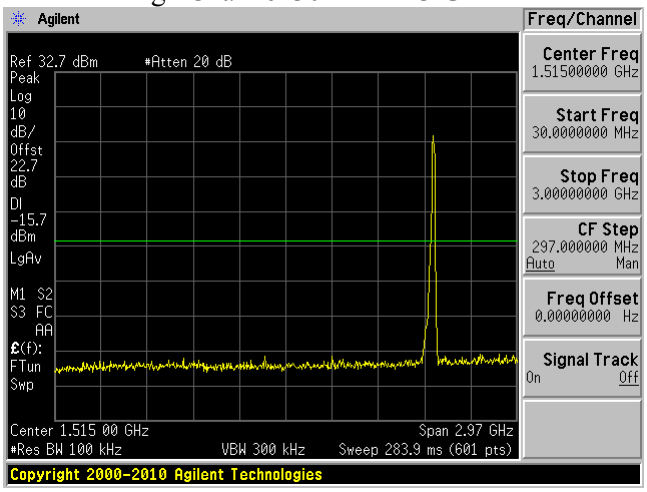
Middle Channel 30 MHz – 3 GHz



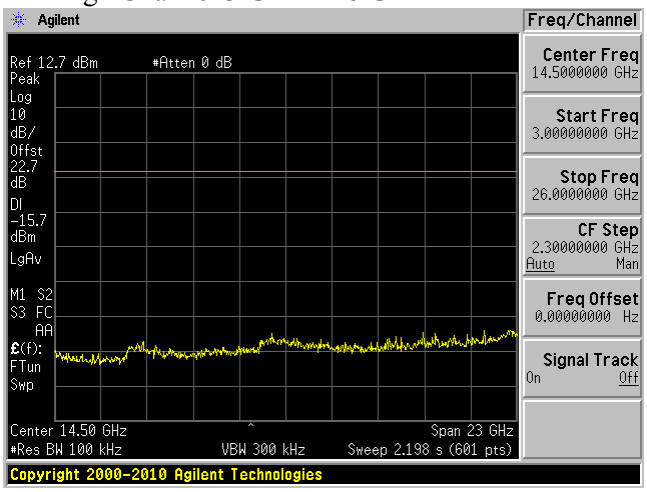
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

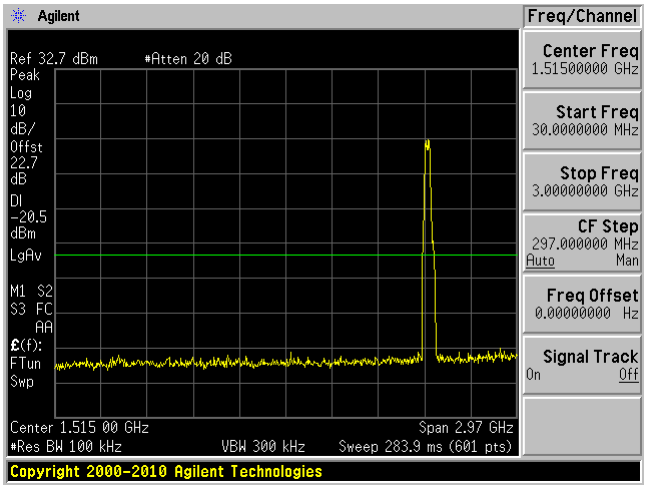


High Channel 3 GHz – 26 GHz

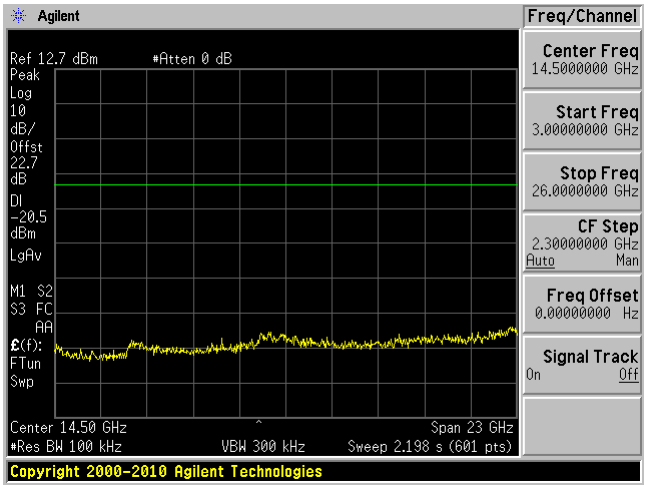


802.11 HT40 STBC

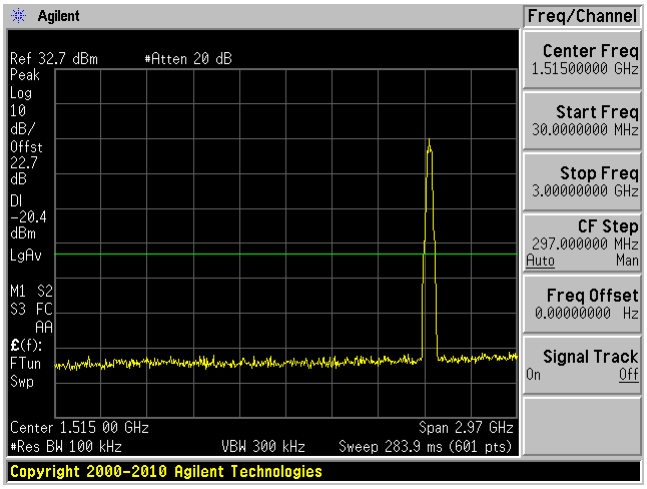
Low Channel 30 MHz – 3 GHz



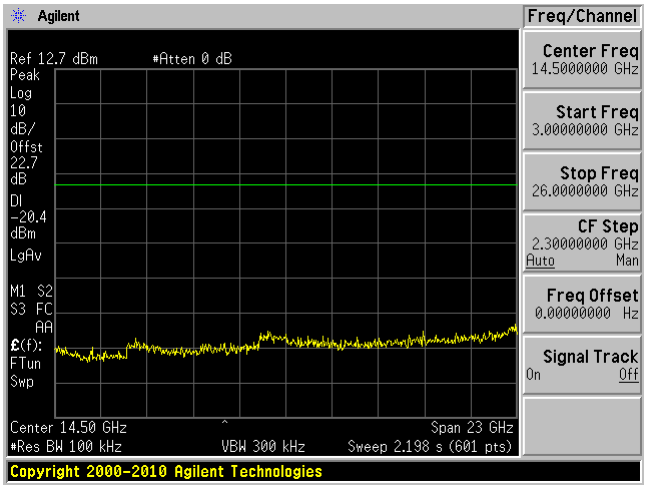
Low Channel 3 GHz – 26 GHz



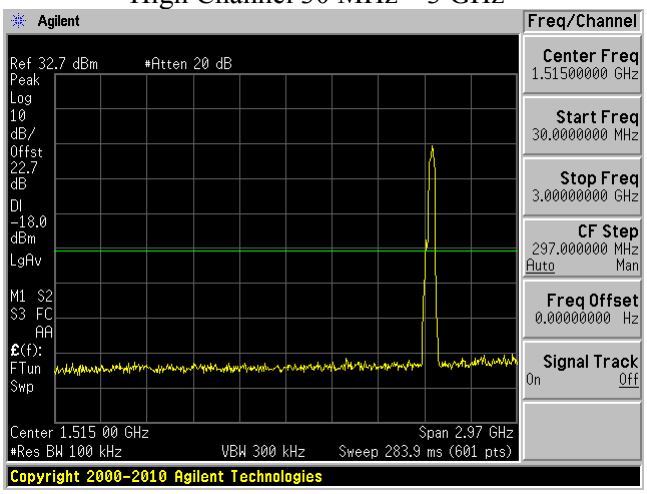
Middle Channel 30 MHz – 3 GHz



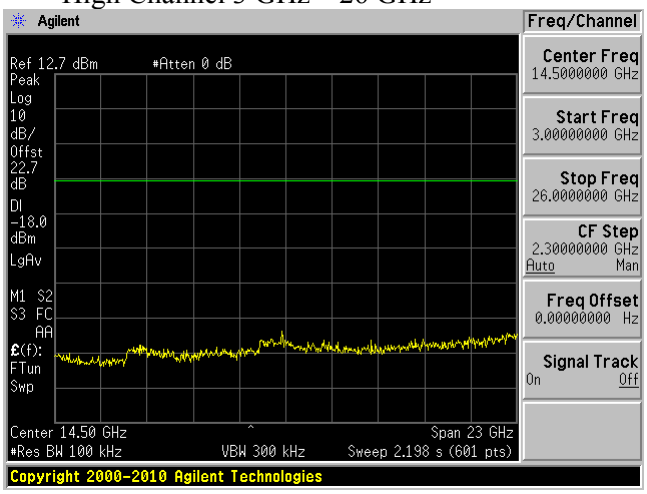
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

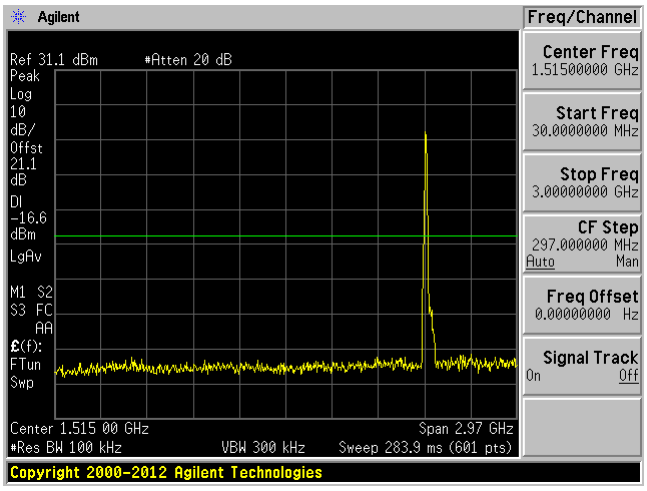


High Channel 3 GHz – 26 GHz

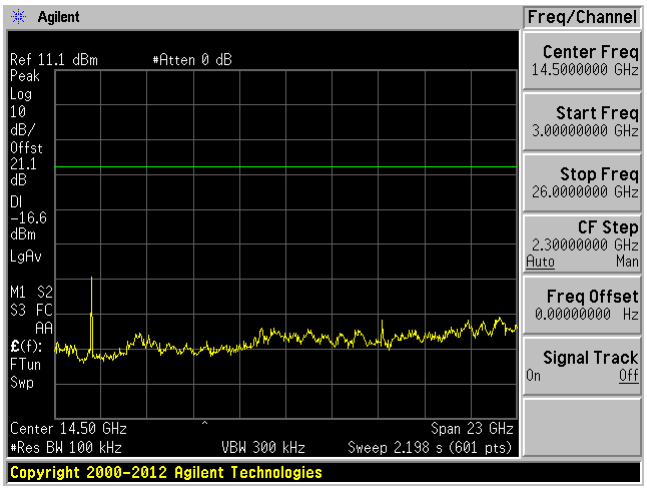


Antenna 3
802.11b mode

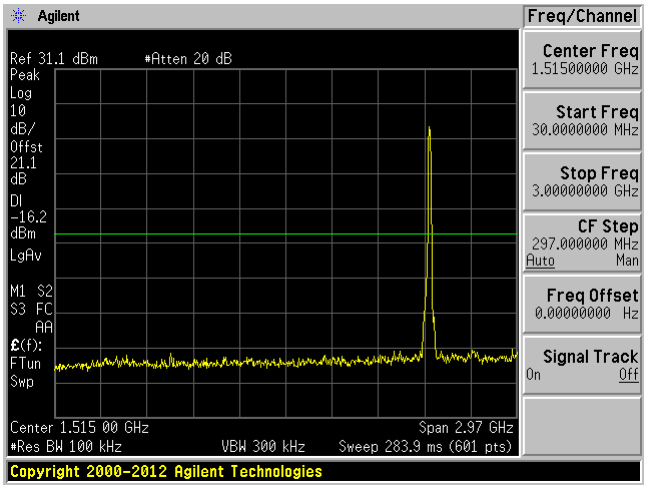
Low Channel 30MHz – 3 GHz



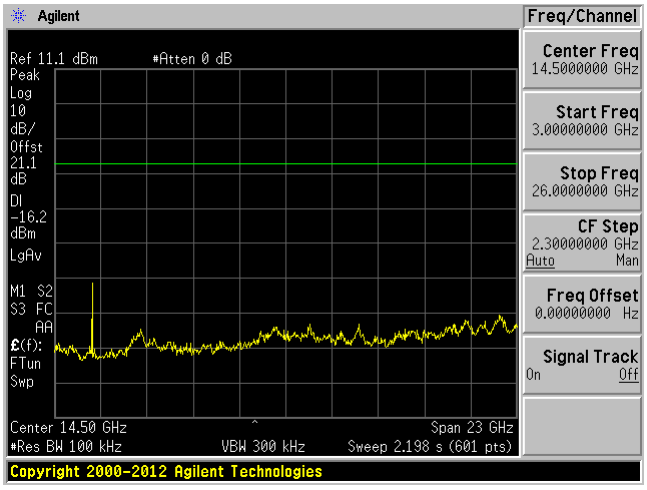
Low Channel 3 GHz – 26 GHz



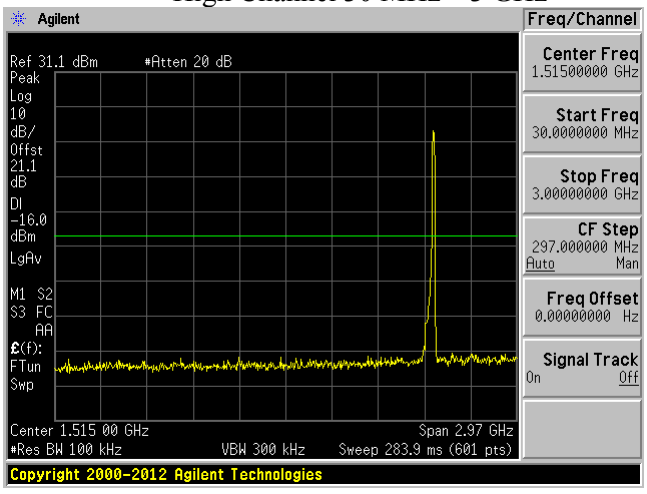
Middle Channel 30 MHz – 3 GHz



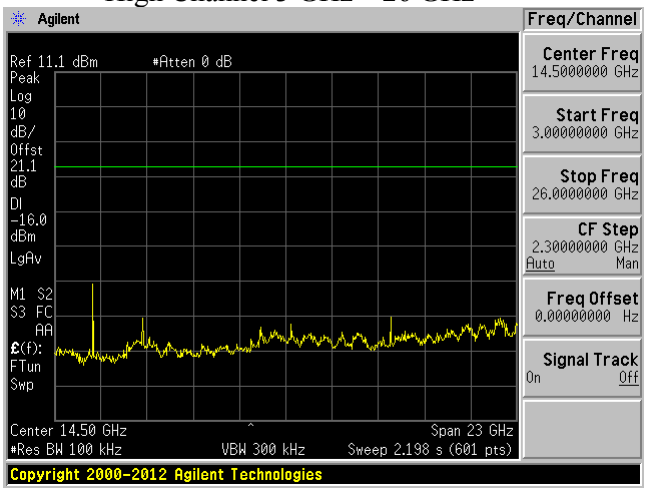
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

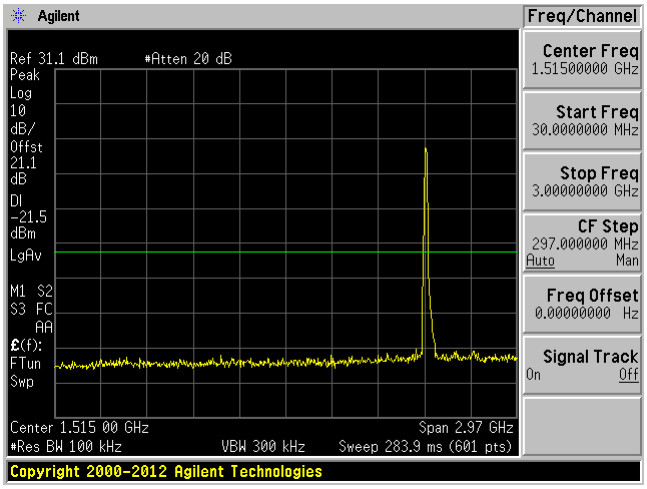


High Channel 3 GHz – 26 GHz

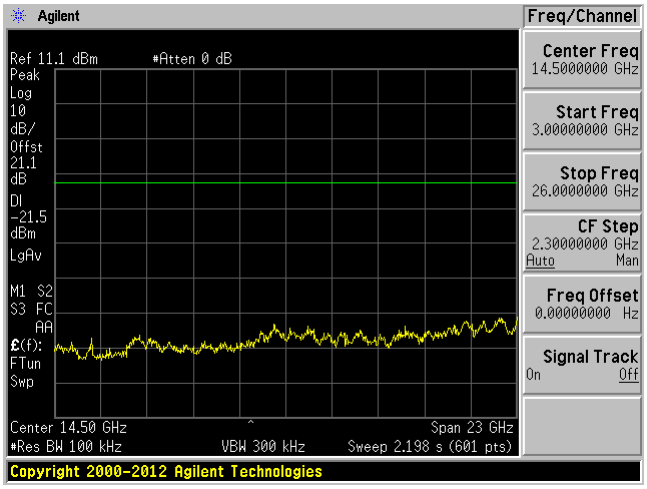


802.11g mode

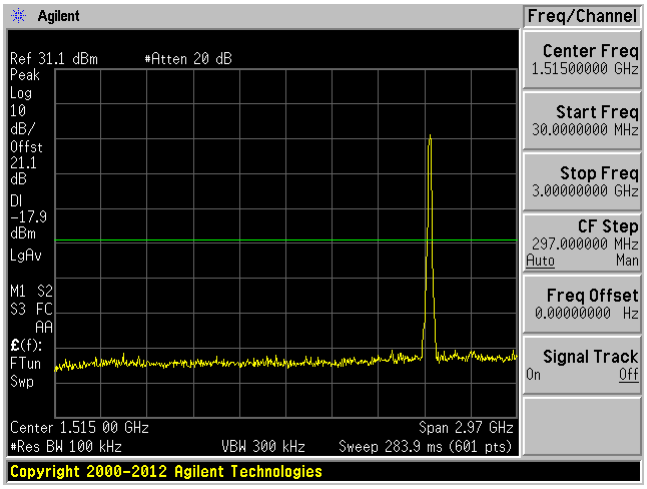
Low Channel 30 MHz – 3 GHz



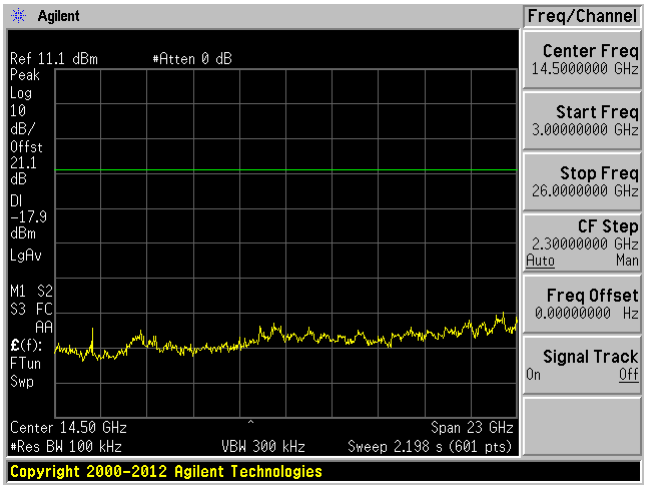
Low Channel 3 GHz – 26 GHz



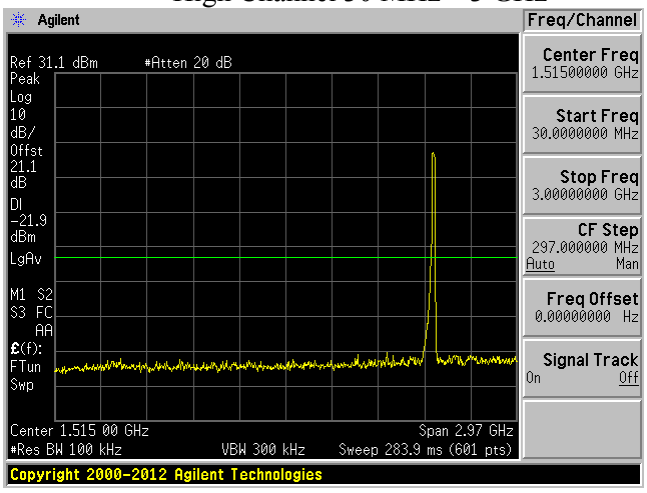
Middle Channel 30 MHz – 3 GHz



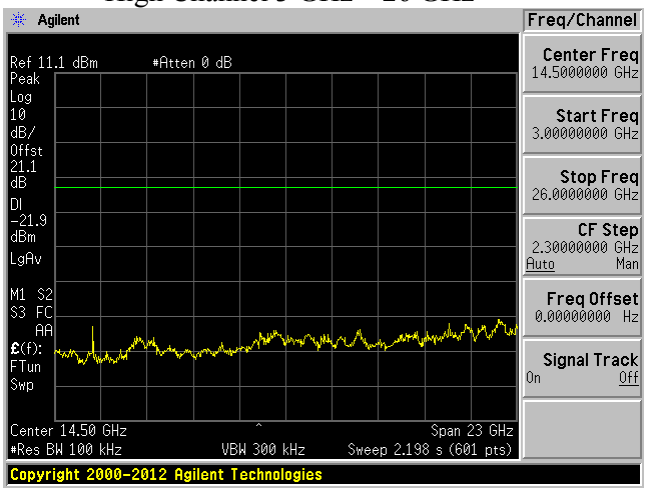
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

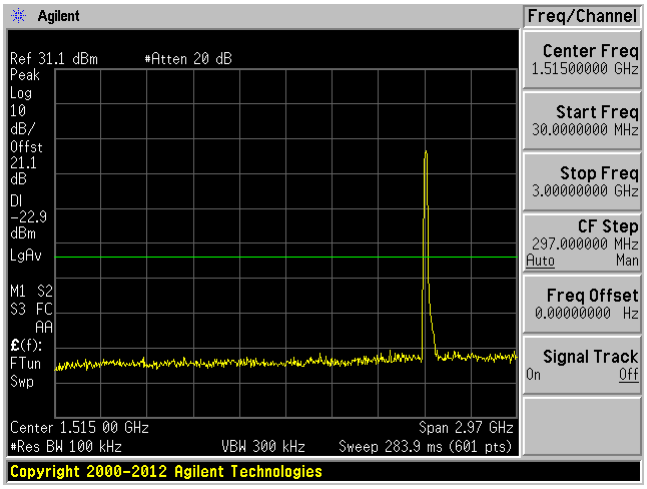


High Channel 3 GHz – 26 GHz

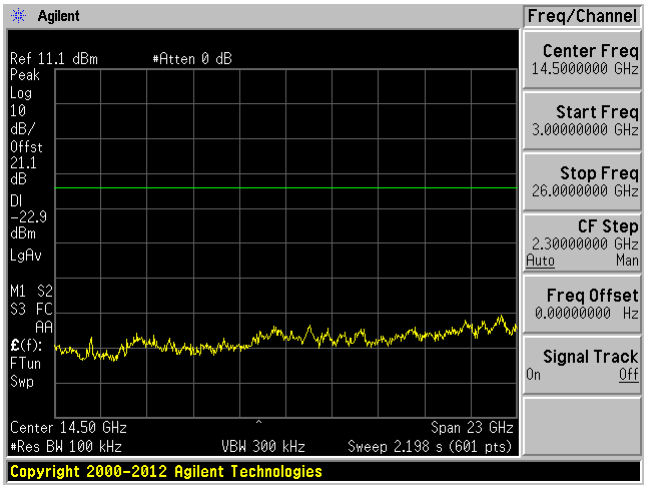


802.11 HT20 mode

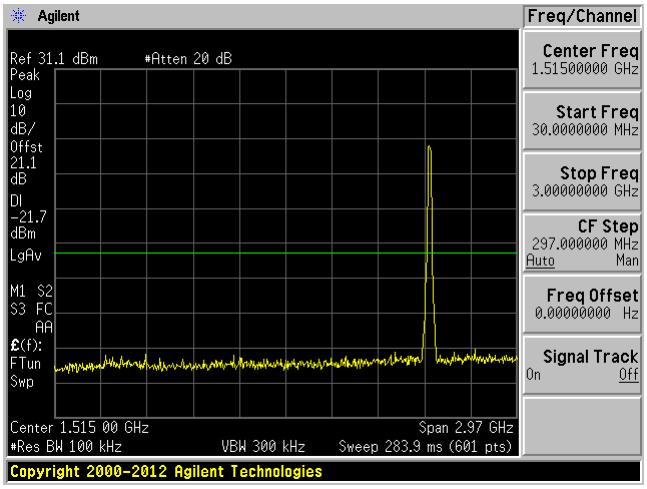
Low Channel 30 MHz – 3 GHz



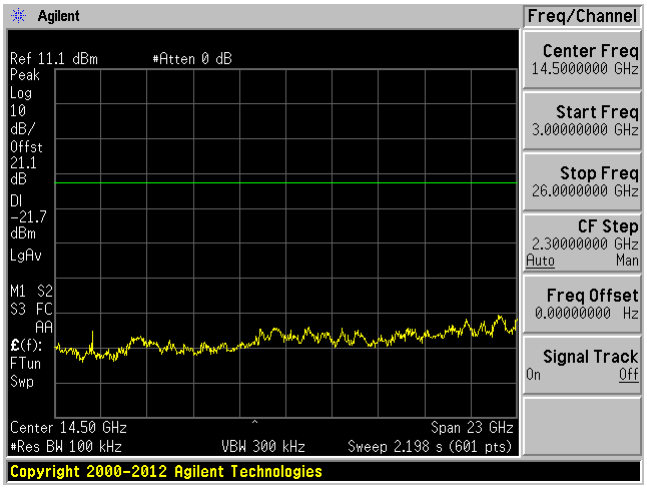
Low Channel 3 GHz – 26 GHz



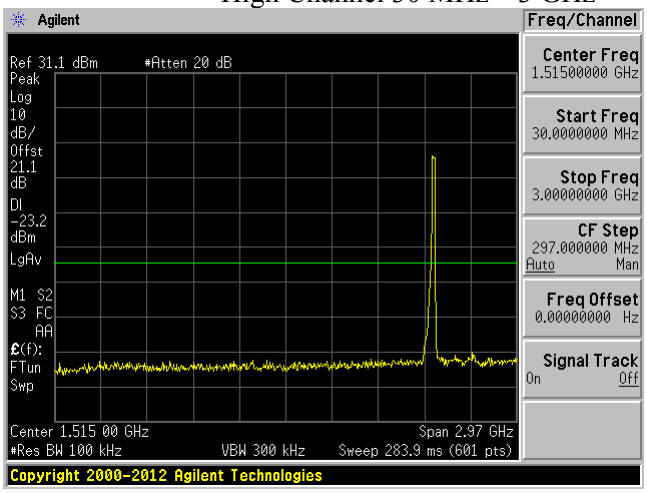
Middle Channel 30 MHz – 3 GHz



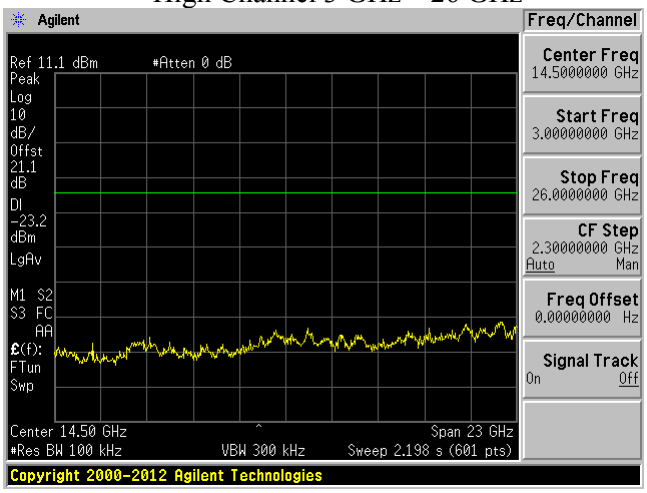
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

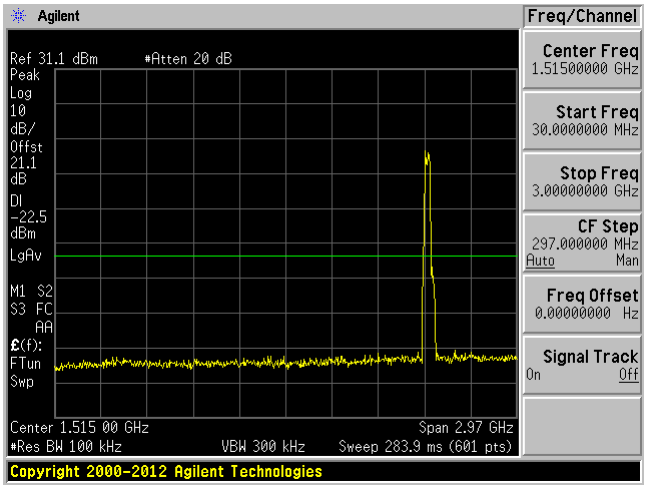


High Channel 3 GHz – 26 GHz

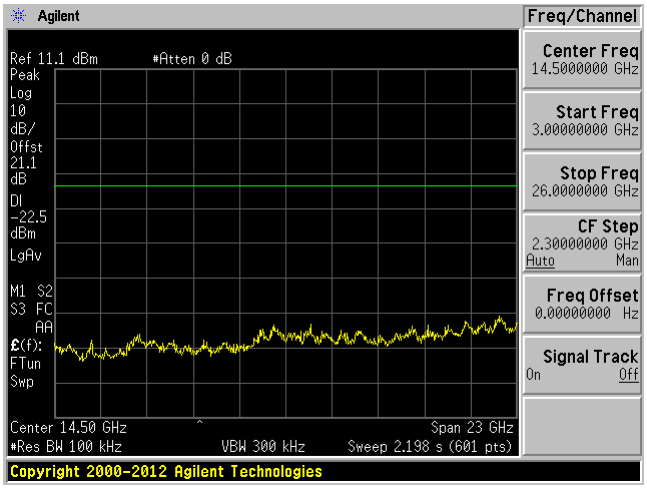


802.11 HT40 mode

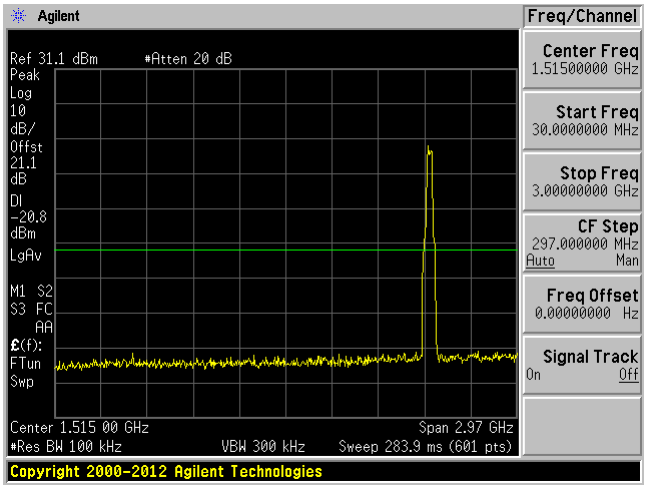
Low Channel 30 MHz – 3 GHz



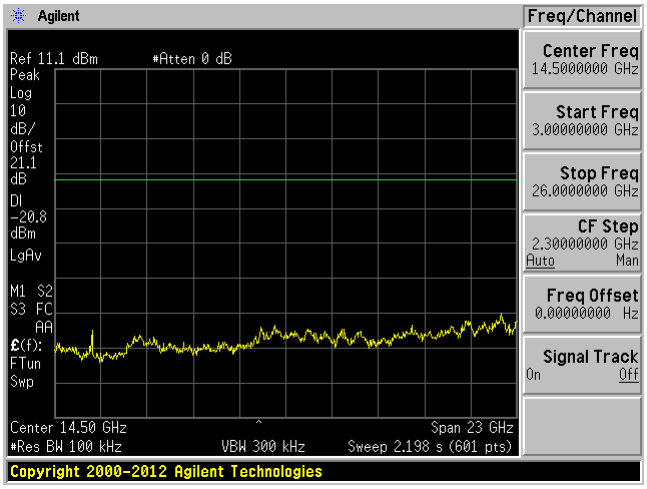
Low Channel 3 GHz – 26 GHz



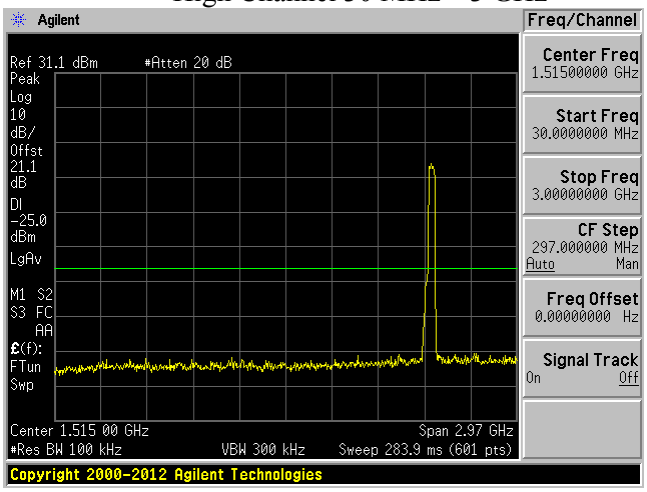
Middle Channel 30 MHz – 3 GHz



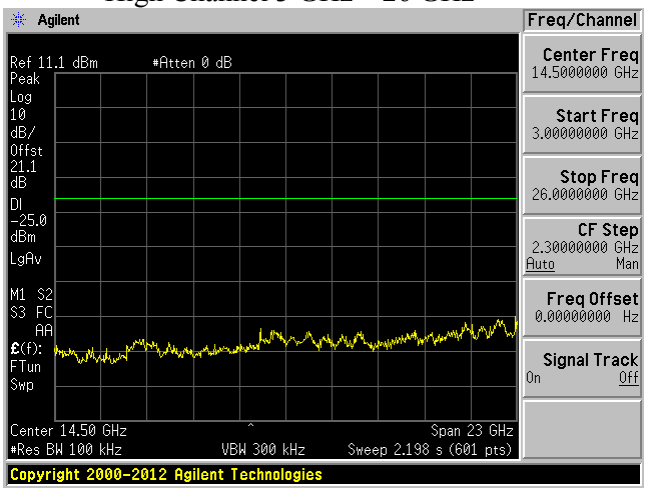
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

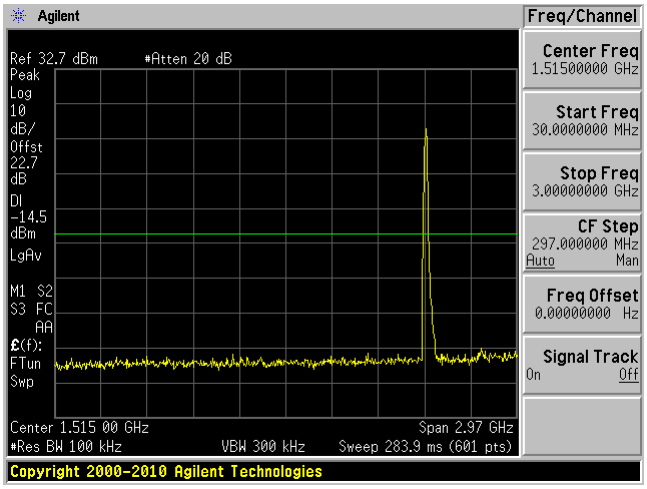


High Channel 3 GHz – 26 GHz

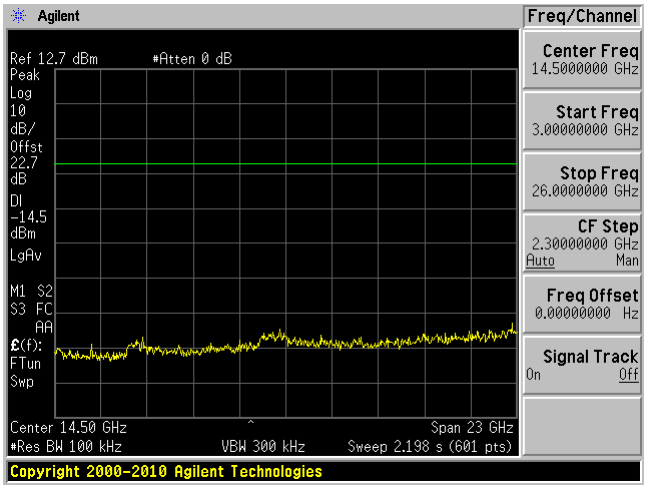


802.11 HT20 STBC

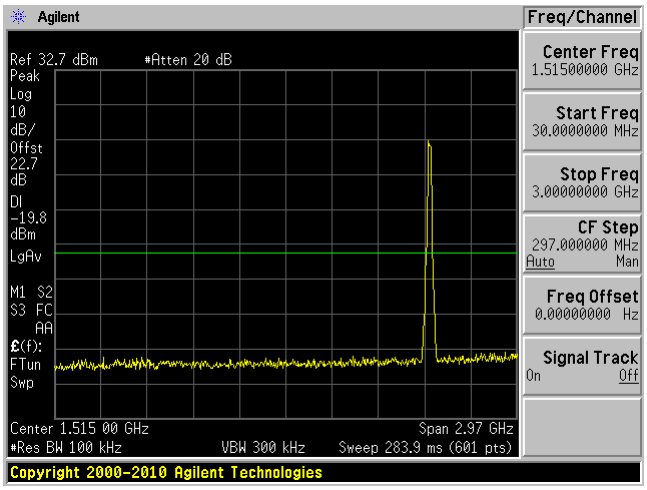
Low Channel 30 MHz – 3 GHz



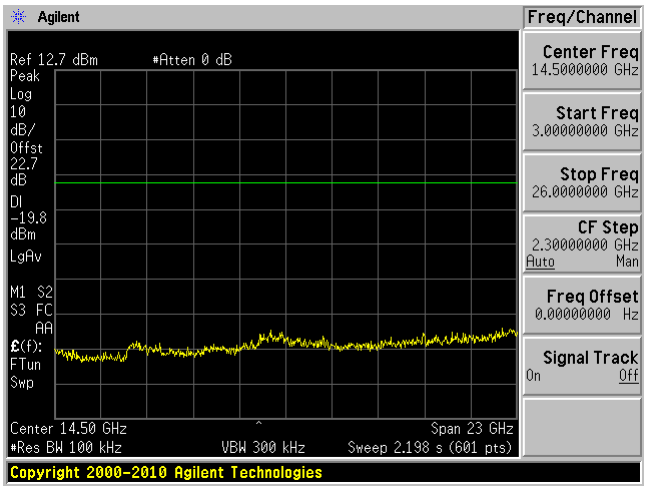
Low Channel 3 GHz – 26 GHz



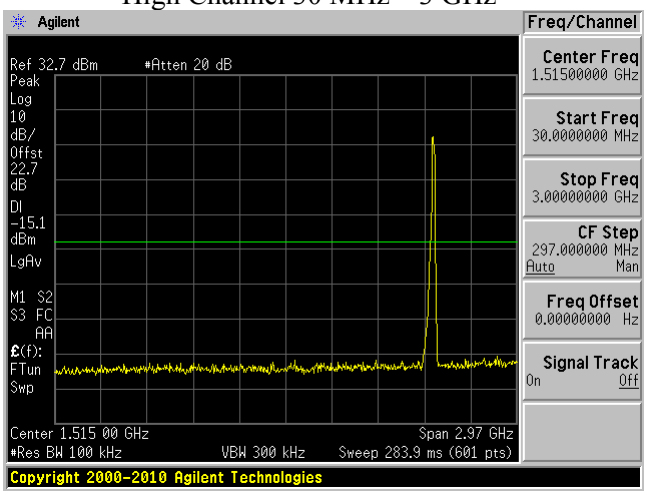
Middle Channel 30 MHz – 3 GHz



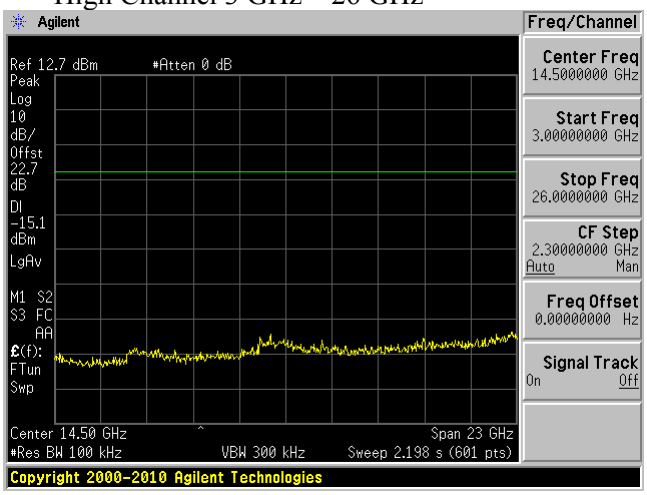
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

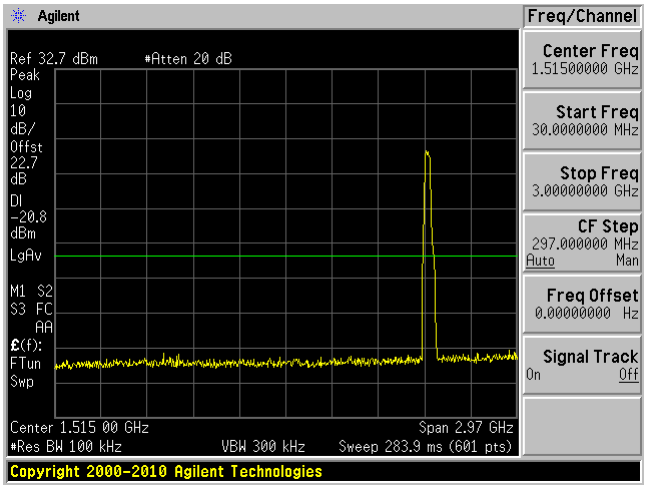


High Channel 3 GHz – 26 GHz

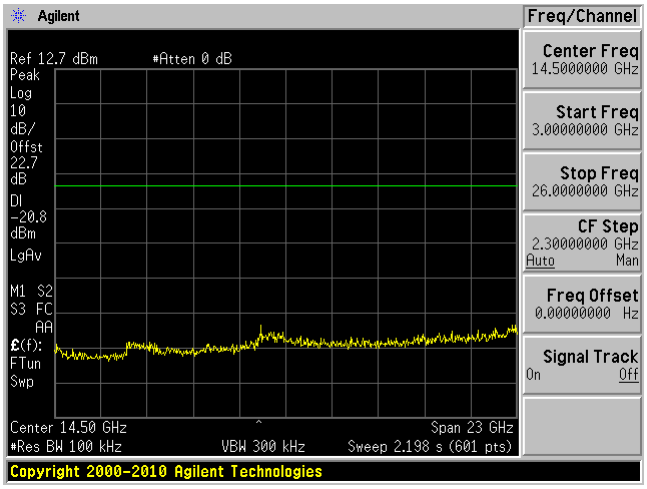


802.11 HT40 STBC

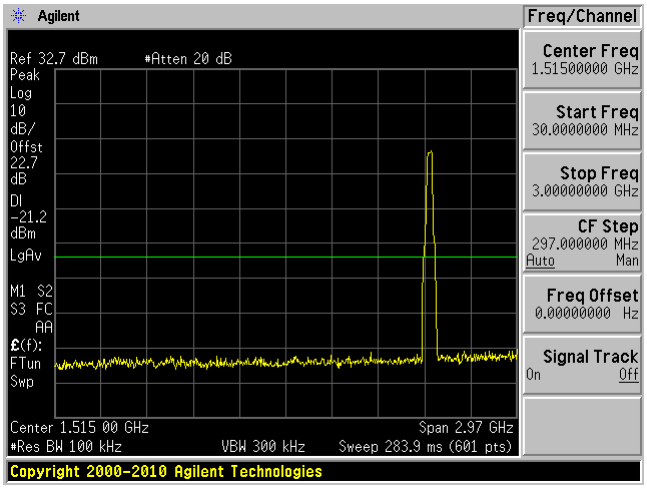
Low Channel 30 MHz – 3 GHz



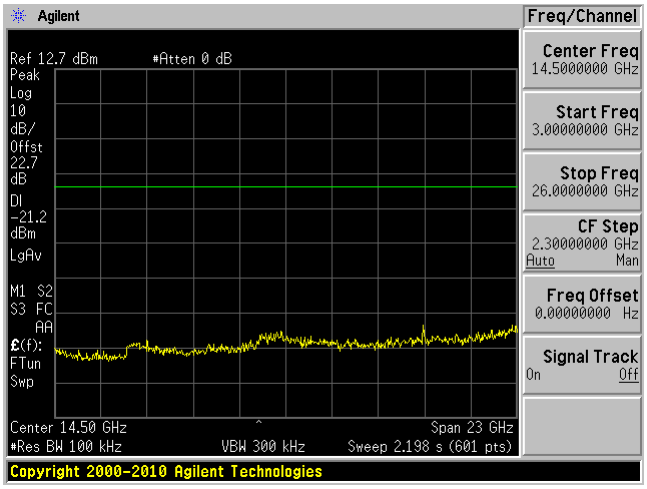
Low Channel 3 GHz – 26 GHz



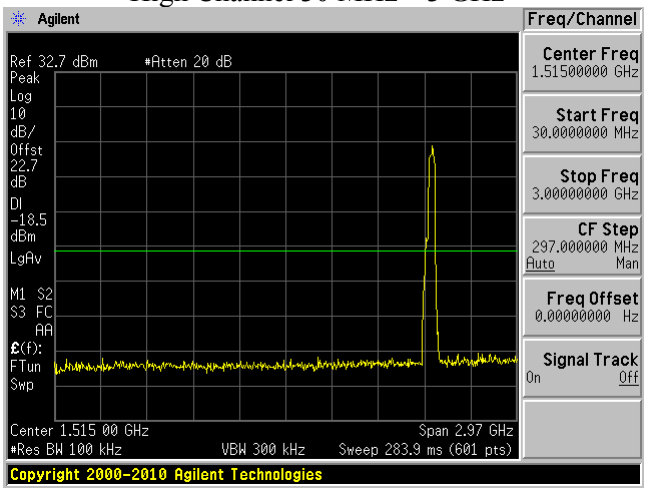
Middle Channel 30 MHz – 3 GHz



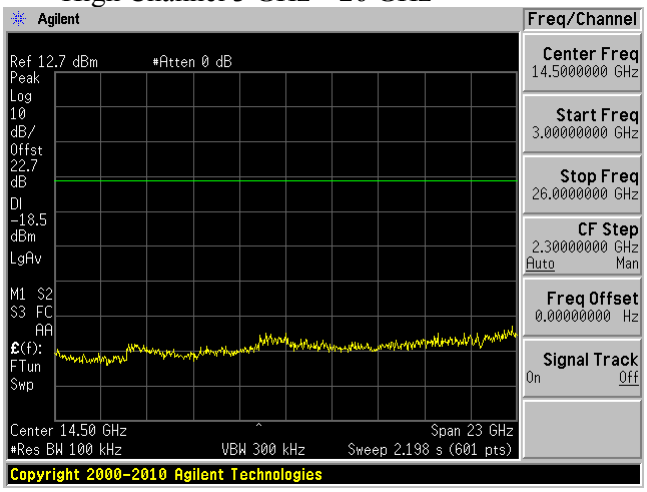
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz



13 Annex A (Normative) - EUT Test Setup Photographs

Please refer to the attachment.

14 Annex B (Normative) - EUT External Photographs

Please refer to the attachment.

15 Annex C (Normative) - EUT Internal Photographs

Please refer to the attachment.

16 Annex D (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 2nd day of October 2018.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to November 30, 2020
Revised August 31, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

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