EN 300 328 V1.9.1 (2015-02)

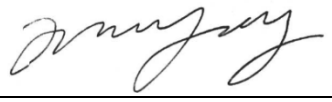
TEST AND MEASUREMENT REPORT

For

Next Thing Company

1940 Union St #32,
Oakland, CA 94607, USA

Model: HELLA1337

Report Type: Original Report		**Product Type:** C.H.I.P Computer
Prepared By	Jin Yang Test Engineer	
Report Number	R15101413-11	
Report Date	2015-12-29	
Reviewed By	Bo Li RF Supervisor	
	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089 Tel: (408) 732-9162 Fax: (408) 732 9164	

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R15101413-11	Original Report	2015-12-29

1 General Information

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Next Thing Co*mpany, and their product *C.H.I.Pcomputer model: HELLA1337* or the "EUT" as referred to in this report. It is a computer, contains 2.4GHz 802.11b/g/n and Bluetooth 4.0 dual modes.

1.2 Mechanical Description of EUT

The EUT measures approximately 60 mm (L) x 41 mm (W) x 10 mm (H) and weighs 23.5 g.

The test data gathered are from typical production sample, serial number: R15101413-01 assigned by BACL.

1.3 Objective

The following type approved report is prepared on behalf *Next Thing, Co.,* in accordance with EN 300 328 V1.9.1(2015-02), Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive.

The objective is to determine compliance with EN 300 328 V1.9.1 (2015-02), Electromagnetic compatibility and Radio spectrum Matters (ERM) for Bluetooth and WLAN portion.

In order to determine compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product maybe which result in lowering the immunity should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing and/or I/O cable changes, etc.).

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted with EN 300 328 V1.9.1, Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive.

All tests were performed at Bay Area Compliance Laboratories Corp.

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.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025:2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65:1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.
The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 EUT TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing according to EN 300 328 V1.9.1.

2.2 EUT Exercise Software

The test utility used is *UART Terminal (RS-232)* provided by *Next Thing, Co.*, the software was verified by *Jin Yang* to comply with the standard requirements being tested against.

2.3 Equipment Modifications

A SMA port was attached to the output signal before the antenna of the EUT to perform conducted measurements.

2.4 Local Support Equipment

Manufacturer	Description	Model No.
Acer	Laptop	ZHK

2.5 EUT Internal Configuration Details

Manufacturer	Description	Model
Realtek Semiconductor Corp.	WIFI/BT Module	RTL8723BS
Allwinner Technology	Soc	R8

2.6 Support Equipment

Manufacturer	Description	Model
Apple	USB Power Adapter	A1357
Asian Power Devices, Inc	AC Adapter	WB-10E05FU

2.7 Interface Ports and Cabling

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

3 Summary of Test Results

EN 300 328 V1.9.1	Description Of Tests	Results
Section 4.3.2.2	RF Output Power	Compliant
Section 4.3.2.3	Maximum e.i.r.p Spectral Density	Compliant
Section 4.3.2.4	Duty Cycle	N/A[1]
Section 4.3.2.5	MU Factor	N/A[1]
Section 4.3.2.6	Adaptivity	Compliant[1]
Section 4.3.2.7	Occupied Channel Bandwidth	Compliant
Section 4.3.2.8	TX Unwanted Emissions in the out of Band Domain	Compliant
Section 4.3.2.9	TX Unwanted Emissions in the Spurious Domain	Compliant
Section 4.3.2.10	Receiver Spurious Emissions	Compliant
Section 4.3.2.11	Receiver Blocking	Compliant[1]
Section 4.3.1.12	Geo-location capability	N/A[2]

N/A[1]: EUT is working at adaptive mode only.
N/A[2]: This EUT does not have the Geo-location capability

Compliant[1]: this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. So only compliant for 2.4GHz WiFi.

4 EN 300 328 §4.3.2.7– Occupied Channel Bandwidth

4.1 Applicable Standard

The Occupied Channel Bandwidth shall fall completely within the band 2.4 GHz to 2.4835 GHz

In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

4.2 Measurement Procedure

Step 1:

Connect the UUT to the spectrum analyser and use the following settings:

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: ~ 1 % of the span without going below 1 %
- Video BW: 3 × RBW
- Frequency Span for frequency hopping equipment: Lowest frequency separation that is used within the hopping sequence
- Frequency Span for other types of equipment: 2 × Nominal Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1 s

Step 2:

Wait for the trace to stabilize.

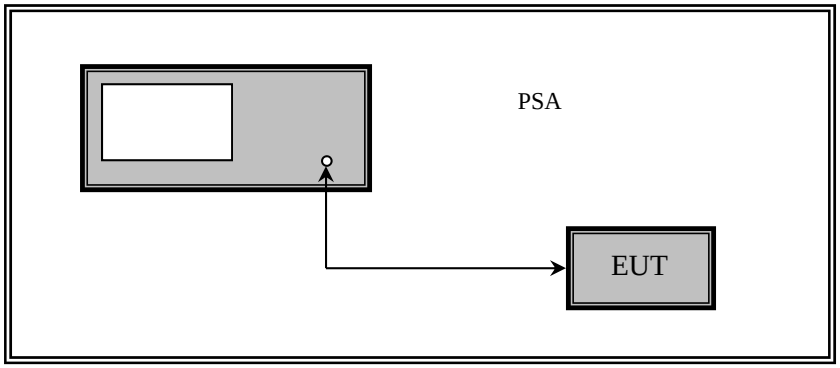
Find the peak value of the trace and place the analyser marker on this peak.

Step 3:

Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.

NOTE: Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

4.3 Test Setup Block Diagram



4.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year

***Statement of Traceability*:** BACL Corp. attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

4.5 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	46 %
ATM Pressure:	102kPa

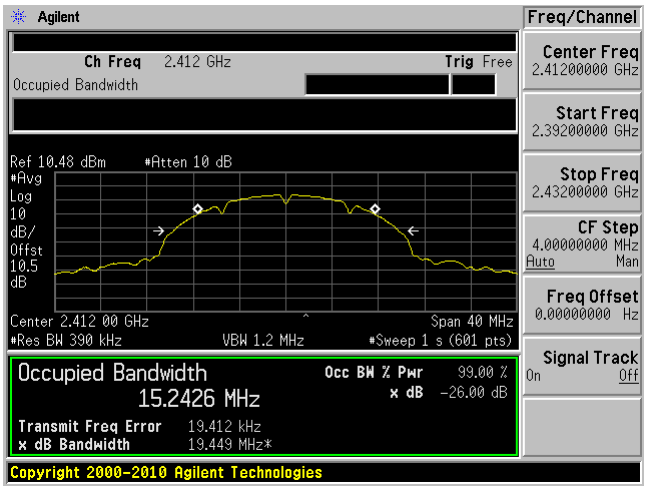
Testing was performed by Jin Yang on 2015-10-23 on RF site.

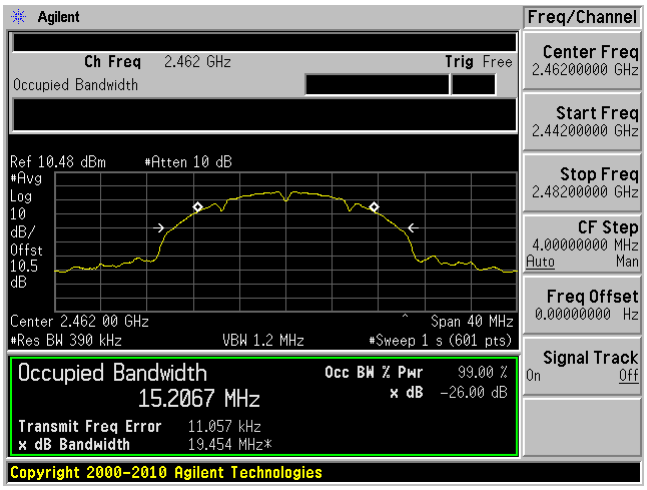
4.6 Test Results

Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
802.11b				
Low	2412	15.2426	2400-2483.5	Pass
High	2462	15.2067	2400-2483.5	Pass
802.11g				
Low	2412	16.5891	2400-2483.5	Pass
High	2462	16.5875	2400-2483.5	Pass
802.11n20				
Low	2412	17.7662	2400-2483.5	Pass
High	2462	17.7719	2400-2483.5	Pass
802.11n40				
Low	2422	36.2194	2400-2483.5	Pass
High	2452	36.2094	2400-2483.5	Pass
BLE				
Low	2402	1.0466	2400-2483.5	Pass
High	2480	1.0462	2400-2483.5	Pass

802.11b mode

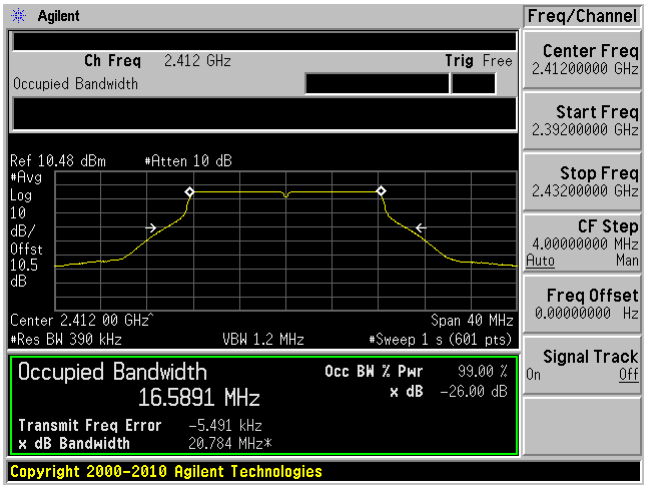
Low Channel 2412 MHz **High Channel 2462 MHz**

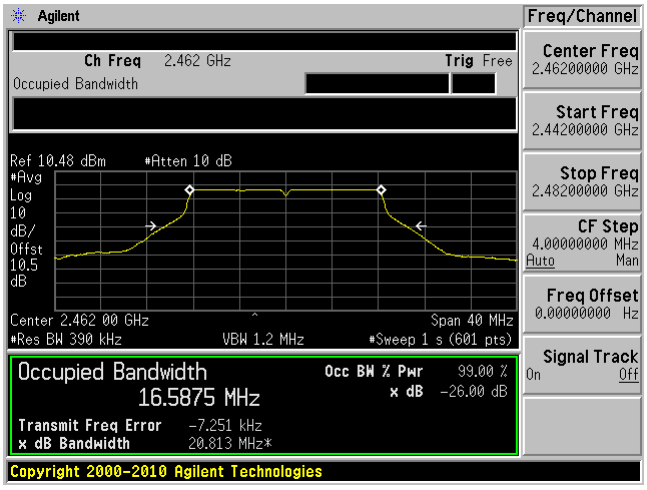




802.11g mode

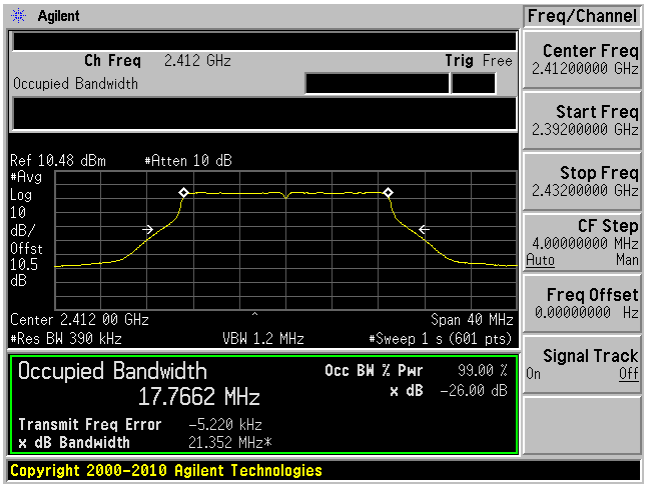
Low Channel 2412 MHz **High Channel 2462 MHz**



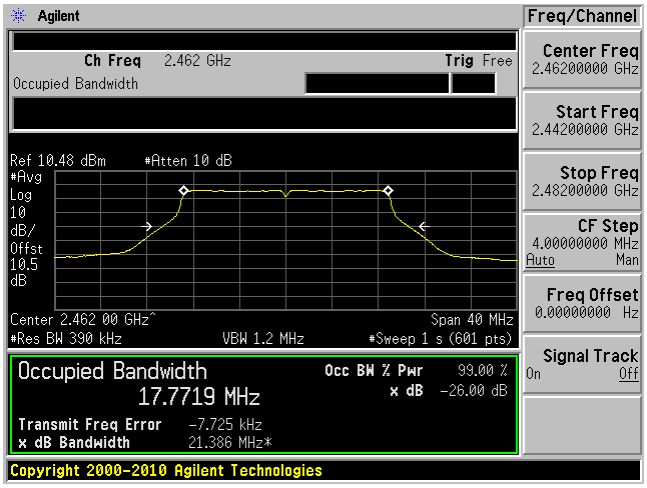


802.11n20 mode

Low Channel 2412 MHz

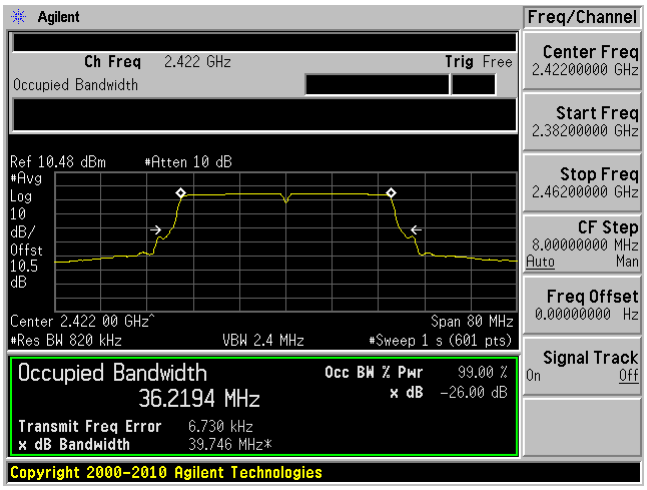


High Channel 2462 MHz

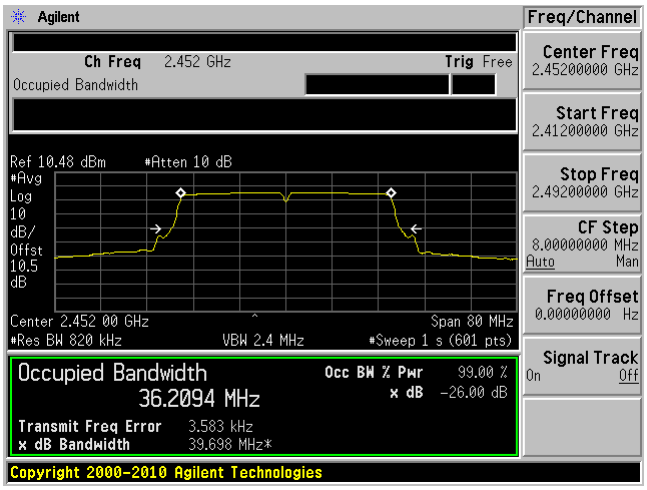


802.11n40 mode

Low Channel 2422 MHz

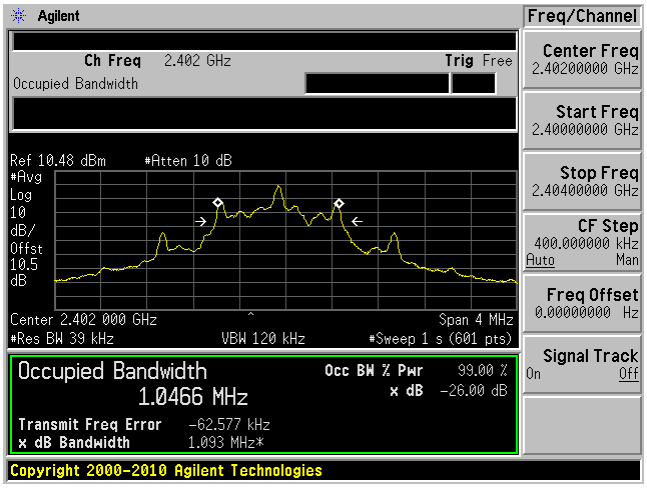


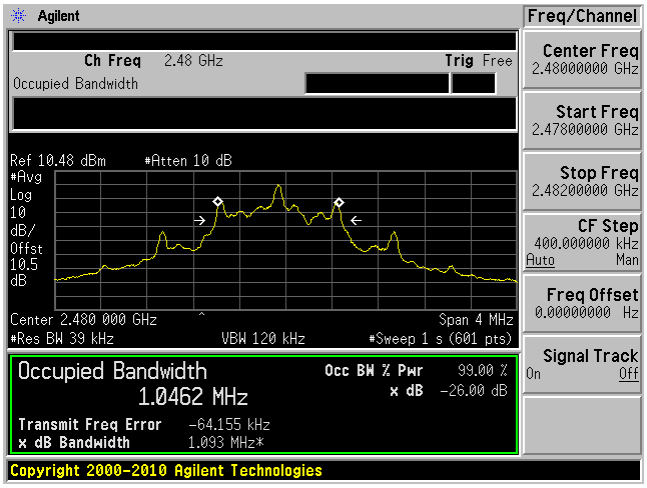
High Channel 2452 MHz



BLE

Low Channel 2402 MHz **High Channel 2480 MHz**





5 EN 300 328 §4.3.2.2 – RF Output Power

5.1 Applicable Standard

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.

The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.3.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

This limit shall apply for any combination of power level and intended antenna assembly.

5.2 Measurement Procedure

Step 1:

- Use a fast power sensor suitable for 2,4 GHz and capable of 1 MS/s.
- Use the following settings:
  - Sample speed 1 MS/s or faster.
  - The samples must represent the power of the signal.
  - Measurement duration: For non-adaptive equipment: equal to the observation period defined in clauses 4.3.1.2.1 or 4.3.2.3.1. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

NOTE 1: For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.

Step 2:

- For conducted measurements on devices with one transmit chain:
  - Connect the power sensor to the transmit port, sample the transmit signal and store the raw data.Use these stored samples in all following steps.
- For conducted measurements on devices with multiple transmit chains:
  - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
  - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than half the time between two samples.
  - For each instant in time, sum the power of the individual samples of all ports and store them. Use these

Step 3:

- Find the start and stop times of each burst in the stored measurement samples.

NOTE 2: The start and stop times are defined as the points where the power is at least 20 dB below the RMS burst power calculated in step 4.

Step 4:

- Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these Pburst values, as well as the start and stop times for each burst.

Step 5:

- The highest of all Pburst values (value "A" in dBm) will be used for maximum e.i.r.p. calculations.

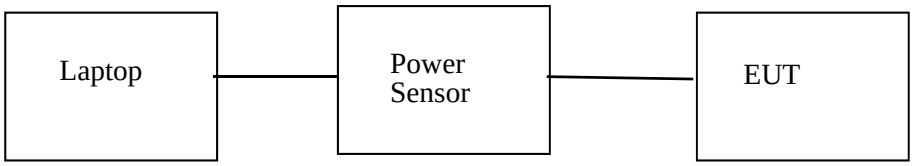
Step 6:

- Add the (stated) antenna assembly gain "G" in dBi of the individual antenna.
- If applicable, add the additional beamforming gain "Y" in dB.
- If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
- The RF Output Power (P) shall be calculated using the formula below:

$$P = A + G + Y$$

- This value, which shall comply with the limit given in clauses 4.3.1.1.2 or 4.3.2.1.2, shall be recorded in the test report.

5.3 Test Setup Block Diagram



5.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
ETS- Lindgren	Power Sensor	7002-006	160097	2014-10-21	2 year

***Statement of Traceability*:** BACL Corp. attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

5.5 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	46 %
ATM Pressure:	102kPa

Testing was performed by Jin Yang on 2015-10-23 on RF site.

5.6 Test Results

Conducted RF Power (dBm)			**Antenna Gain (dBi)**	**E.I.R.P (dBm)**			**E.I.R.P Limit(dBm)**
802.11b mode							
2412MHz	**2437MHz**	**2462MHz**	-	**2412MHz**	**2437MHz**	**2462MHz**	-
7.27	7.43	8.36	2.5	9.77	9.93	10.86	20
802.11g mode							
12.29	12.46	13.37	2.5	14.79	14.96	15.87	20
802.11n20 mode							
11.4	11.53	12.36	2.5	13.9	14.03	14.86	20
802.11n40 mode							
2422MHz	**2437MHz**	**2452MHz**	-	**2422MHz**	**2437MHz**	**2452MHz**	-
11.22	11.16	12.17	2.5	13.72	13.66	14.67	20
BLE							
2402MHz	**2440MHz**	**2480MHz**	-	**2402MHz**	**2440MHz**	**2480MHz**	-
3.62	3.88	4.03	2.5	6.12	6.38	6.53	20

6 EN 300 328 §4.3.2.3 – Power Spectral Density

6.1 Applicable Standard

For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz.

6.2 Measurement Procedure

Step 1:

Connect the UUT to the spectrum analyser and use the following settings:

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- Resolution BW: 10 kHz
- Video BW: 30 kHz
- Sweep Points: > 8 350

NOTE: For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented.

- Detector: RMS
- Trace Mode: Max Hold
- Sweep time: 10 s; the sweep time may be increased further until a value where the sweep time has no impact on the RMS value of the signal

For non-continuous signals, wait for the trace to stabilize.

Save the data (trace data) set to a file.

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.1.3.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

Add up the values for power for all the samples in the file using the formula below.

$$P_{Sum} = \sum_{n=1}^{k} P_{sample}(n)$$

with 'k' being the total number of samples and 'n' the actual sample number

Step 4:

Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.3.2 and save the corrected data. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$

$$P_{Samplecorr}(n) = P_{Sample}(n) - C_{Corr}$$

with 'n' being the actual sample number

Step 5:

Starting from the first sample $P_{Samplecorr}(n)$ (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

Step 6:

Shift the start point of the samples added up in step 5 by one sample and repeat the procedure in step 5 (i.e. sample #2 to sample #101).

Step 7:

Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments.

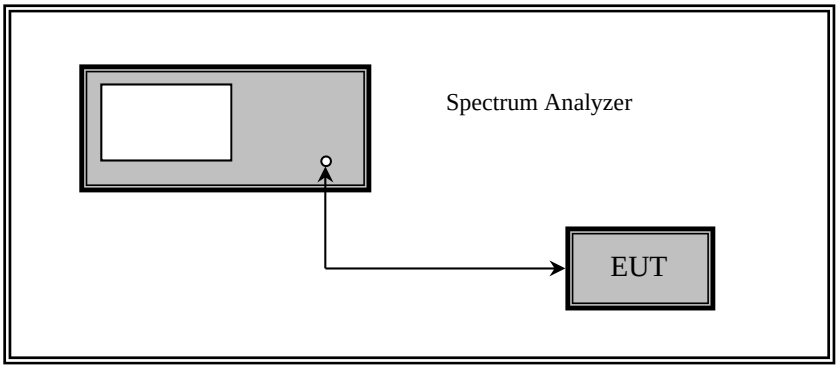
From all the recorded results, the highest value is the maximum Power Spectral Density for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

6.3 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	46 %
ATM Pressure:	102kPa

Testing was performed by Jin Yang on 2015-10-23 on RF site.

6.4 Test Setup Block Diagram



6.5 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year

***Statement of Traceability*:** BACL Corp. attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

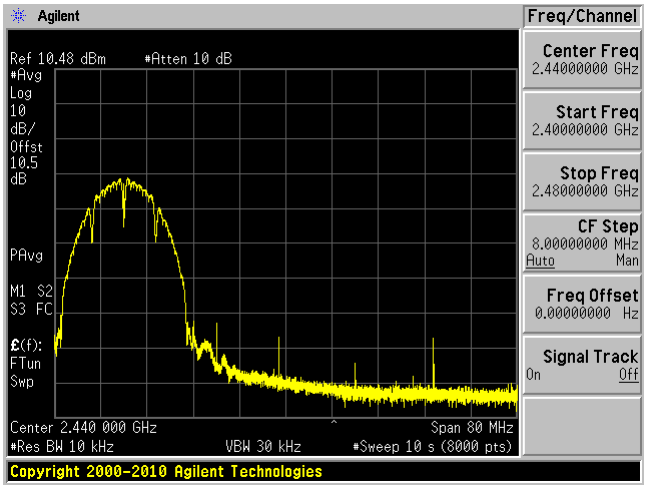
6.6 Test Results

Mode	Frequency (MHz)	Conducted Power Spectral Density (dBm/MHz)	Antenna Gain (dBi)	E.I.R.P Spectral Density (dBm/MHz)	Limit (dBm/MHz)
802.11b	2412	-1.397	2.5	1.103	10
	2437	-1.256	2.5	1.244	10
	2462	-0.302	2.5	2.198	10
802.11g	2412	0.475	2.5	2.975	10
	2437	0.644	2.5	3.144	10
	2462	1.513	2.5	4.013	10
802.11n20	2412	-0.723	2.5	1.777	10
	2437	-0.547	2.5	1.953	10
	2462	0.237	2.5	2.737	10
802.11n40	2422	-3.712	2.5	-1.212	10
	2437	-3.746	2.5	-1.246	10
	2452	-2.777	2.5	-0.277	10
BLE	2402	3.418	2.5	5.918	10
	2440	3.680	2.5	6.18	10
	2480	3.830	2.5	6.33	10

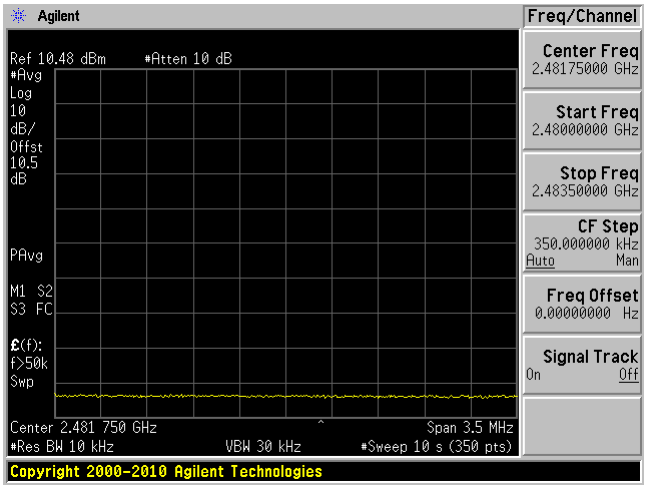
802.11b mode

Low Channel

2400 MHz – 2480 MHz

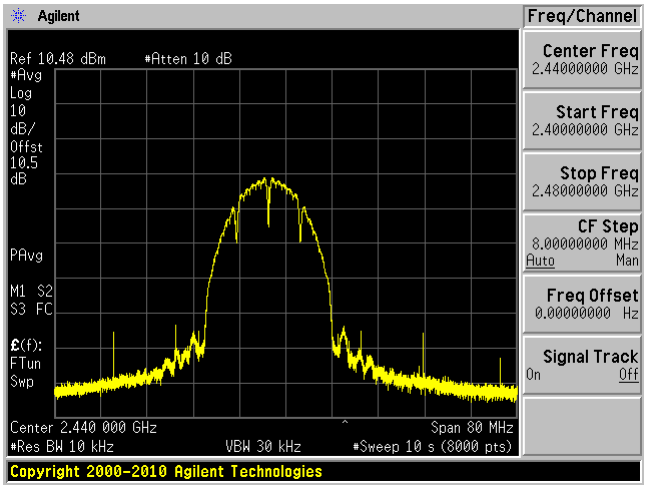


2480 MHz – 2483.5 MHz

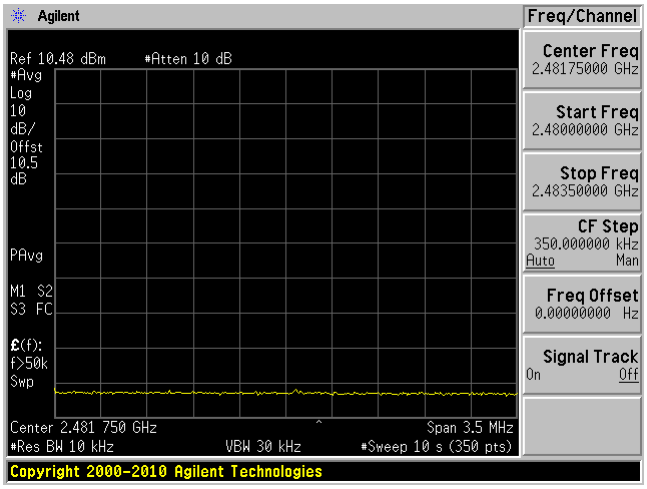


Middle Channel

2400 MHz – 2480 MHz

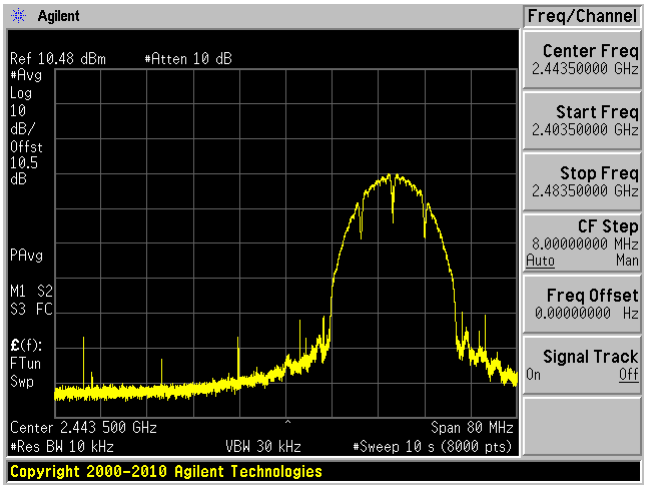


2480 MHz – 2483.5 MHz

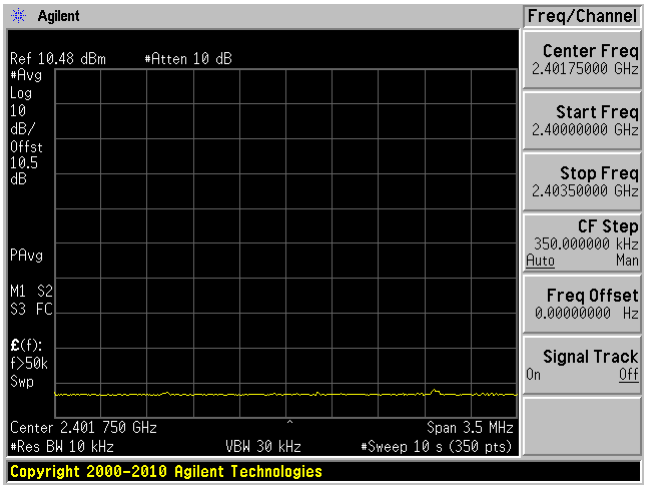


High Channel

2403.5 MHz – 2483.5 MHz



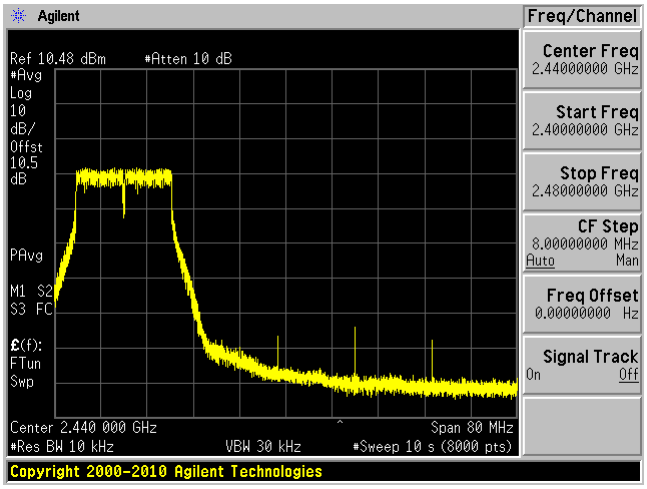
2400 MHz – 2403.5 MHz



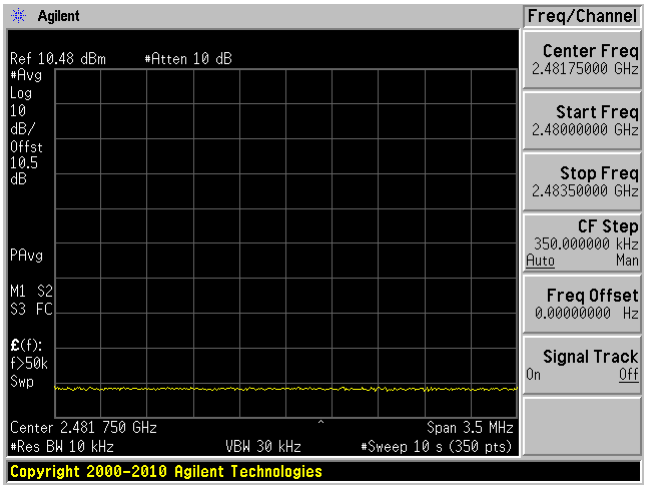
802.11g mode

Low Channel

2400 MHz – 2480 MHz

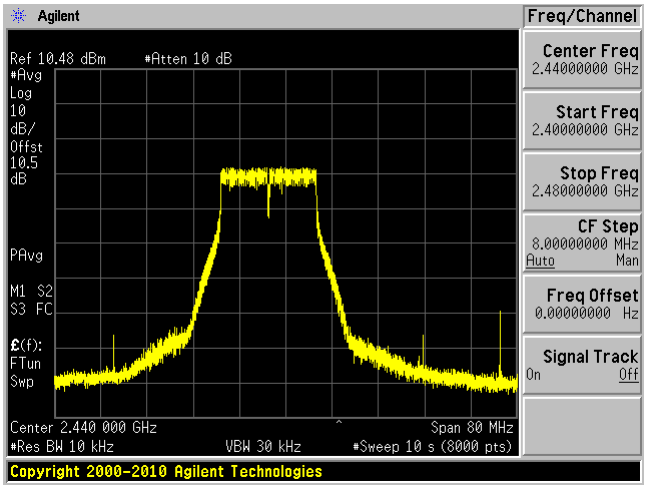


2480 MHz – 2483.5 MHz

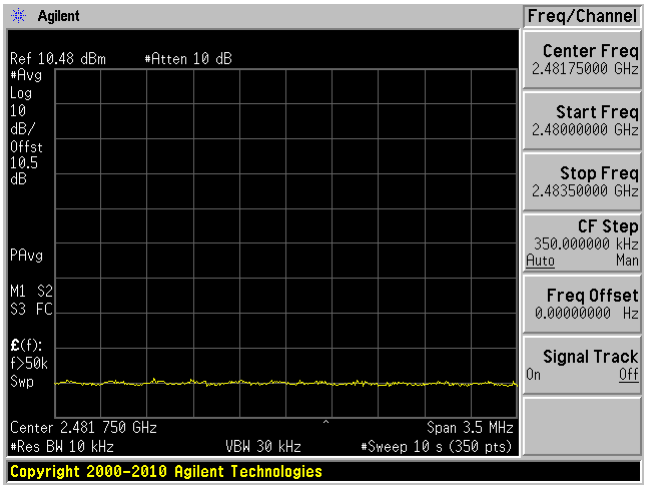


Middle Channel

2400 MHz – 2480 MHz

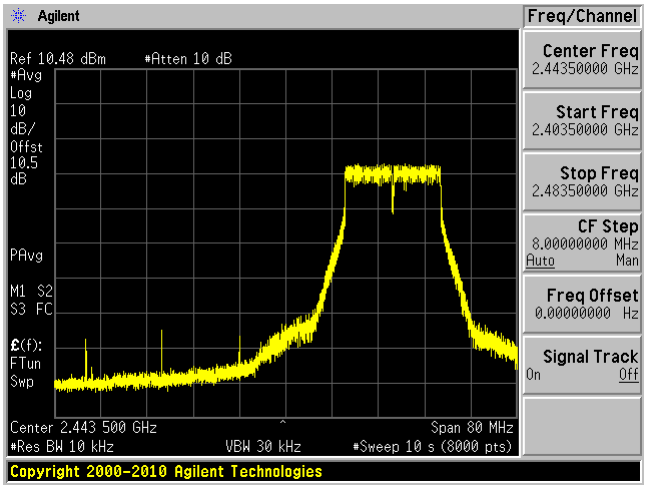


2480 MHz – 2483.5 MHz

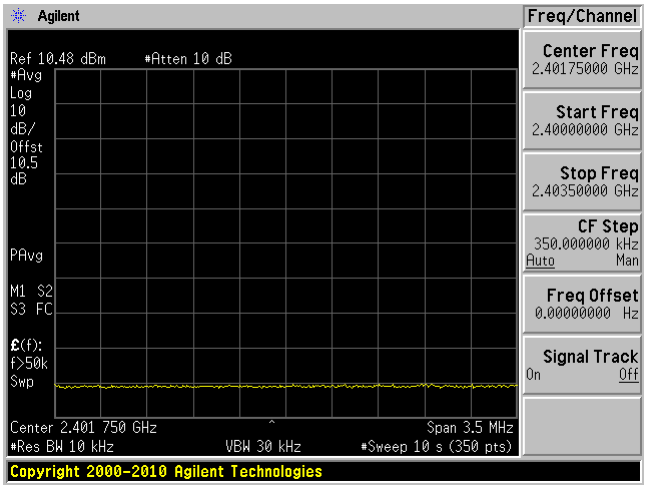


High Channel

2403.5 MHz – 2483.5 MHz



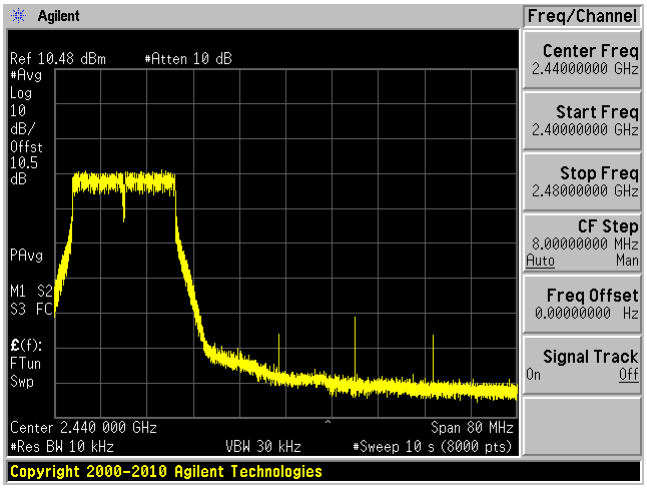
2400 MHz – 2403.5 MHz



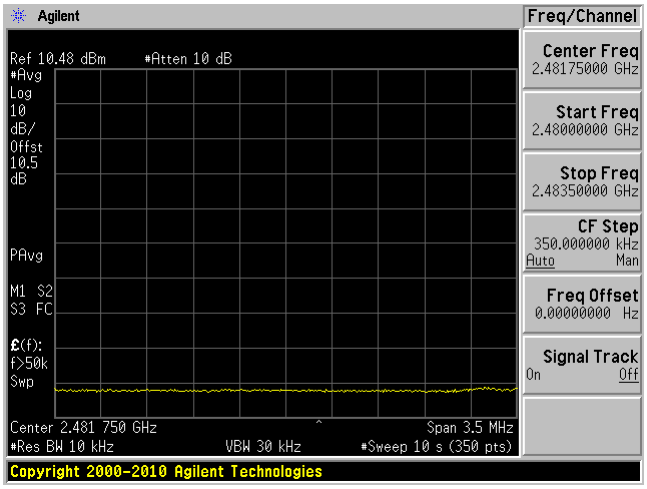
802.11n20 mode

Low Channel

2400 MHz – 2480 MHz

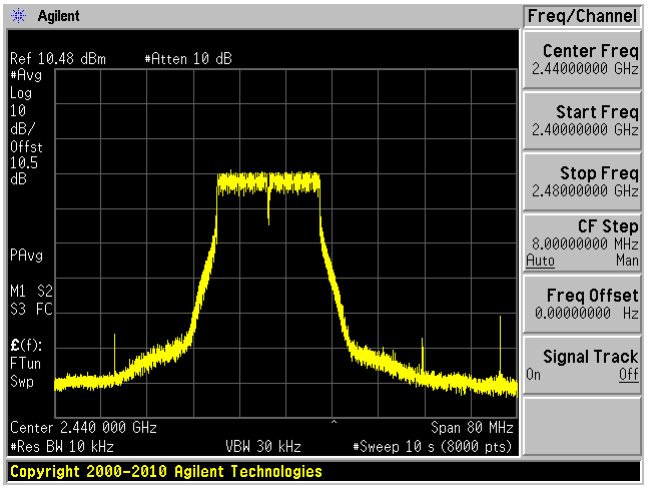


2480 MHz – 2483.5 MHz

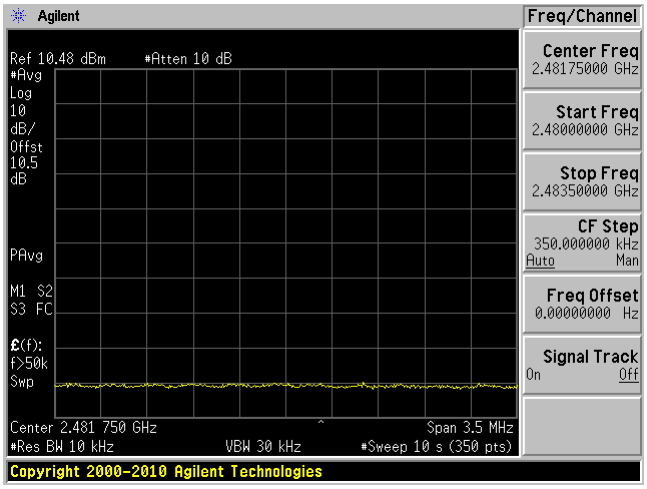


Middle Channel

2400 MHz – 2480 MHz

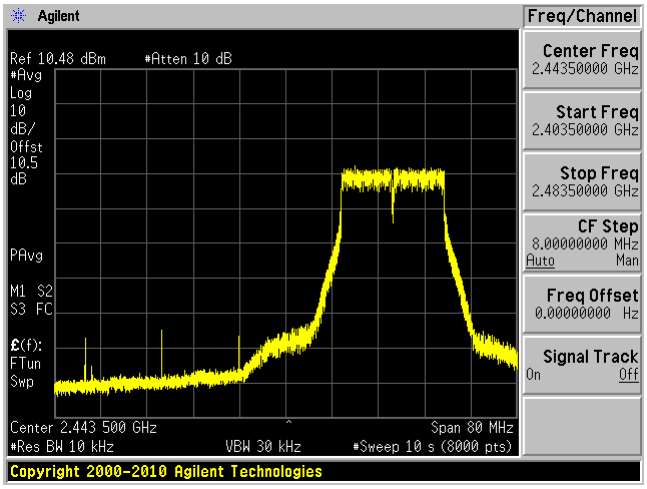


2480 MHz – 2483.5 MHz

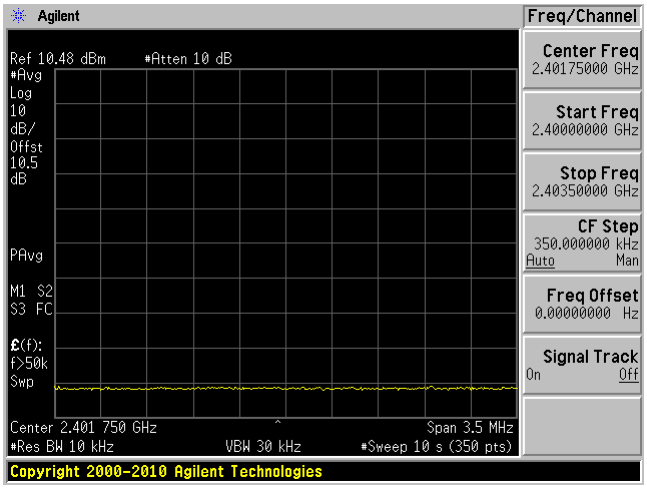


High Channel

2403.5 MHz – 2483.5 MHz



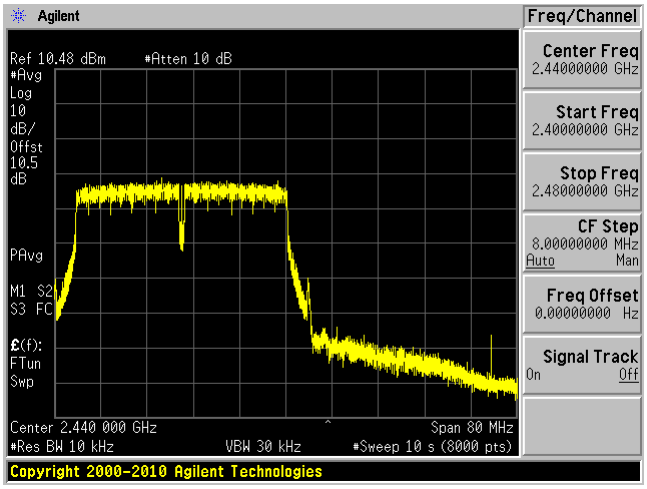
2400 MHz – 2403.5 MHz



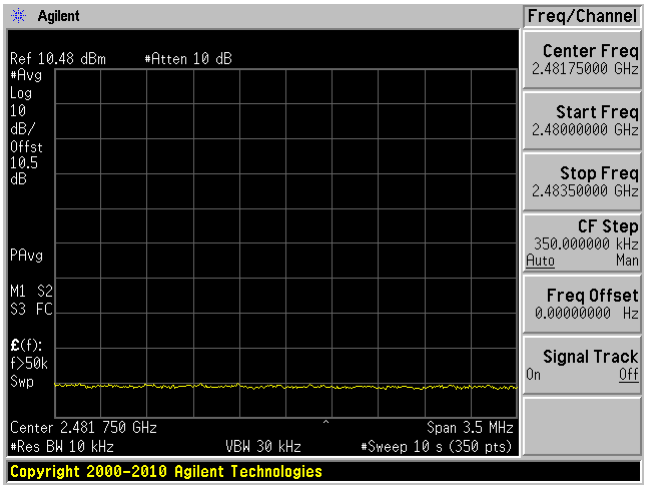
802.11n40 mode

Low Channel

2400 MHz – 2480 MHz

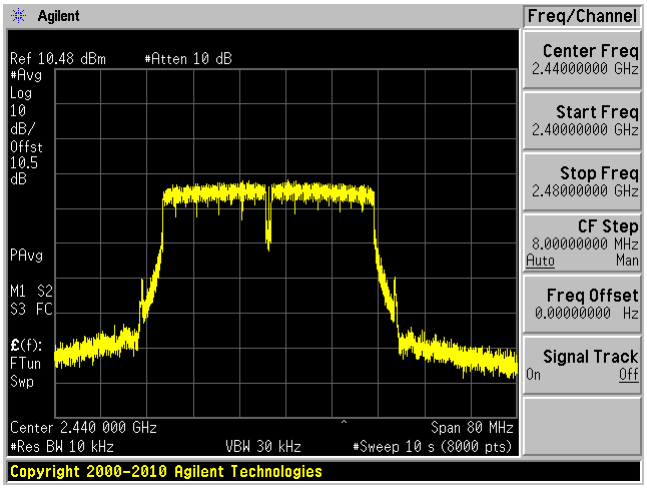


2480 MHz – 2483.5 MHz

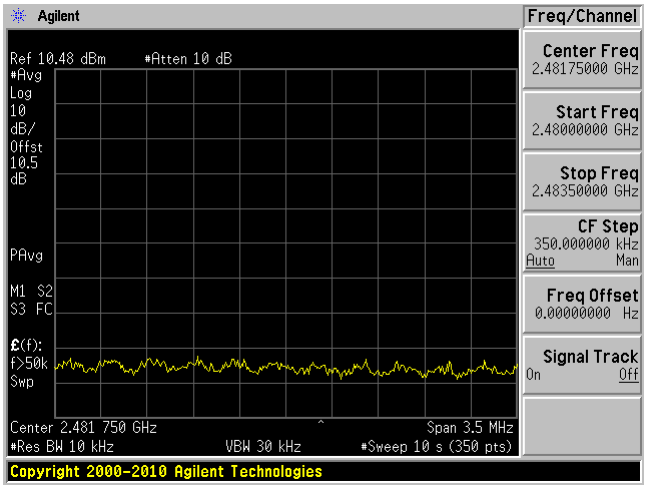


Middle Channel

2400 MHz – 2480 MHz

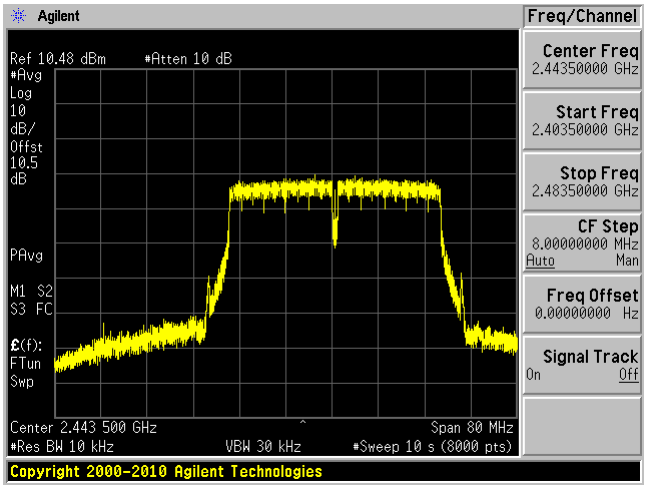


2480 MHz – 2483.5 MHz

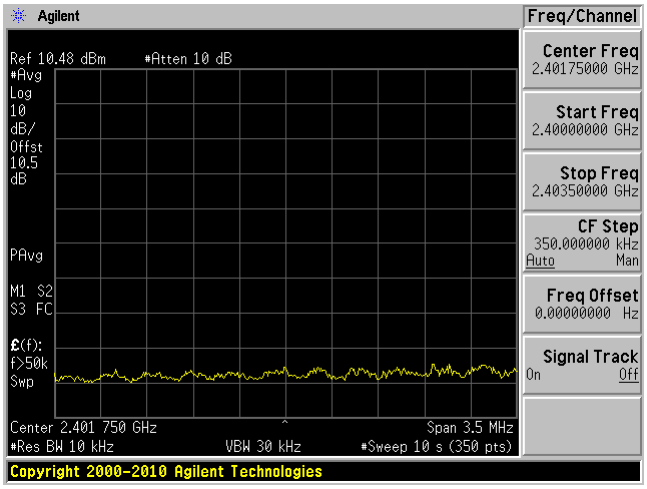


High Channel

2403.5 MHz – 2483.5 MHz



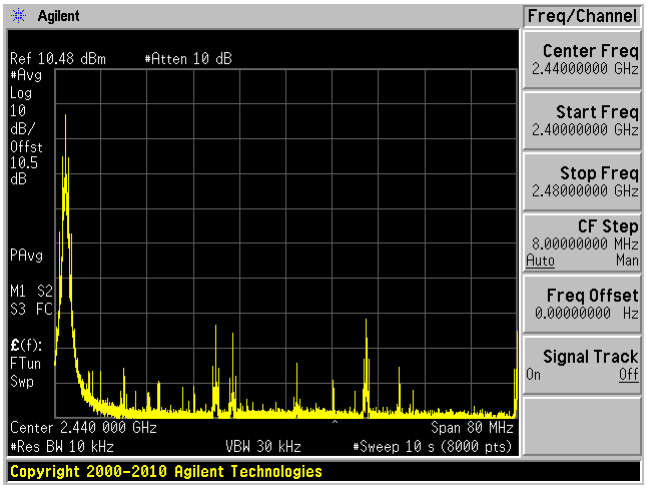
2400 MHz – 2403.5 MHz



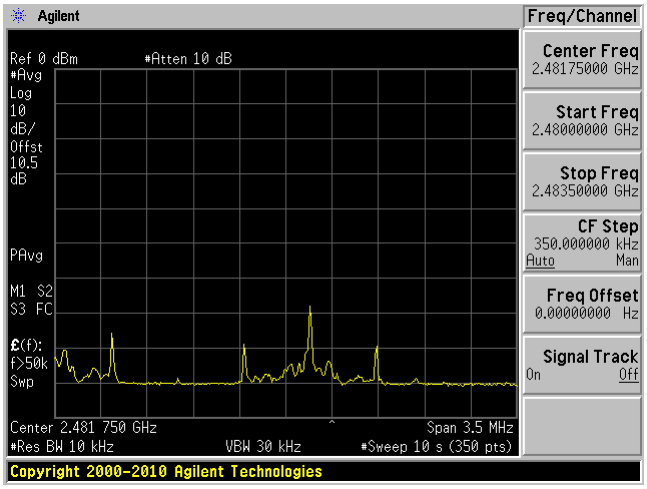
BLE

Low Channel

2400 MHz – 2480 MHz

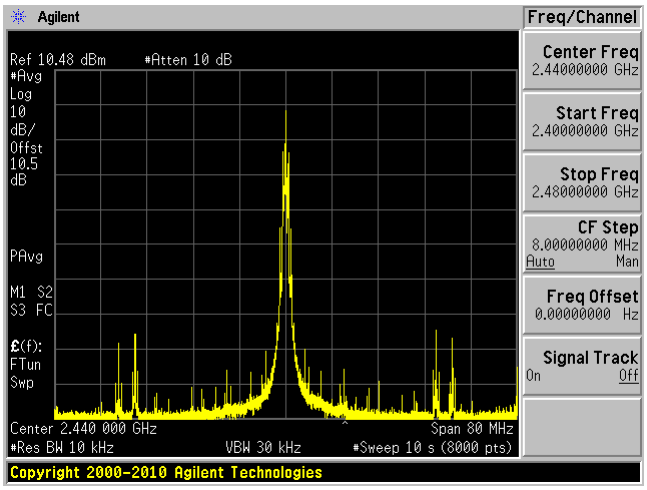


2480 MHz – 2483.5 MHz

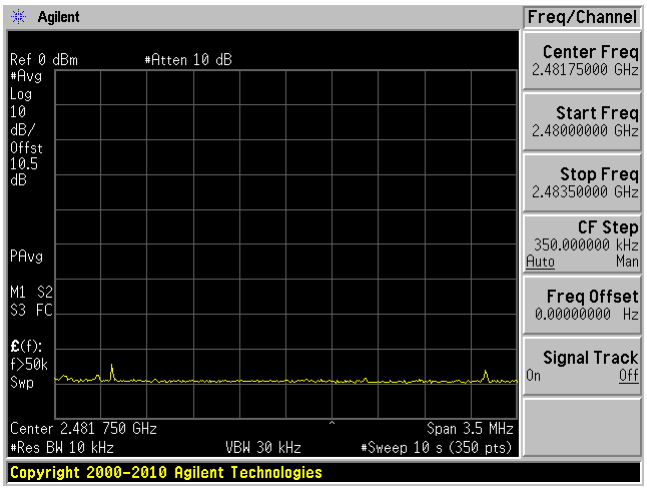


Middle Channel

2400 MHz – 2480 MHz

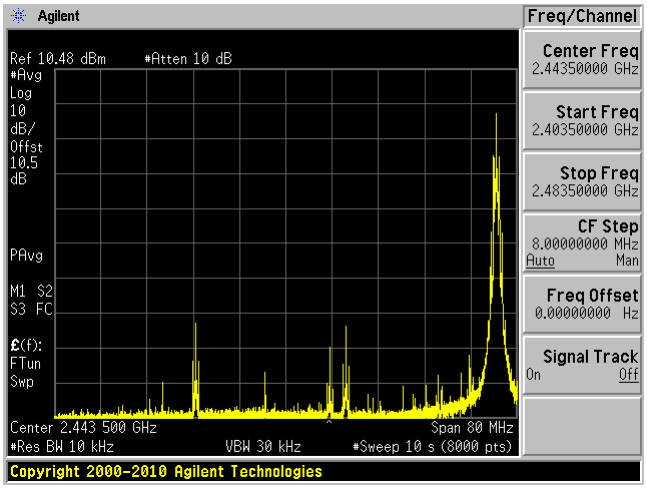


2480 MHz – 2483.5 MHz

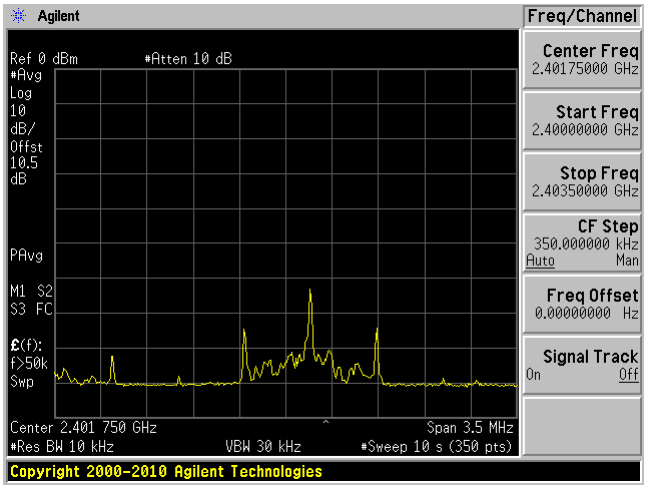


High Channel

2403.5 MHz – 2483.5 MHz



2400 MHz – 2403.5 MHz



7 EN 300 328 §4.3.2.8 – TX Unwanted Emissions in the out of Band Domain

7.1 Applicable Standard

According to EN 300 328 V1.9.1, §4.3.2.8.3

NOTE: Within the 2 400 MHz to 2 483,5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.2.7.

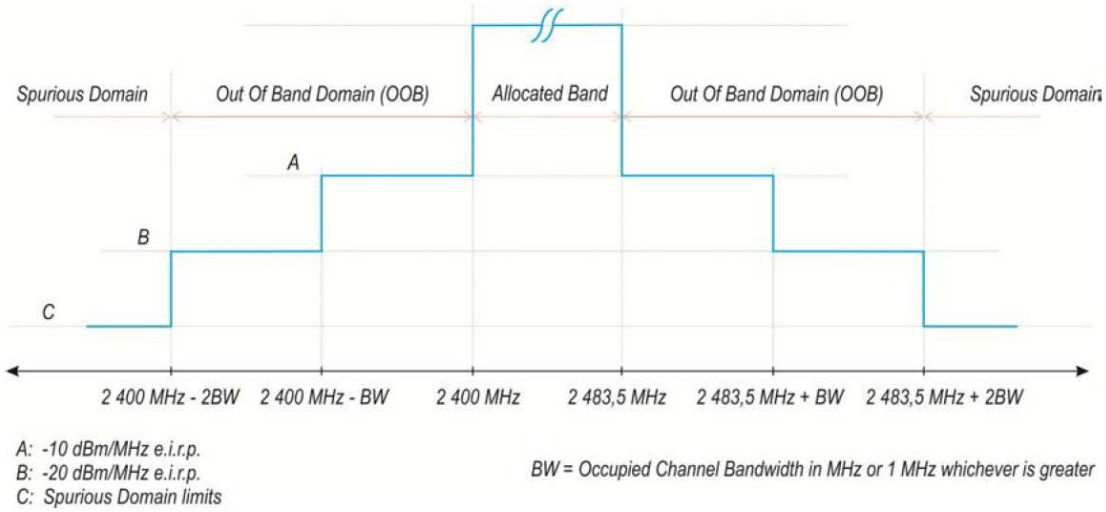


Figure 3: Transmit mask

7.2 Measurement Procedure

Step 1:

- Connect the UUT to the spectrum analyser and use the following settings:
  - Centre Frequency: 2 484 MHz
  - Span: 0 Hz
  - Resolution BW: 1 MHz
  - Filter mode: Channel filter
  - Video BW: 3 MHz
  - Detector Mode: RMS
  - Trace Mode: Max Hold
  - Sweep Mode: Continuous
  - Sweep Points: Sweep Time [s] / (1 µs) or 5 000 whichever is greater
  - Trigger Mode: Video trigger

NOTE 1: In case video triggering is not possible, an external trigger source may be used.

  - Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Step 2 (segment 2 483,5 MHz to 2 483,5 MHz + BW):

- Adjust the trigger level to select the transmissions with the highest power level.

- For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.
- Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.
- Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.
- Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3 (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW):

- Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 4 (segment 2 400 MHz - BW to 2 400 MHz):

- Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 5 (segment 2 400 MHz - 2BW to 2 400 MHz - BW):

- Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 6:

- In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figure 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.
- In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:
  - Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figure 1 or figure 3.
  - Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by $10 \times \log_{10}(A_{ch})$ and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE 2: A_{ch} refers to the number of active transmit chains.

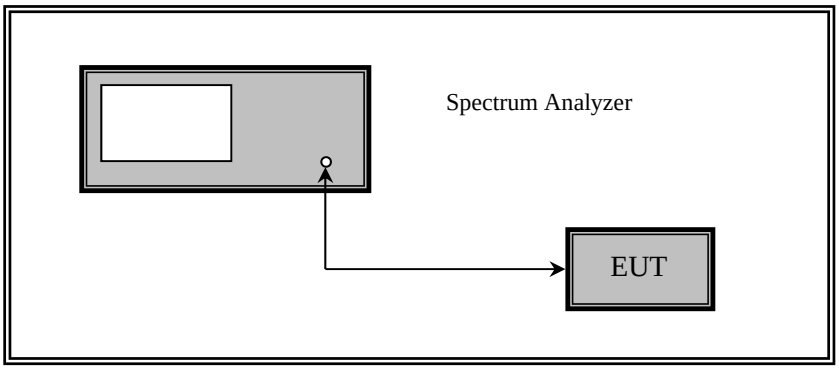
It shall be recorded whether the equipment complies with the mask provided in figure 1 or figure 3.

7.3 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	46 %
ATM Pressure:	102kPa

Testing was performed by Jin Yang on 2015-10-23 on RF site.

7.4 Test Setup Block Diagram



7.5 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

7.6 Test Results

Channel	Frequency (MHz)	Max S.A Amp. (dBm/MHz)	Antenna Gain (dBi)	Limit e.i.r.p (dBm/MHz)	Results
802.11b mode					
2412MHz	2360-2380	-53.51	2.5	-20	Pass
2412MHz	2380-2400	-41.34	2.5	-10	Pass
2462MHz	2483.5-2503.5	-49.85	2.5	-10	Pass
2462MHz	2503.5-2523.5	-52.84	2.5	-20	Pass
802.11g mode					
2412MHz	2360-2380	-50.47	2.5	-20	Pass
2412MHz	2380-2400	-21.81	2.5	-10	Pass
2462MHz	2483.5-2503.5	-39.73	2.5	-10	Pass
2462MHz	2503.5-2523.5	-49.58	2.5	-20	Pass
802.11n20 mode					
2412MHz	2360-2380	-49.95	2.5	-20	Pass
2412MHz	2380-2400	-22.58	2.5	-10	Pass
2462MHz	2483.5-2503.5	-42.19	2.5	-10	Pass
2462MHz	2503.5-2523.5	-50.70	2.5	-20	Pass
802.11n40 mode					
2422MHz	2320-2360	-51.16	2.5	-20	Pass
2422MHz	2360-2400	-29.59	2.5	-10	Pass
2452MHz	2483.5-2523.5	-38.38	2.5	-10	Pass
2452MHz	2523.5-2563.5	-50.41	2.5	-20	Pass
BLE					
2402MHz	2396-2398	-50.37	2.5	-20	Pass
2402MHz	2398-2400	-26.73	2.5	-10	Pass
2480MHz	2483.5-2485.5	-47.32	2.5	-10	Pass
2480MHz	2485.5-2487.5	-54.44	2.5	-20	Pass

8 EN 300 328 §4.3.2.9 – TX Unwanted emissions in the Spurious Domain

8.1 Applicable Standard

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 4.

Table 4: Transmitter limits for spurious emissions

Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

8.2 EUT Setup

The radiated emissions tests were performed in a shield room, using the setup accordance with the EN 300 328 V1.9.1. The specification used was the EN 300 328 V1.9.1 limits.

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

8.3 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	46 %
ATM Pressure:	102kPa

Testing was performed by Jin Yang on 2015-10-23 on RF site.

The radiated testing was performed by Jimmy Xiao on 2015-10-30 at 5 meter chamber #3.

8.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2015-07-11	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2015-03-20	1 year
HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A0113	2015-03-11	1year
Sunol	Horn antenna	DRH-118	A052704	2015-03-09	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
HP	Signal Generator	83650B	18485-91	2015-08-19	1 year
COM-POWER	Antenna, Dipole	AD-100	721033DB1,721033DB2,721033DB3,721033DB4,	2014-11-03	2 year

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

8.5 Measurement Procedure

For the radiated emissions test, the EUT and all support equipment power cords were connected to the AC floor outlet since the power supply used in the EUT did not provide an accessory power outlet.

Maximization procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "**QP**" in the data table.

8.6 Summary of Test Results

According to the data in following tables, the EUT complied with the EN 300 328 V1.9.1 standards and had the worst margin of:

2.4GHz WiFi:

-2.17 dB at 550 **MHz** in the **Vertical** polarization

BLE:

-2.42 dB at 550 **MHz** in the **Vertical** polarization

Their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation).

Radiated Spurious Emission

Note: After pre-scan, the worst case is g mode for 802.11 20MHz Bandwidth.

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
802.11 20MHz Bandwidth Low Channel											
4824	43.67	62	100	H	4824	-56.24	10.978	1.39	-46.652	-30	-16.652
4824	43.46	0	100	V	4824	-56.32	11.017	1.39	-46.693	-30	-16.693
7236	42.84	0	100	H	7236	-50.37	11.539	1.81	-40.641	-30	-10.641
7236	42.77	0	100	V	7236	-50.57	11.51	1.81	-40.87	-30	-10.87
550	39.44	91	148	H	550	-56.03	0	0.5	-56.53	-54	-2.53
550	38.06	193	100	V	550	-56.73	0	0.5	-57.23	-54	-3.23
750	29.84	231	151	H	750	-62.89	0	0.54	-63.43	-54	-9.43
650	27.15	234	143	V	650	-65.67	0	0.58	-66.25	-54	-12.25
450	36.09	282	114	H	450	-61.36	0	0.4	-61.76	-36	-25.76
450	34.81	169	121	V	450	-61.6	0	0.4	-62	-36	-26
802.11 20MHz Bandwidth High Channel											
4924	43.33	61	100	H	4924	-55.83	10.896	1.41	-46.344	-30	-16.344
4924	43.95	0	100	V	4924	-54.76	10.871	1.41	-45.299	-30	-15.299
7386	43.7	0	100	H	7386	-49.08	11.137	1.85	-39.793	-30	-9.793
7386	43.18	0	100	V	7386	-50.11	11.136	1.85	-40.824	-30	-10.824
550	39.51	129	100	H	550	-55.96	0	0.5	-56.46	-54	-2.46
550	38.98	252	133	V	550	-55.81	0	0.5	-56.31	-54	-2.31
750	28.56	209	135	H	750	-64.17	0	0.54	-64.71	-54	-10.71
650	25.68	175	142	V	650	-67.14	0	0.58	-67.72	-54	-13.72
450	32.35	104	149	H	450	-65.1	0	0.4	-65.5	-36	-29.5
450	30.38	162	100	V	450	-66.03	0	0.4	-66.43	-36	-30.43

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
802.11 40MHz Bandwidth Low Channel											
4844	43.83	68	100	H	4844	-55.85	10.978	1.39	-46.262	-30	-16.262
4844	43.68	0	100	V	4844	-56.05	11.017	1.39	-46.423	-30	-16.423
7266	42.76	0	100	H	7266	-50.55	11.221	1.87	-41.199	-30	-11.199
7266	43.11	0	100	V	7266	-50.02	11.244	1.87	-40.646	-30	-10.646
550	38.53	128	102	H	550	-56.94	0	0.5	-57.44	-54	-3.44
550	39.12	270	137	V	550	-55.67	0	0.5	-56.17	-54	**-2.17**
750	29.66	200	135	H	750	-63.07	0	0.54	-63.61	-54	-9.61
650	27.24	188	149	V	650	-65.58	0	0.58	-66.16	-54	-12.16
450	33.68	108	138	H	450	-63.77	0	0.4	-64.17	-36	-28.17
450	32.48	167	112	V	450	-63.93	0	0.4	-64.33	-36	-28.33
802.11 40MHz Bandwidth High Channel											
4904	44.01	87	100	H	4904	-55.33	10.896	1.41	-45.844	-30	-15.844
4904	43.81	0	100	V	4904	-54.99	10.871	1.41	-45.529	-30	-15.529
7356	43.26	0	100	H	7356	-49.55	11.137	1.85	-40.263	-30	-10.263
7356	42.84	0	100	V	7356	-50.45	11.136	1.85	-41.164	-30	-11.164
550	38.54	142	100	H	550	-56.93	0	0.5	-57.43	-54	-3.43
550	38.65	265	114	V	550	-56.14	0	0.5	-56.64	-54	-2.64
750	28.05	174	132	H	750	-64.68	0	0.54	-65.22	-54	-11.22
650	26.87	234	124	V	650	-65.95	0	0.58	-66.53	-54	-12.53
450	35.15	166	131	H	450	-62.3	0	0.4	-62.7	-36	-26.7
450	34.87	218	118	V	450	-61.54	0	0.4	-61.94	-36	-25.94

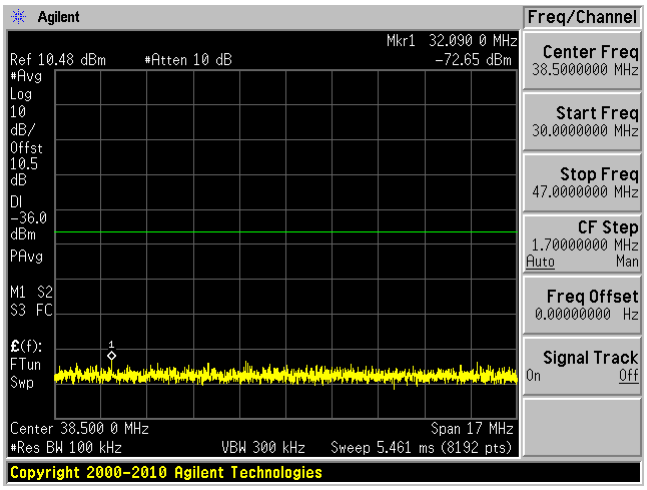
Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
BLE Low Channel											
4804	43.35	0	100	H	4804	-56.97	10.978	1.39	-47.382	-30	-17.382
4804	43.41	0	100	V	4804	-56.38	11.017	1.39	-46.753	-30	-16.753
7206	43.05	0	100	H	7206	-50.4	11.539	1.81	-40.671	-30	-10.671
7206	43.17	0	100	V	7206	-50.09	11.51	1.81	-40.39	-30	-10.39
550	38.81	124	100	H	550	-56.66	0	0.5	-57.16	-54	-3.16
550	38.77	255	127	V	550	-56.02	0	0.5	-56.52	-54	-2.52
750	28.68	138	141	H	750	-64.05	0	0.54	-64.59	-54	-10.59
650	25.78	175	136	V	650	-67.04	0	0.58	-67.62	-54	-13.62
450	34.97	156	140	H	450	-62.48	0	0.4	-62.88	-36	-26.88
450	33.12	231	100	V	450	-63.29	0	0.4	-63.69	-36	-27.69
BLE High Channel											
4960	43.56	0	100	H	4960	-55.61	10.917	1.37	-46.063	-30	-16.063
4960	43.3	0	100	V	4960	-55.06	10.931	1.37	-45.499	-30	-15.499
7440	42.97	0	100	H	7440	-50.18	11.137	1.85	-40.893	-30	-10.893
7440	42.87	0	100	V	7440	-50.31	11.136	1.85	-41.024	-30	-11.024
550	39.08	127	105	H	550	-56.39	0	0.5	-56.89	-54	-2.89
550	38.87	280	127	V	550	-55.92	0	0.5	-56.42	-54	**-2.42**
750	26.02	128	134	H	750	-66.71	0	0.54	-67.25	-54	-13.25
650	26.78	271	124	V	650	-66.04	0	0.58	-66.62	-54	-12.62
450	35.21	136	142	H	450	-62.24	0	0.4	-62.64	-36	-26.64
450	32.32	259	134	V	450	-64.09	0	0.4	-64.49	-36	-28.49

Conducted TX Spurious Emission:

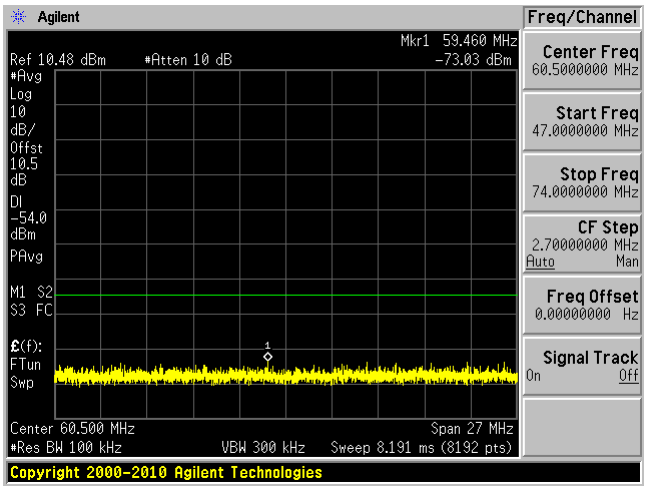
Note: all the emissions have more than 2.5 dB margin from the limits, so after adding the peak antenna gain 2.5dBi, all the emissions can still pass.

802.11b mode, Low Channel

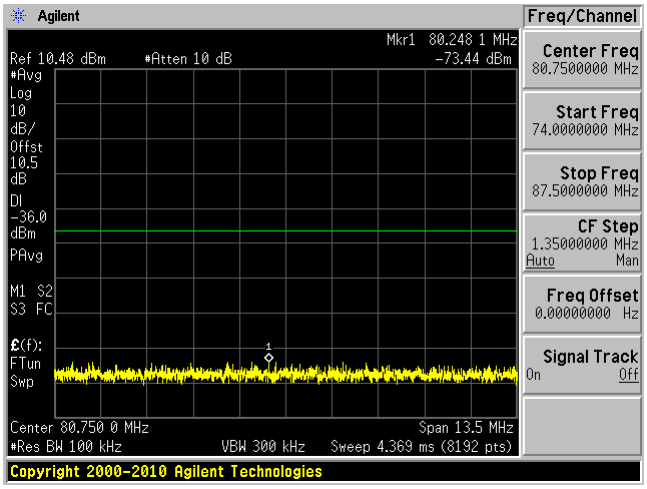
30MHz to 47MHz



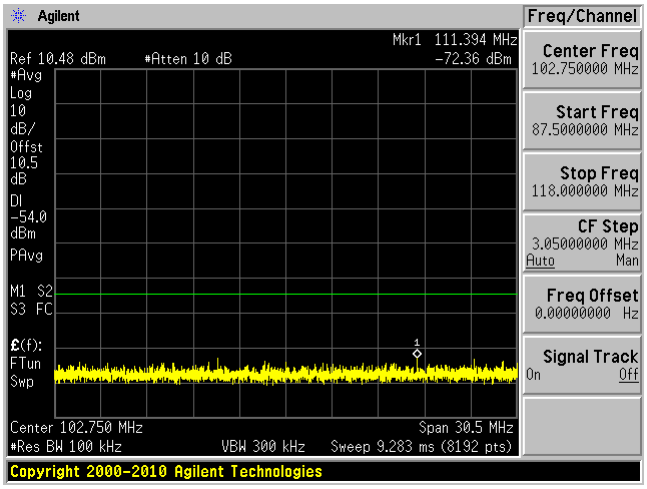
47MHz to 74MHz



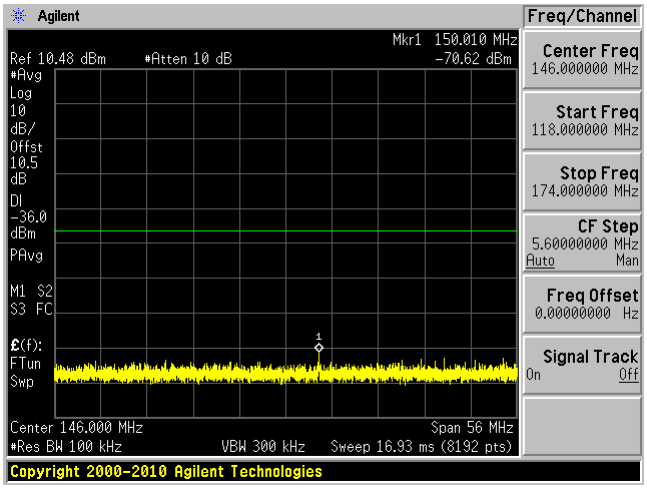
74MHz to 87.5MHz



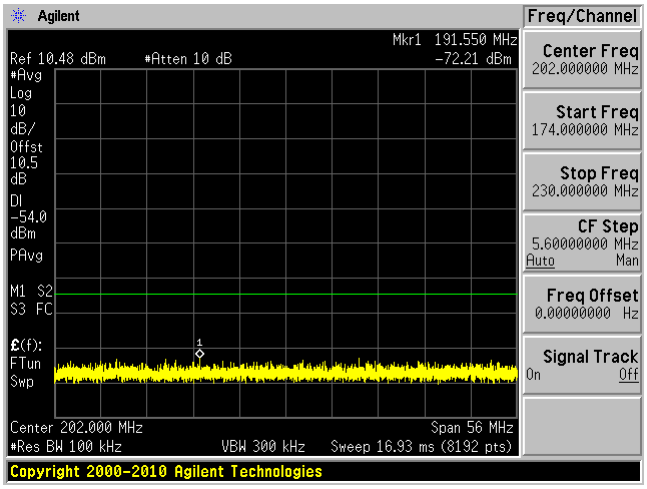
87.5MHz to 118MHz



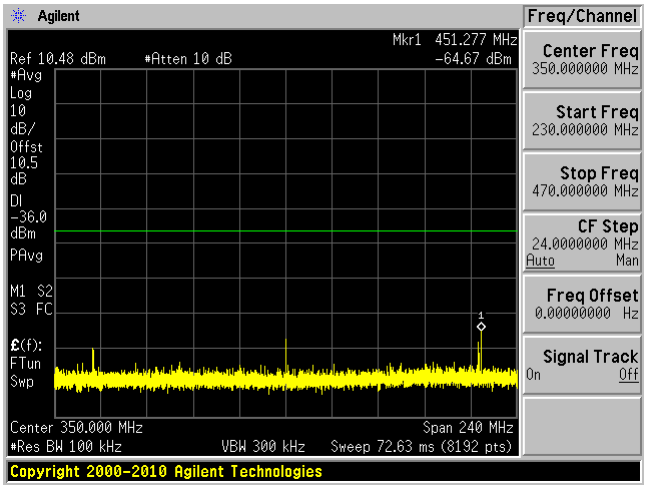
118MHz to 174MHz



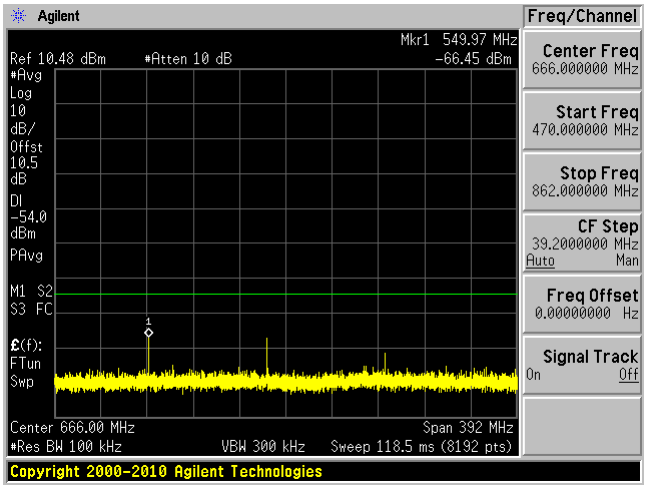
174MHz to 230MHz



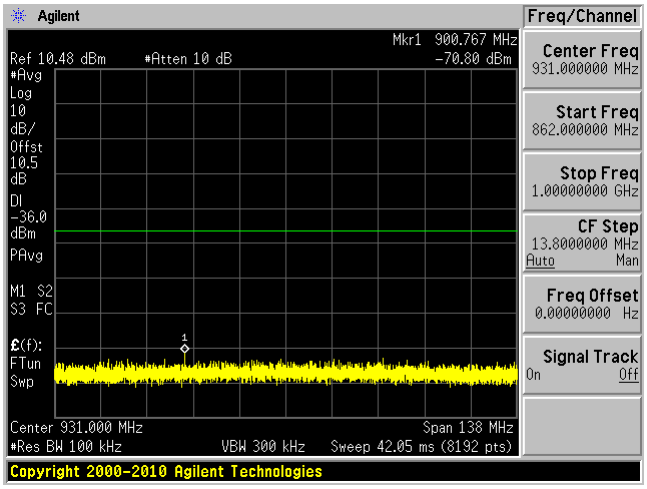
230MHz to 470MHz



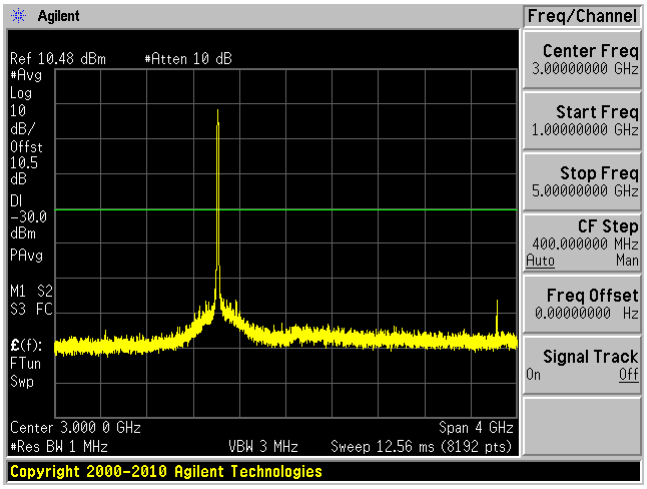
470MHz to 862MHz



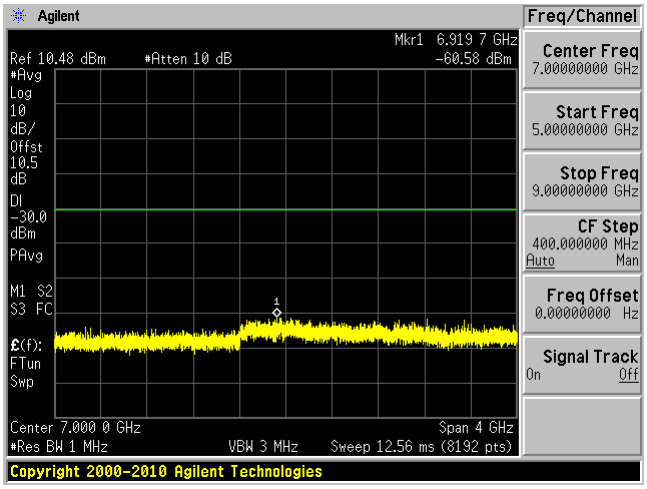
862MHz to 1GHz



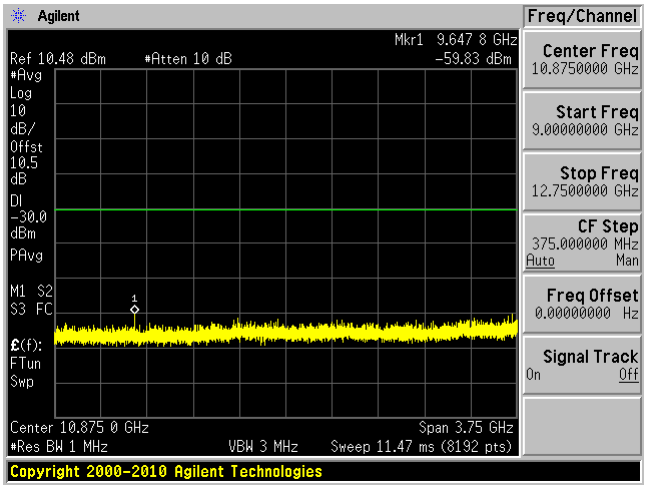
1GHz to 5GHz



5GHz to 9GHz

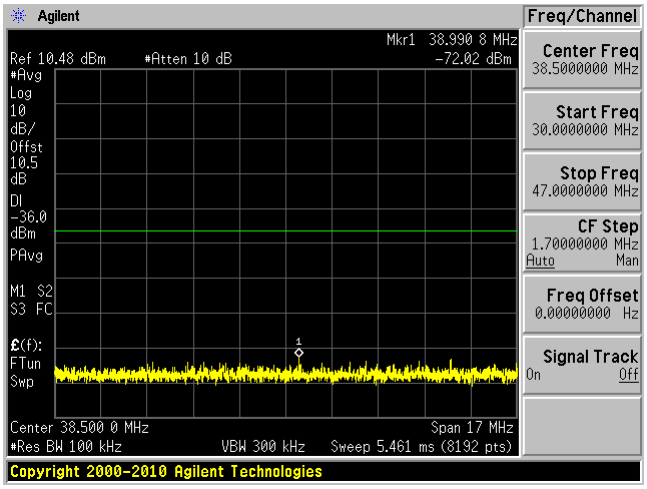


9GHz to 12.75GHz

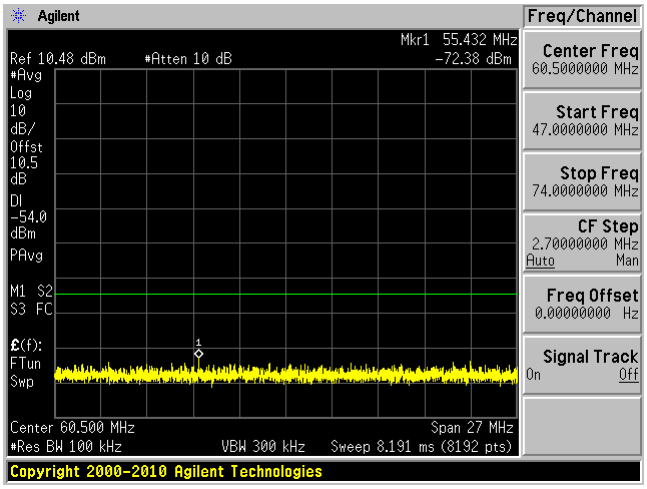


802.11b mode, High Channel

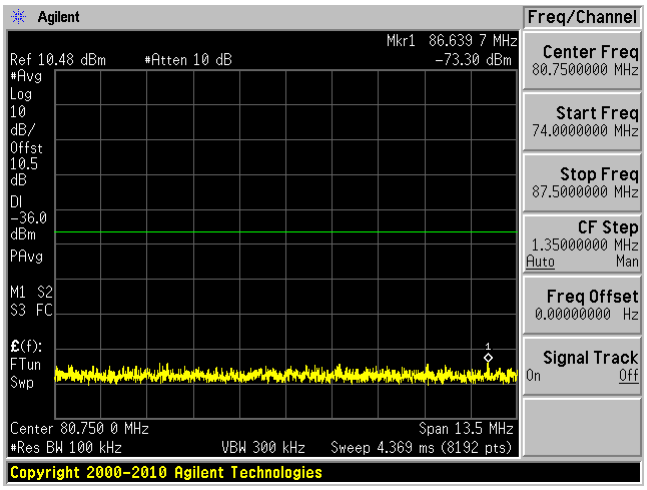
30MHz to 47MHz



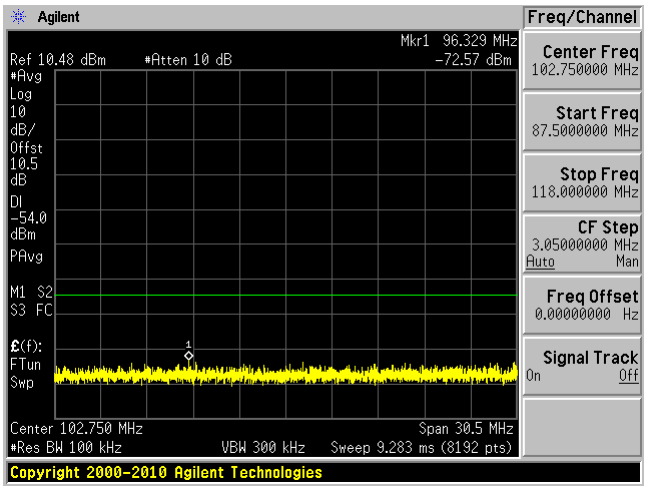
47MHz to 74MHz



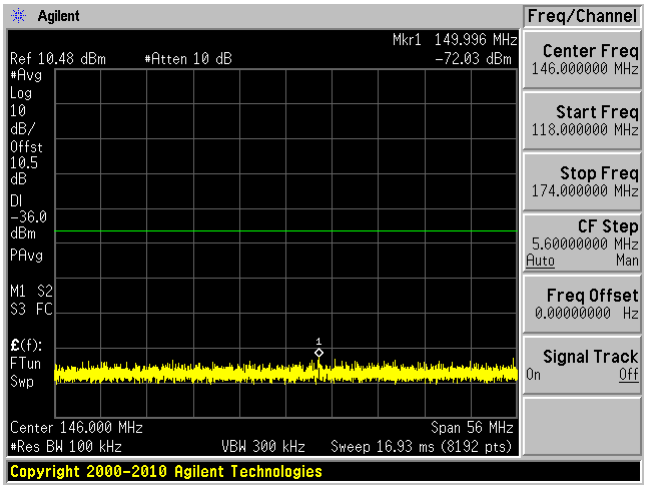
74MHz to 87.5MHz



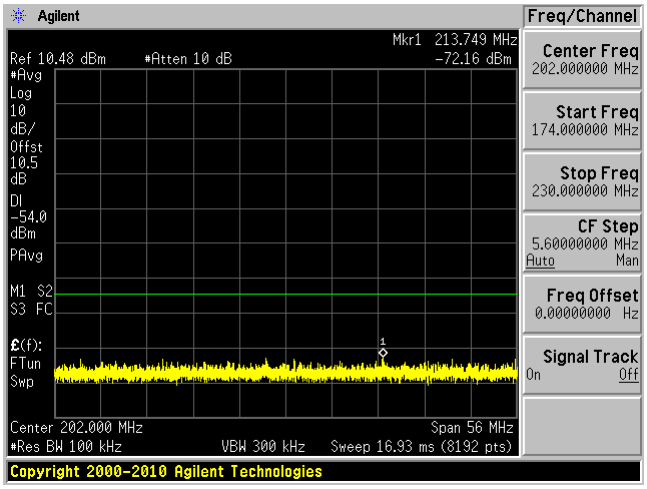
87.5MHz to 118MHz



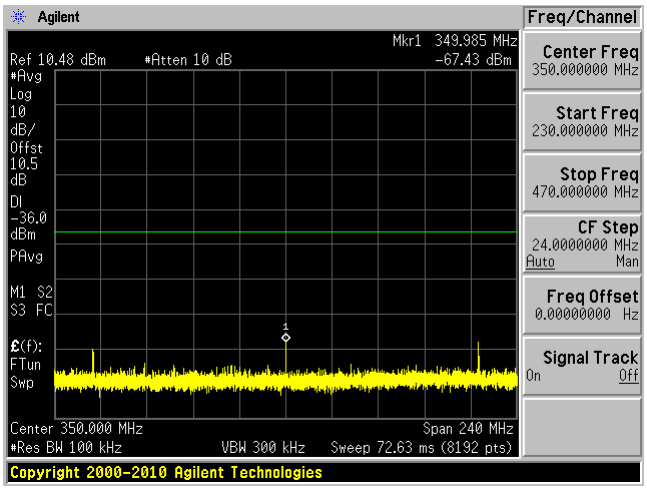
118MHz to 174MHz



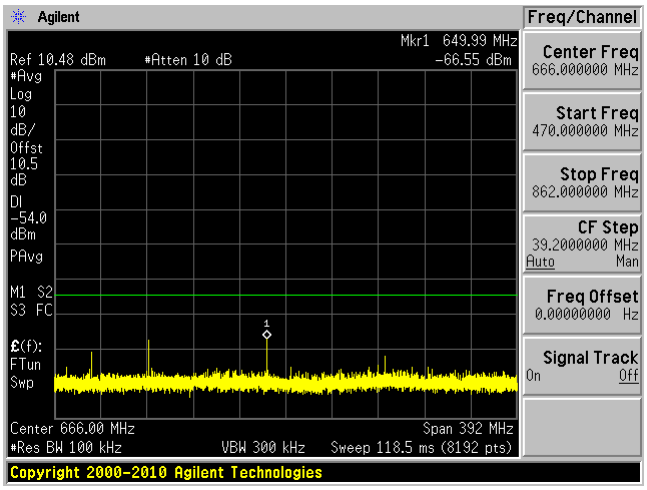
174MHz to 230MHz



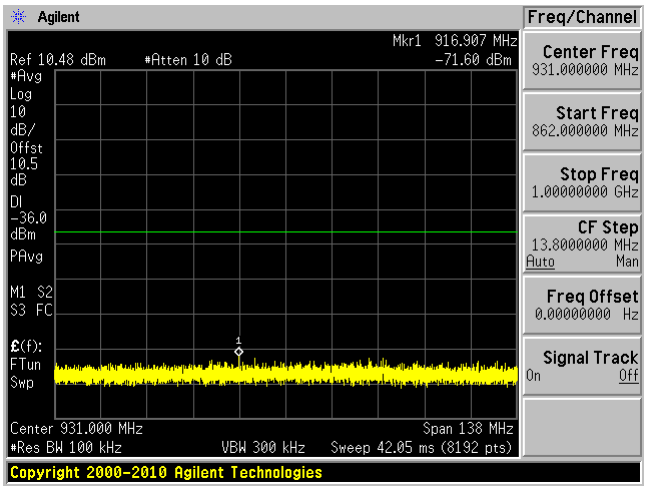
230MHz to 470MHz



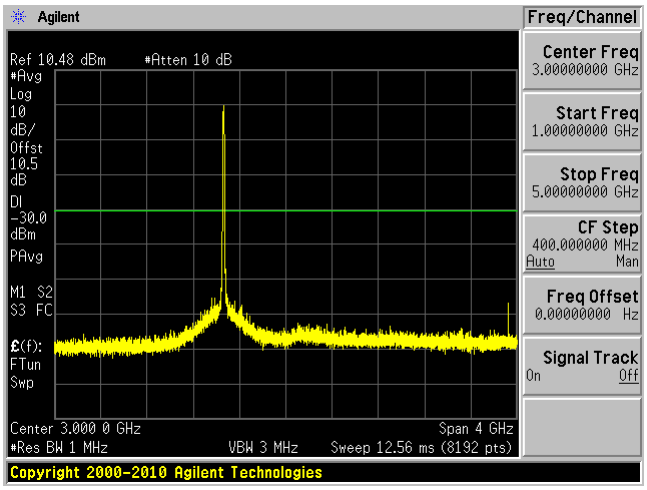
470MHz to 862MHz



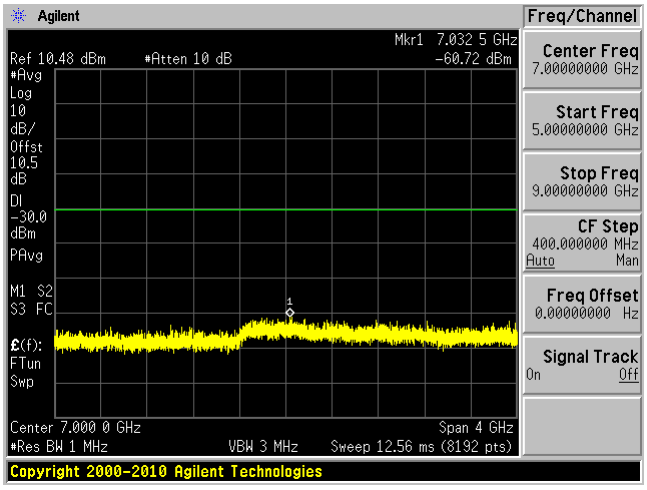
862MHz to 1GHz



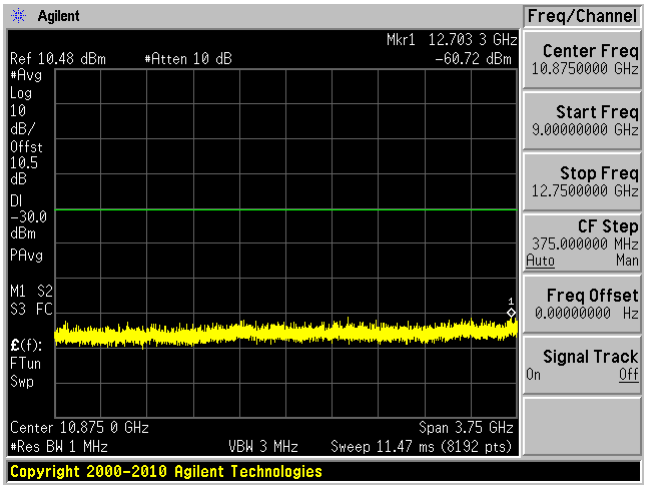
1GHz to 5GHz



5GHz to 9GHz

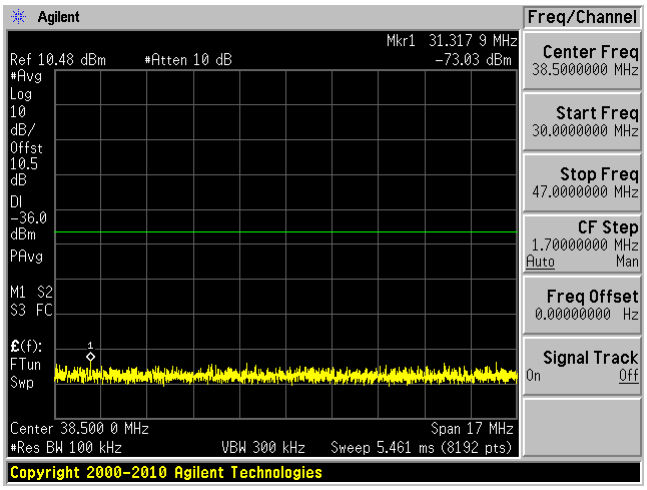


9GHz to 12.75GHz

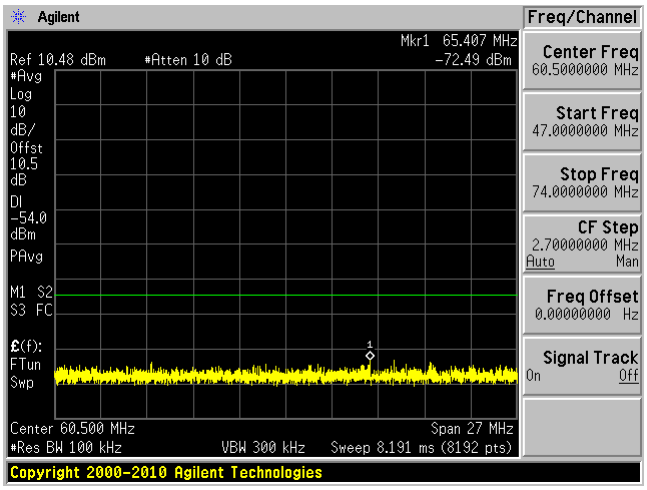


802.11g mode, Low Channel

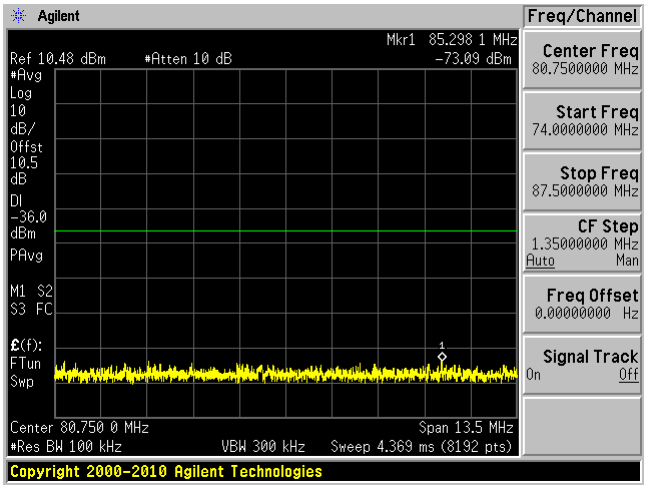
30MHz to 47MHz



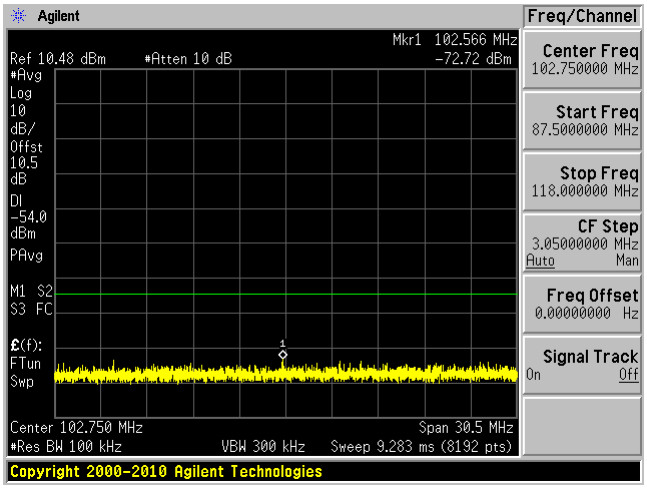
47MHz to 74MHz



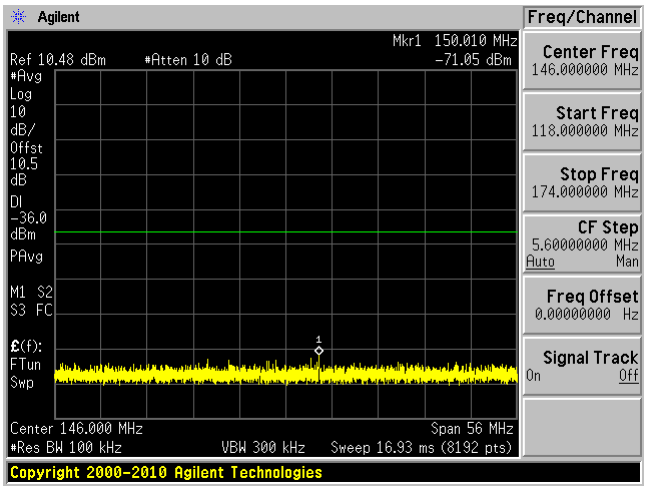
74MHz to 87.5MHz



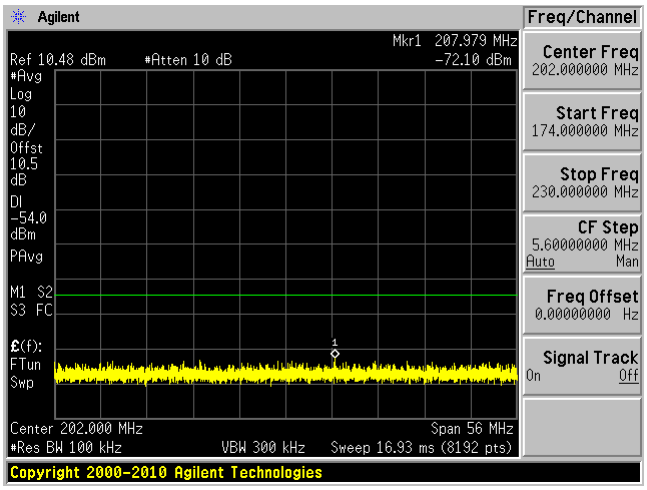
87.5MHz to 118MHz



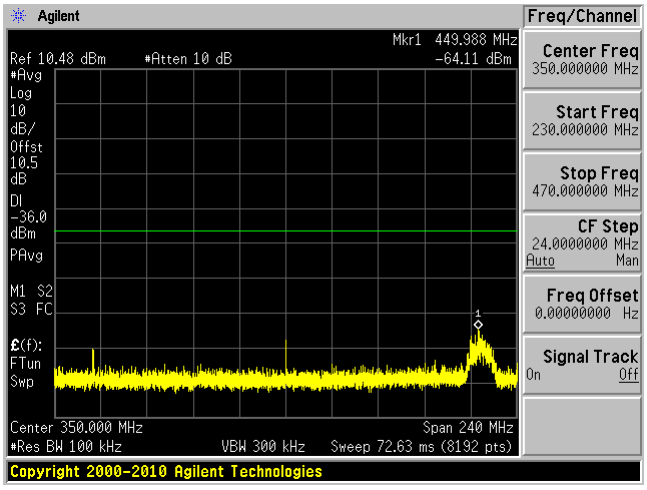
118MHz to 174MHz



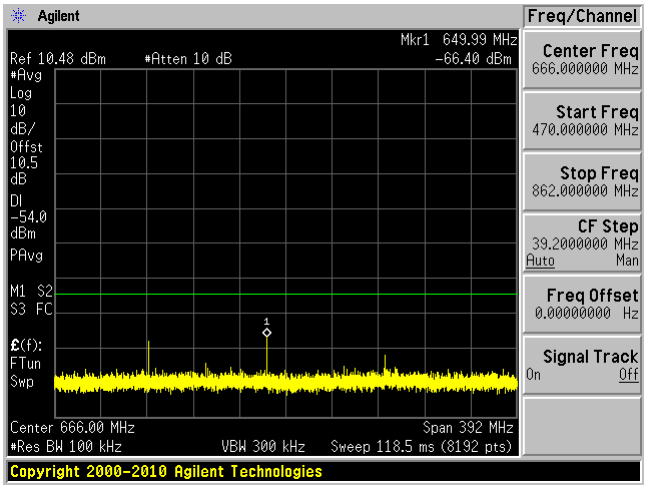
174MHz to 230MHz



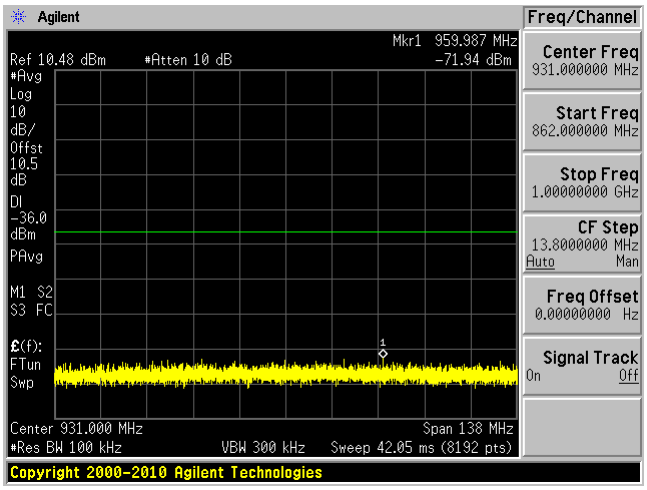
230MHz to 470MHz



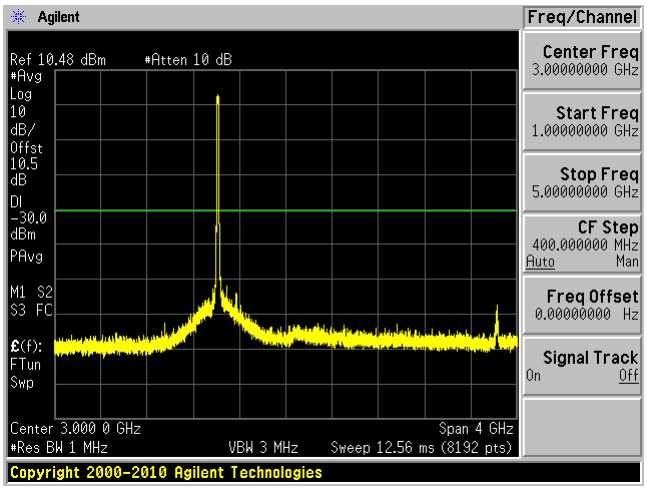
470MHz to 862MHz



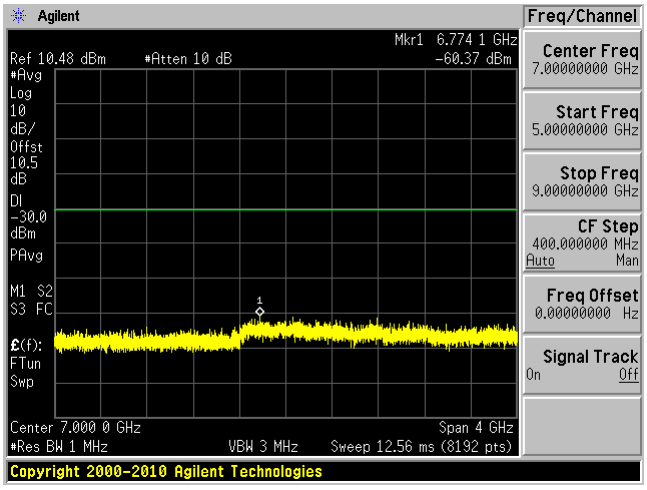
862MHz to 1GHz



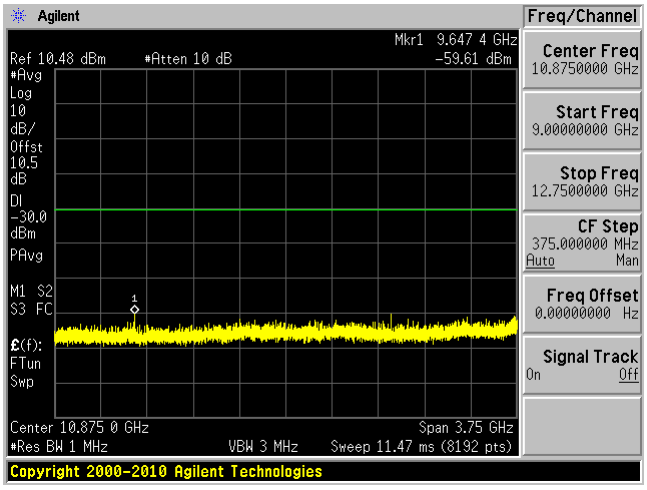
1GHz to 5GHz



5GHz to 9GHz

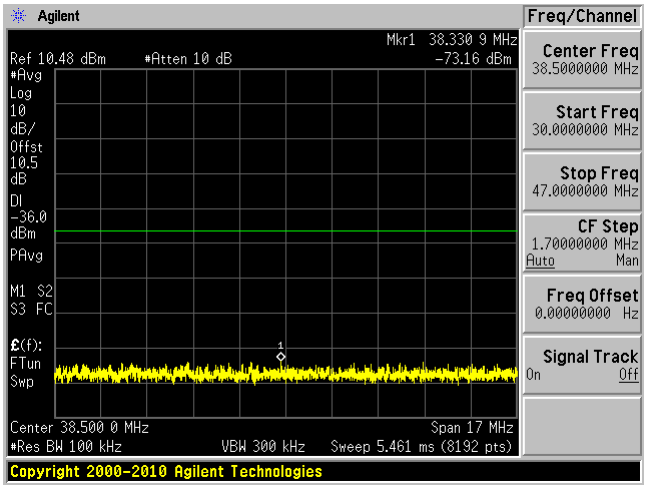


9GHz to 12.75GHz

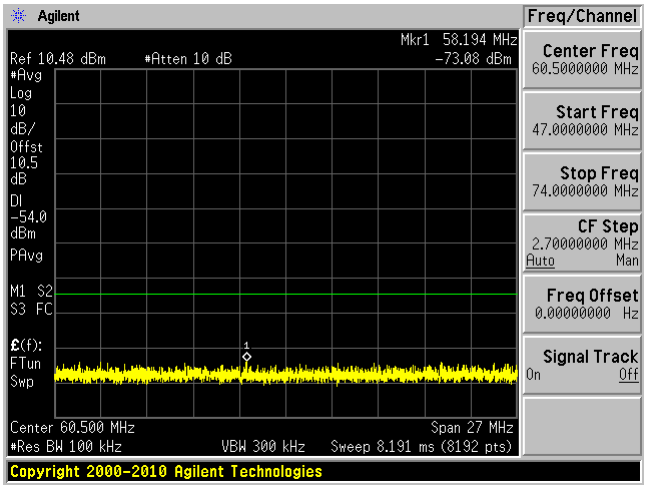


802.11g mode, High Channel

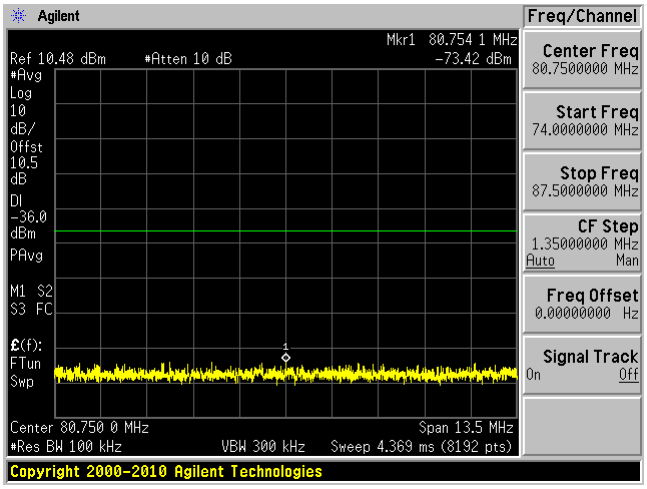
30MHz to 47MHz



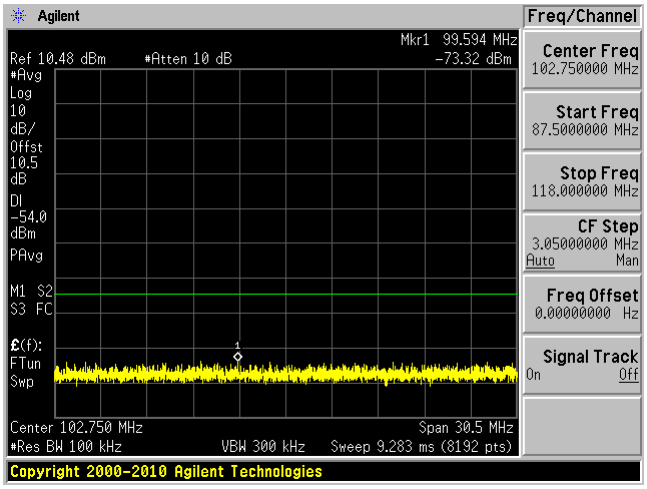
47MHz to 74MHz



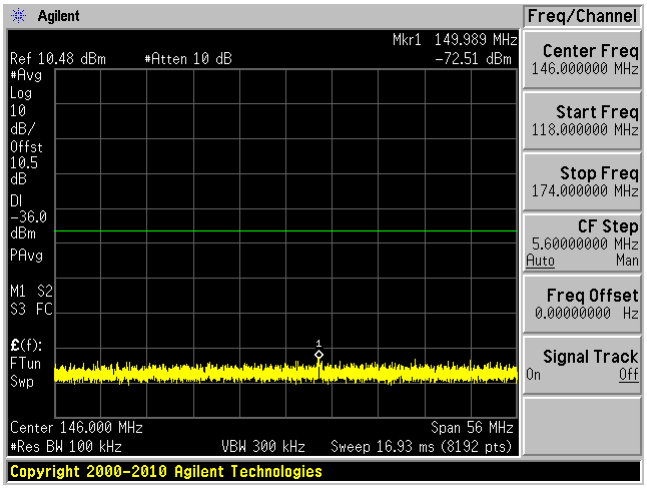
74MHz to 87.5MHz



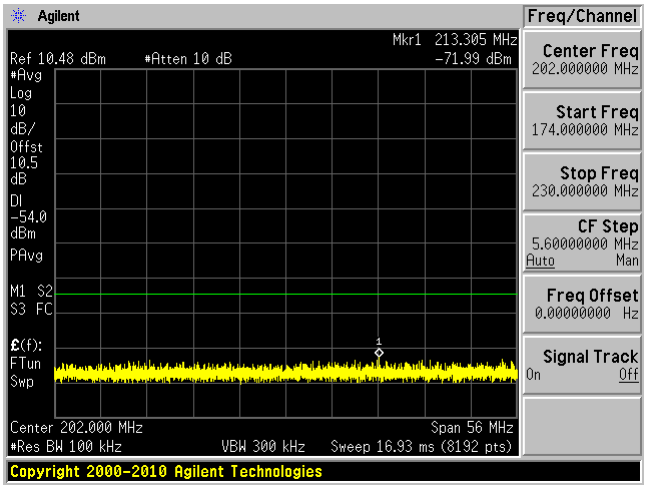
87.5MHz to 118MHz



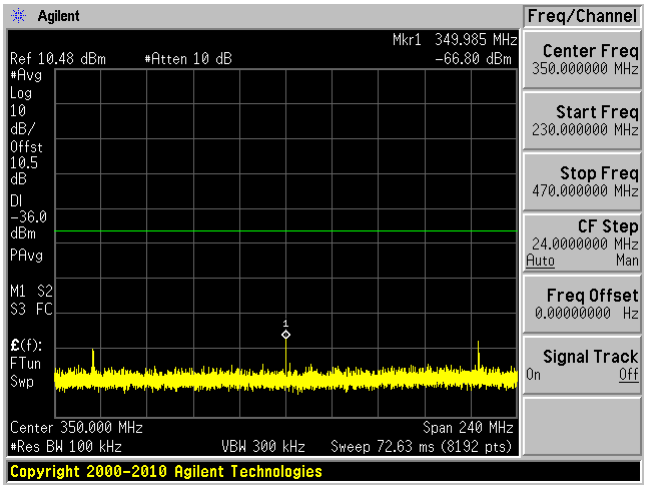
118MHz to 174MHz



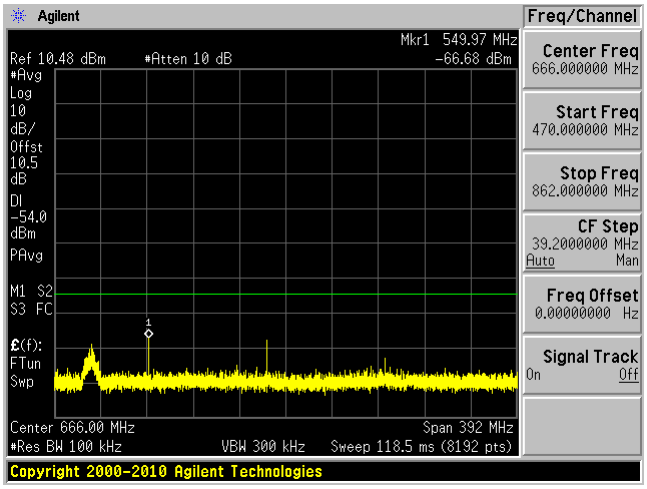
174MHz to 230MHz



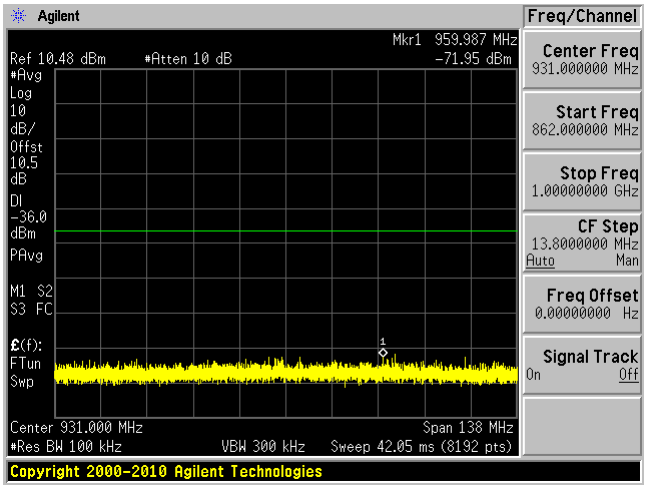
230MHz to 470MHz



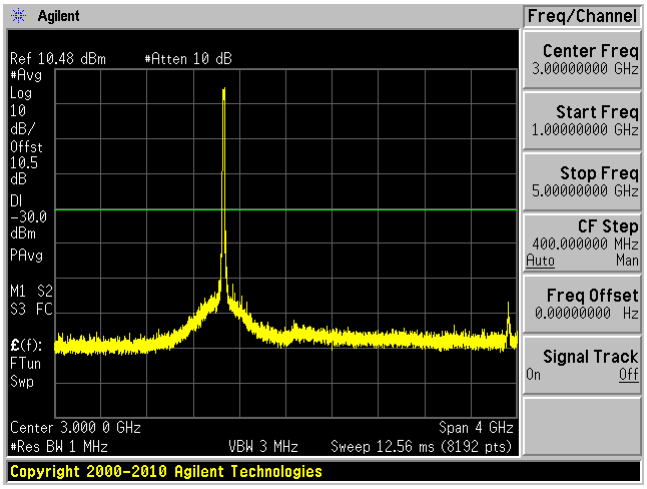
470MHz to 862MHz



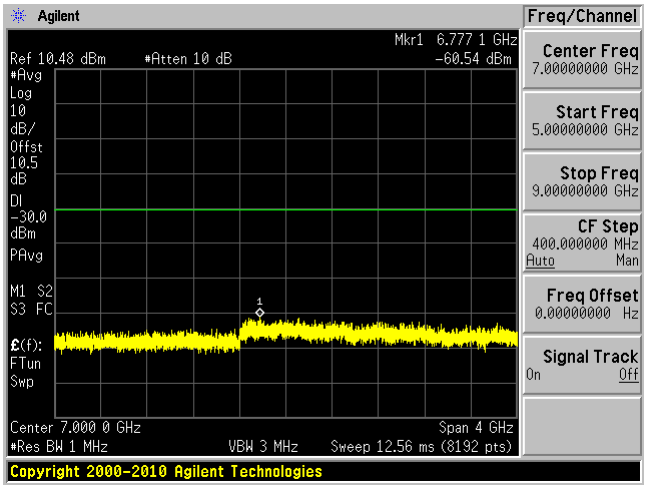
862MHz to 1GHz



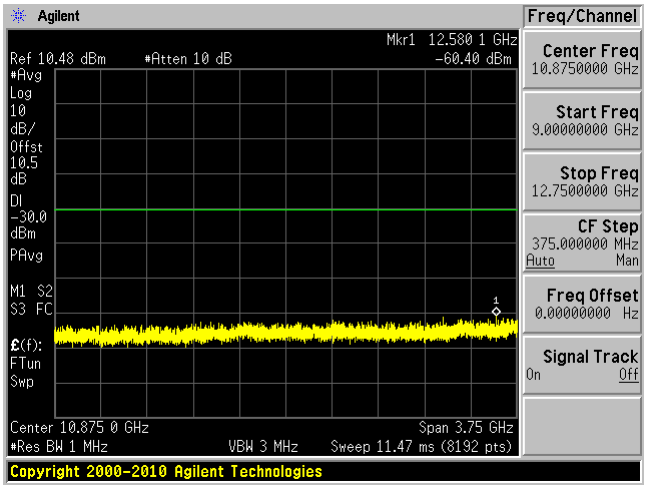
1GHz to 5GHz



5GHz to 9GHz

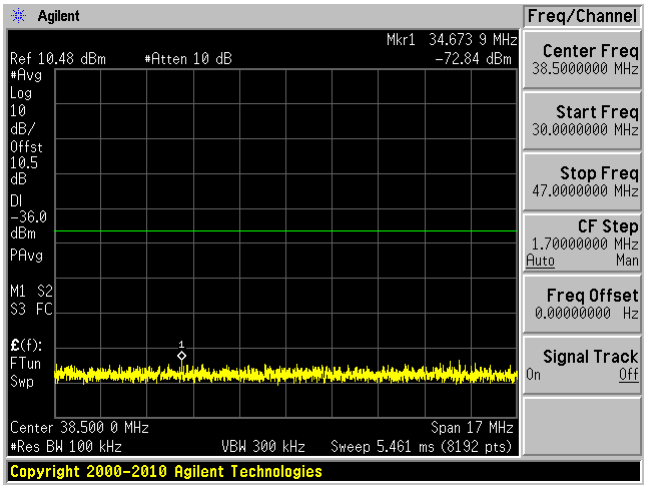


9GHz to 12.75GHz

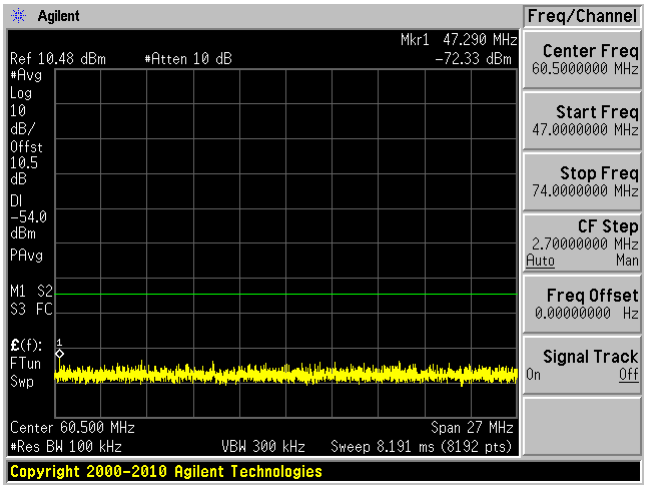


802.11n20 mode, Low Channel

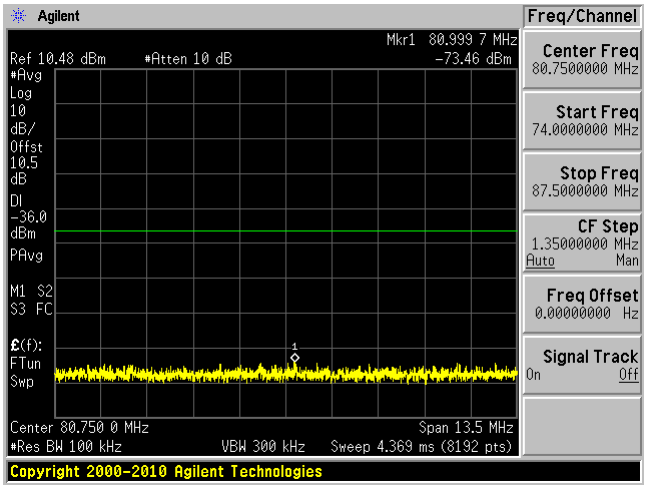
30MHz to 47MHz



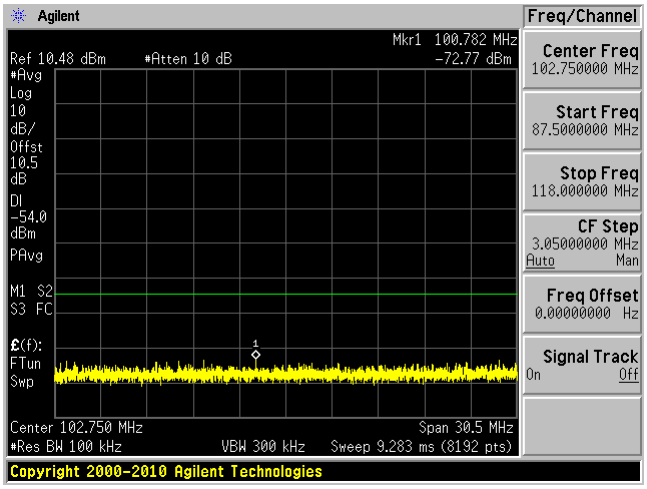
47MHz to 74MHz



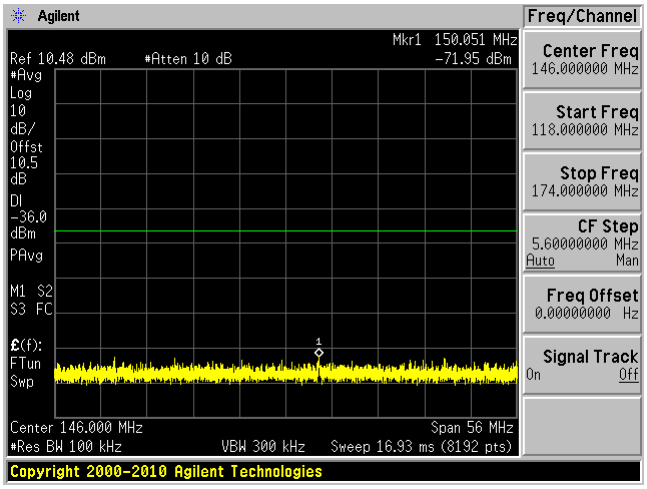
74MHz to 87.5MHz



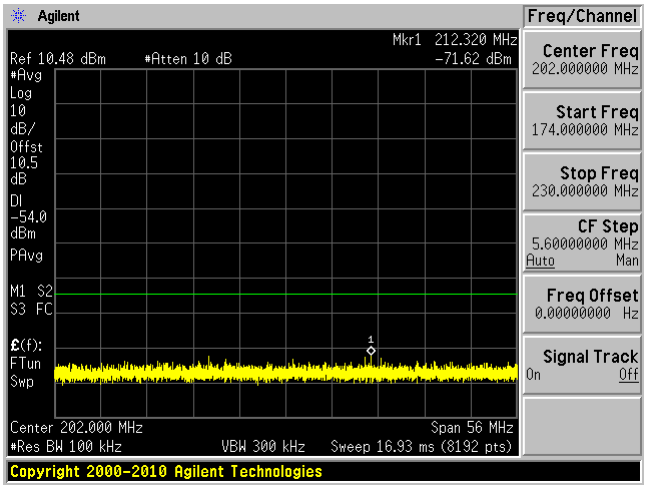
87.5MHz to 118MHz



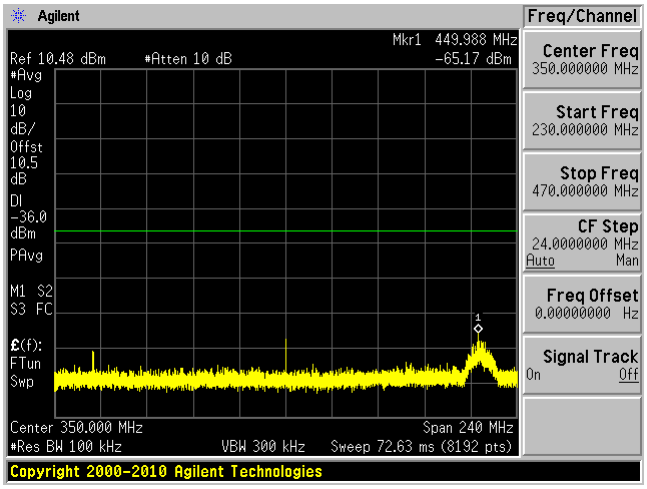
118MHz to 174MHz



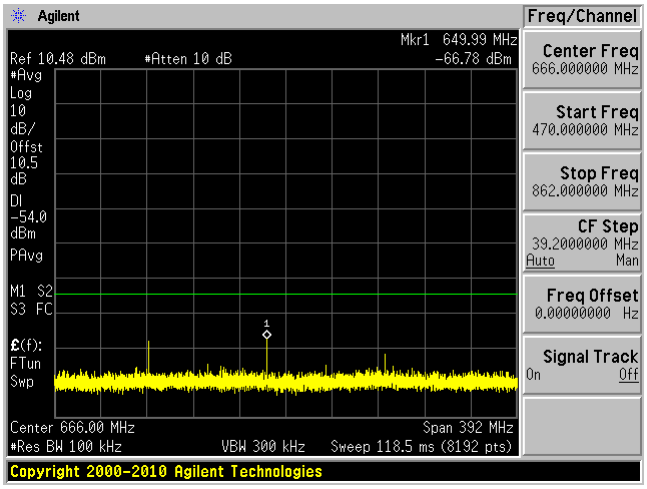
174MHz to 230MHz



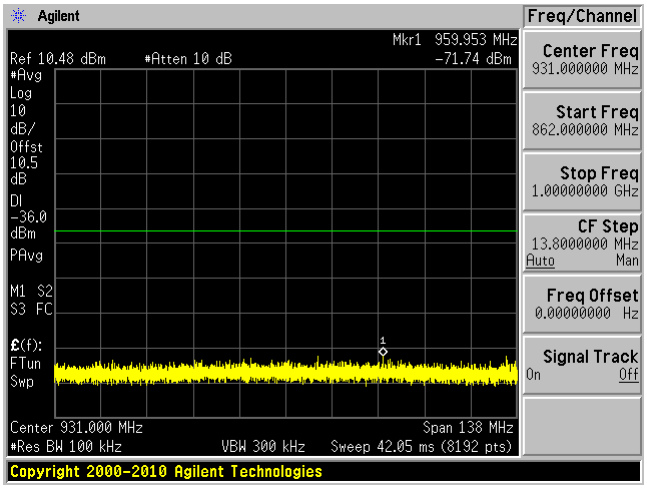
230MHz to 470MHz



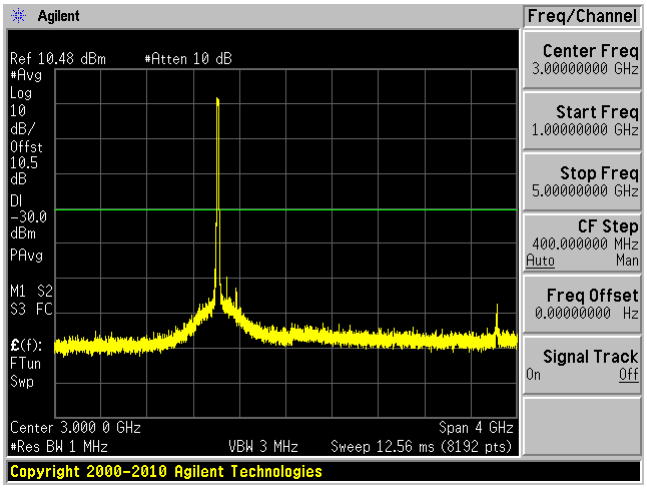
470MHz to 862MHz



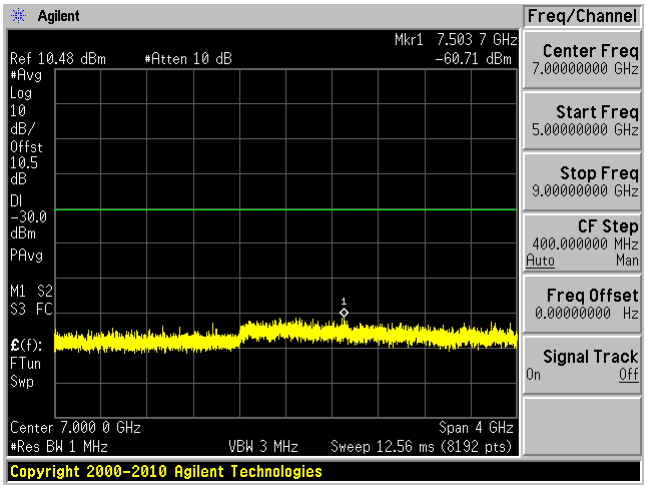
862MHz to 1GHz



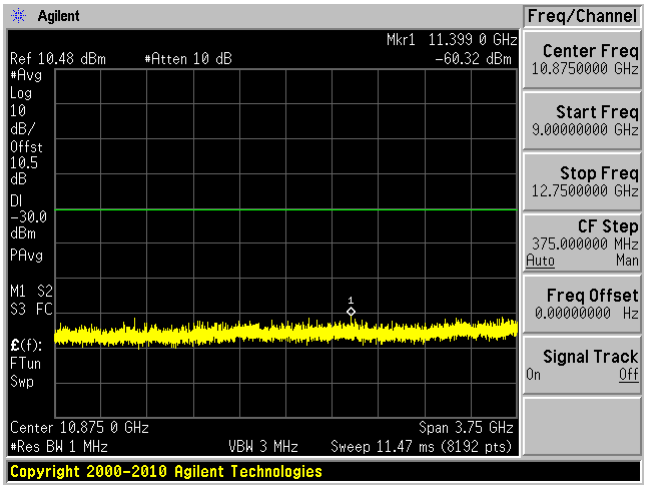
1GHz to 5GHz



5GHz to 9GHz

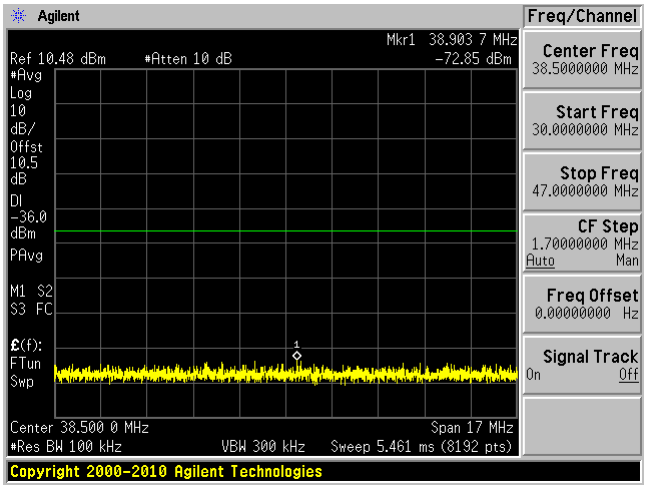


9GHz to 12.75GHz

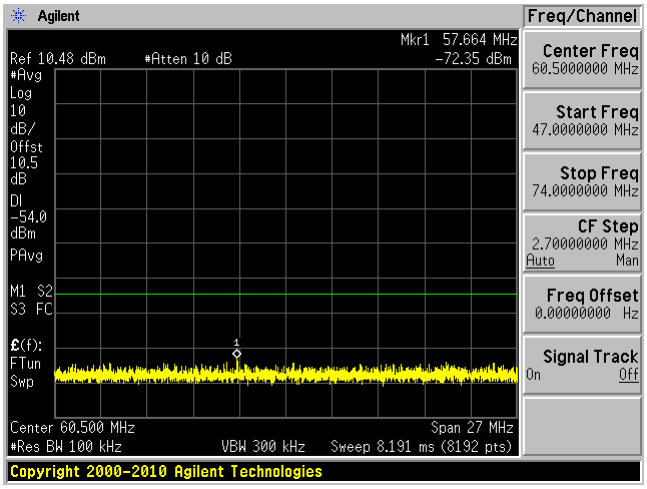


802.11n20 mode, High Channel

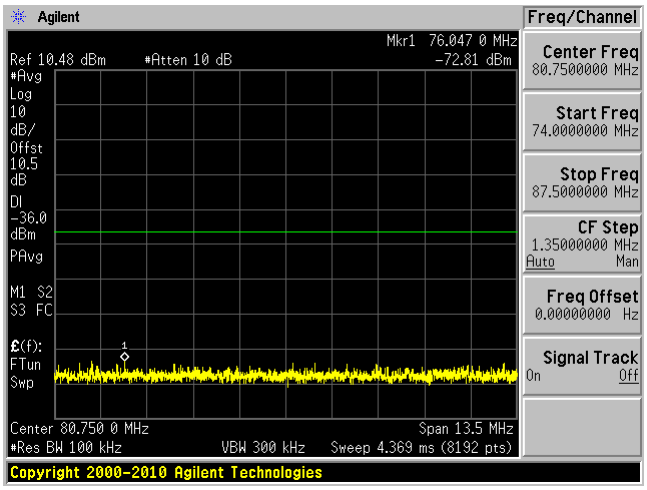
30MHz to 47MHz



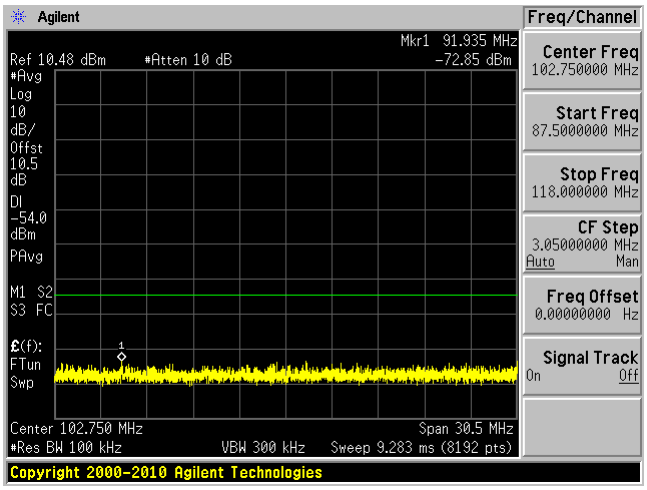
47MHz to 74MHz



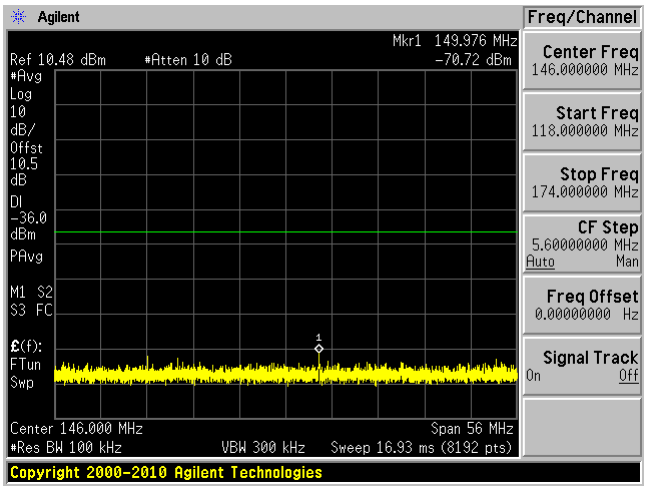
74MHz to 87.5MHz



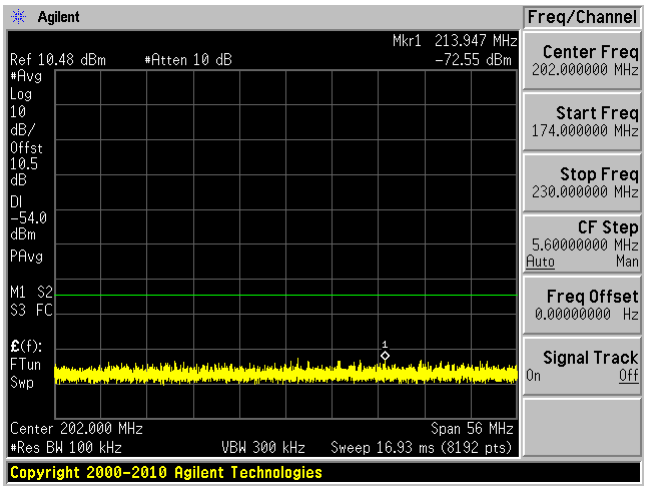
87.5MHz to 118MHz



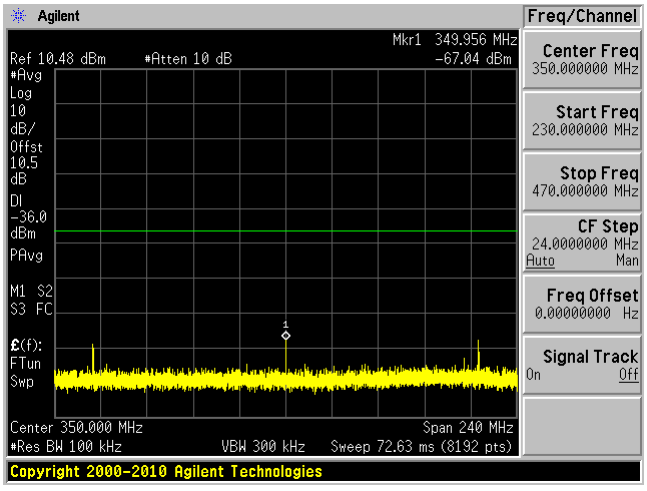
118MHz to 174MHz



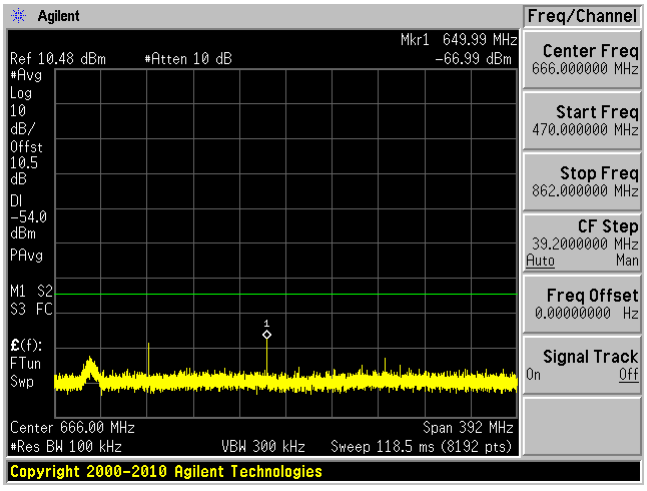
174MHz to 230MHz



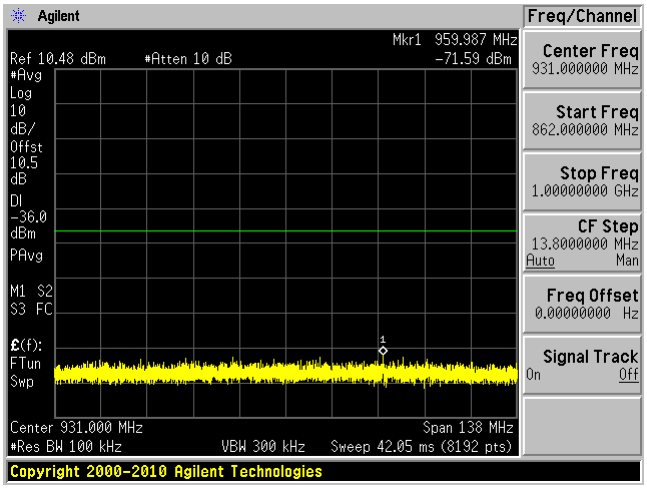
230MHz to 470MHz



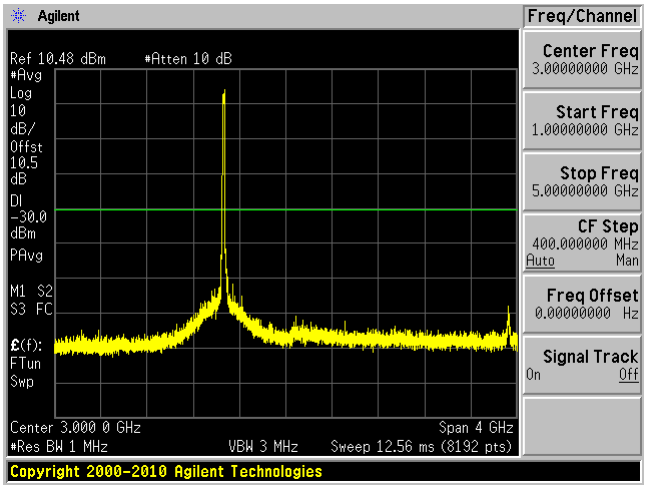
470MHz to 862MHz



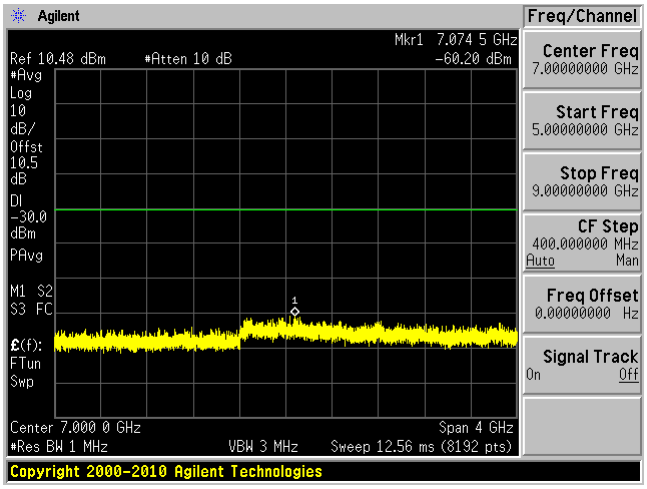
862MHz to 1GHz



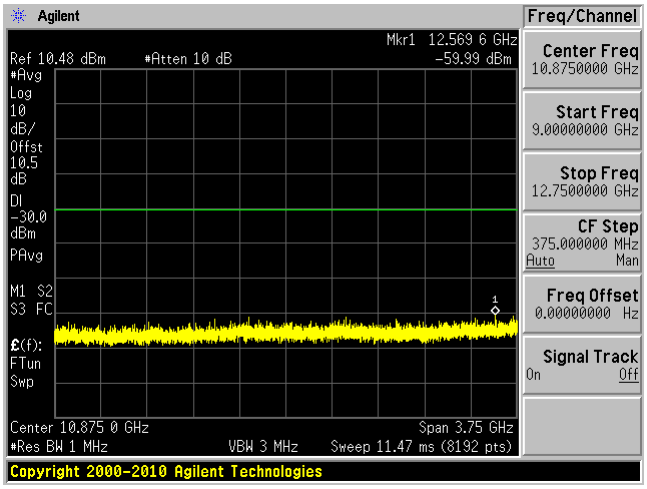
1GHz to 5GHz



5GHz to 9GHz

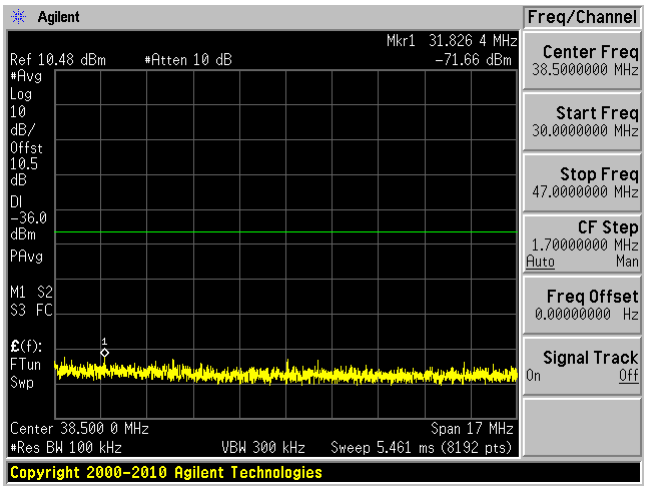


9GHz to 12.75GHz

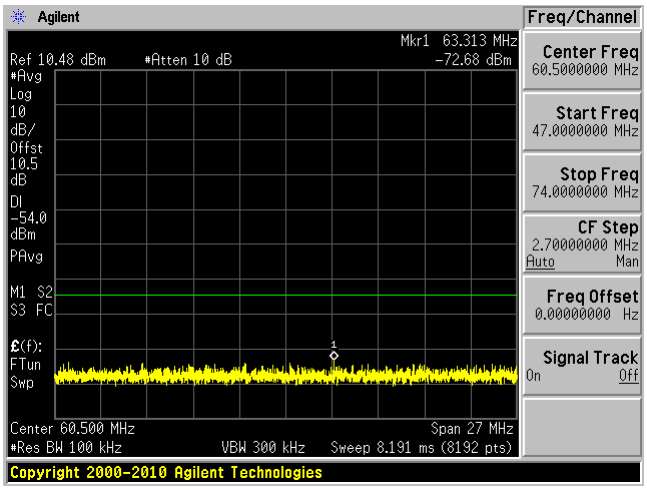


802.11n40 mode, Low Channel

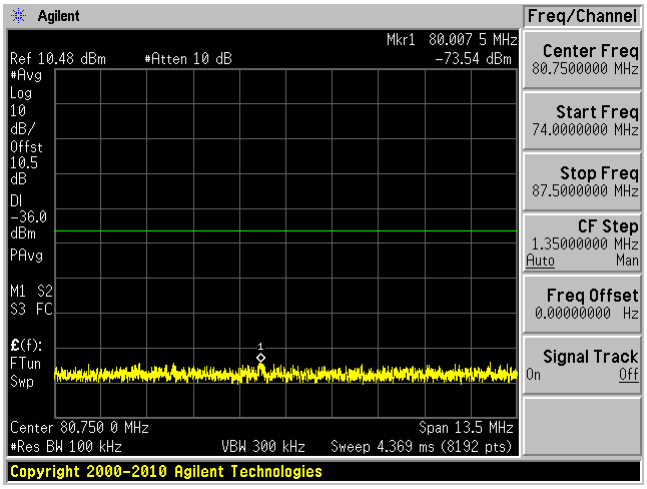
30MHz to 47MHz



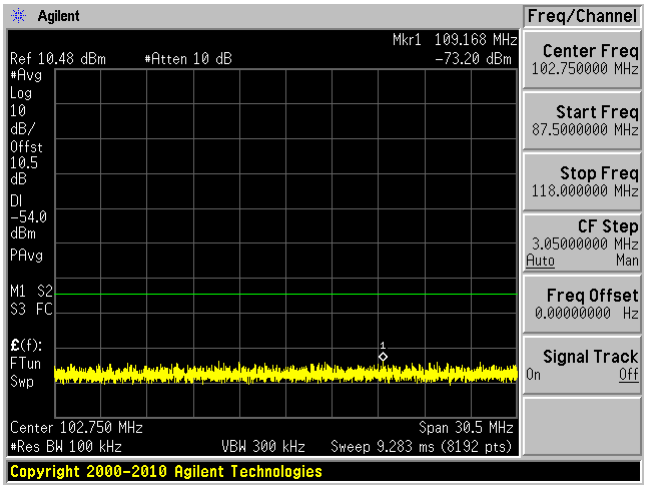
47MHz to 74MHz



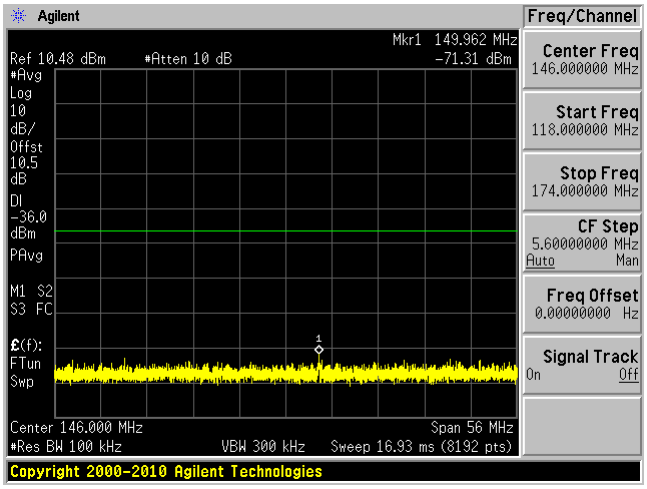
74MHz to 87.5MHz



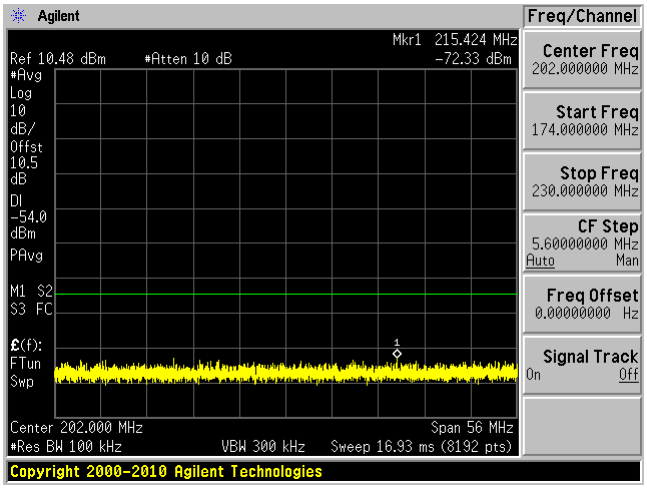
87.5MHz to 118MHz



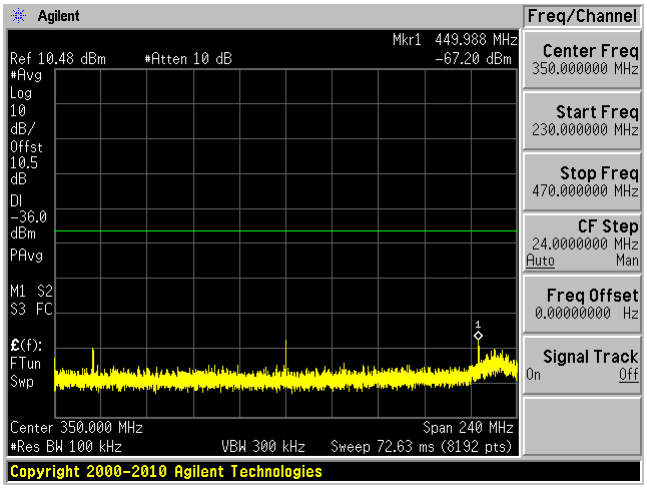
118MHz to 174MHz



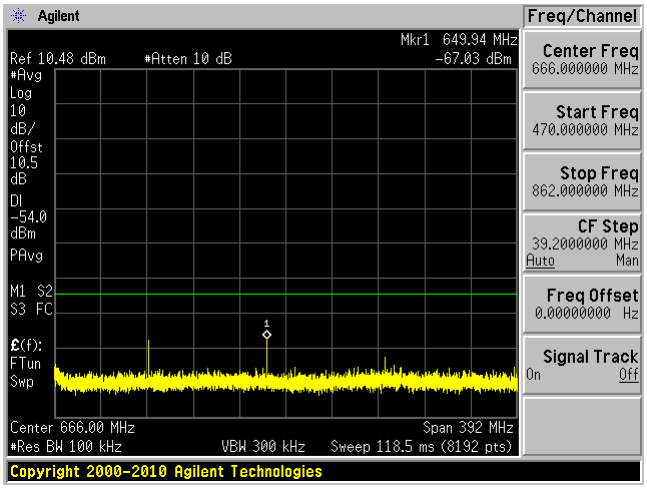
174MHz to 230MHz



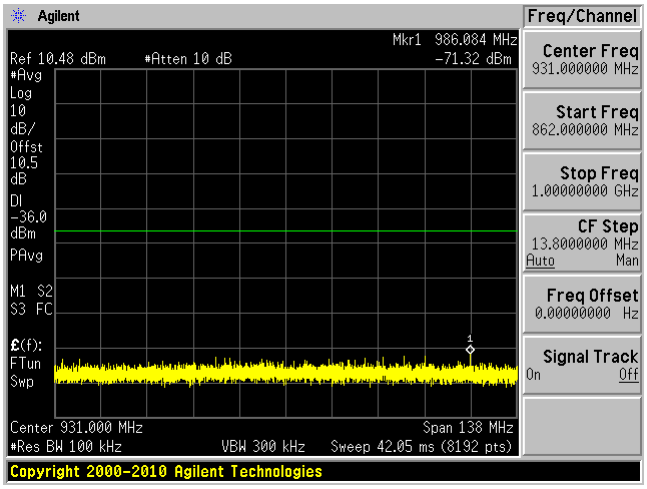
230MHz to 470MHz



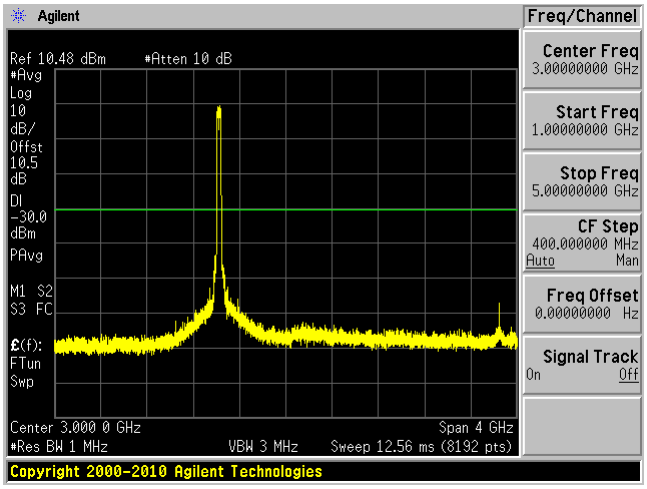
470MHz to 862MHz



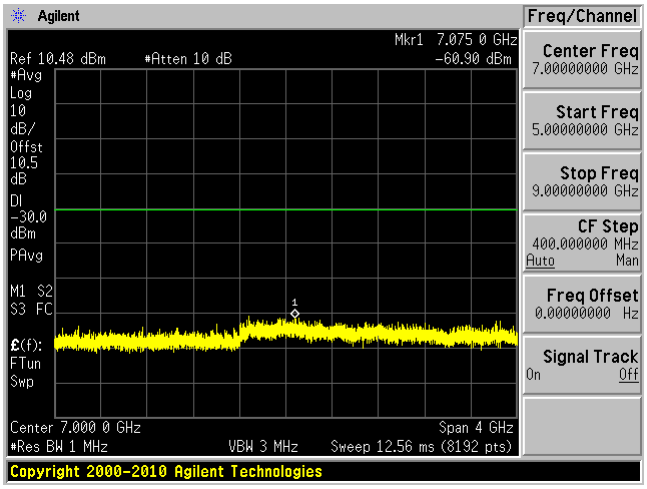
862MHz to 1GHz



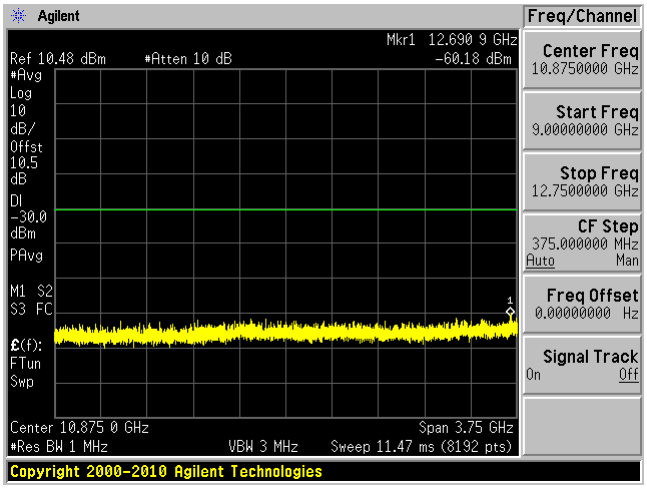
1GHz to 5GHz



5GHz to 9GHz

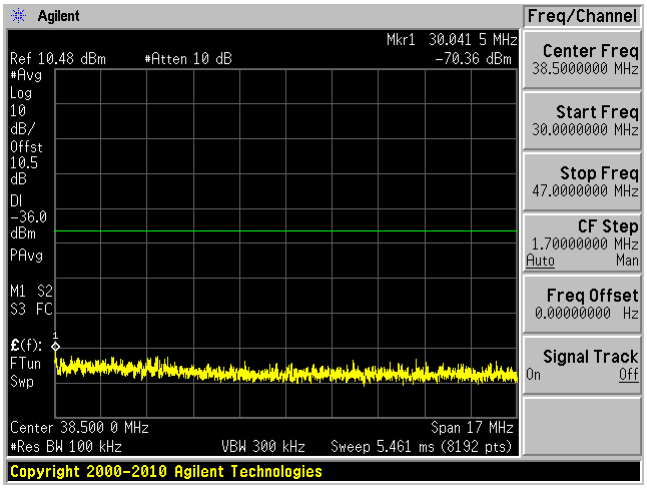


9GHz to 12.75GHz

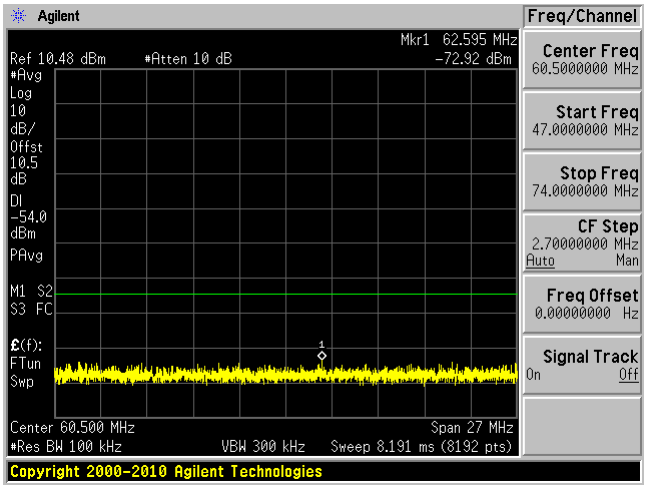


802.1n40 mode, High Channel

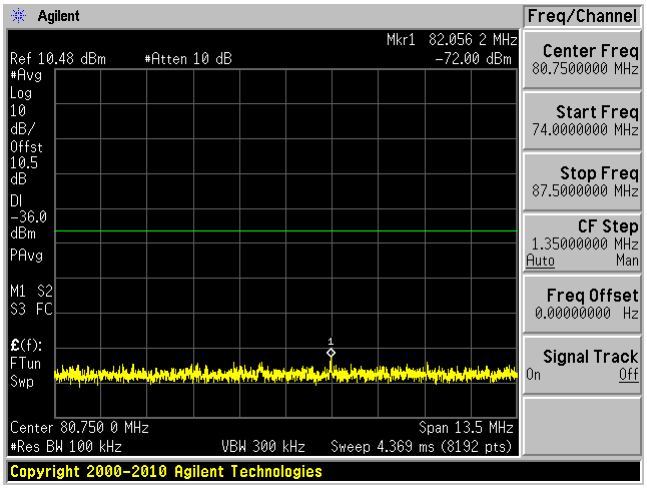
30MHz to 47MHz



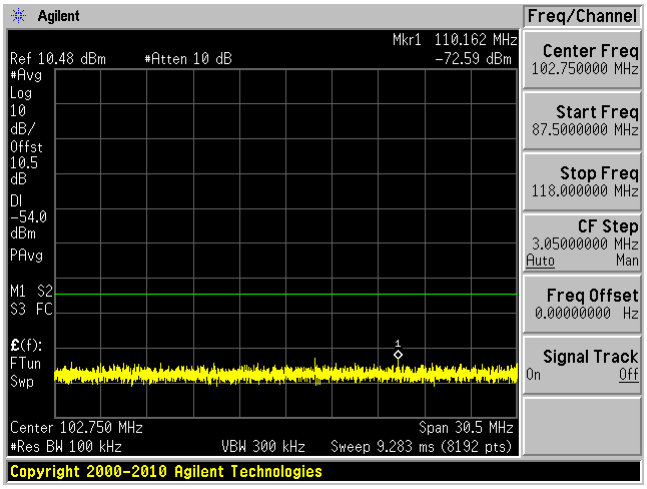
47MHz to 74MHz



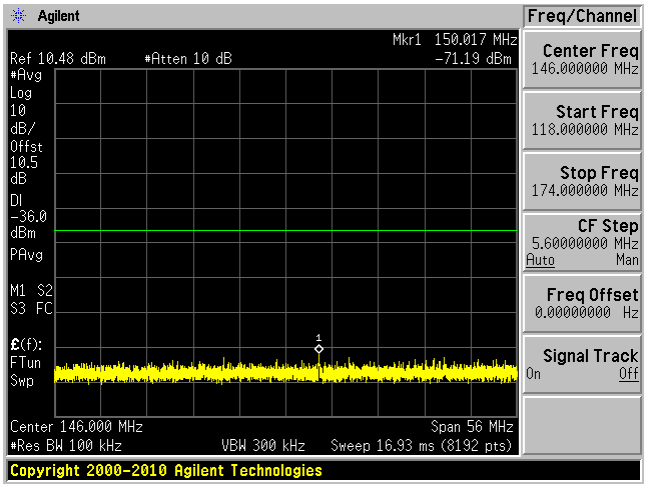
74MHz to 87.5MHz



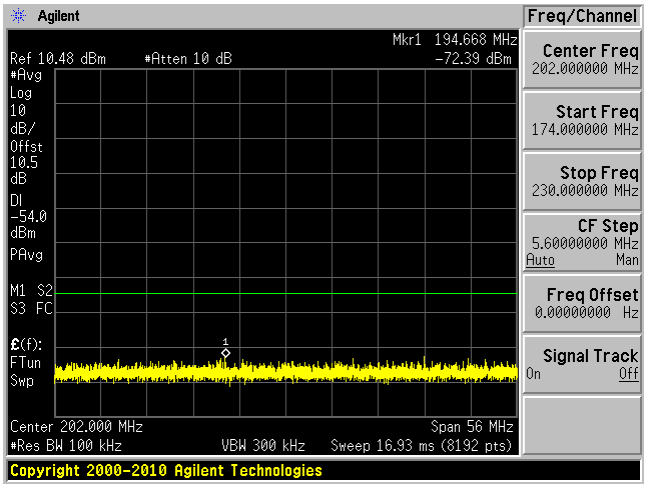
87.5MHz to 118MHz



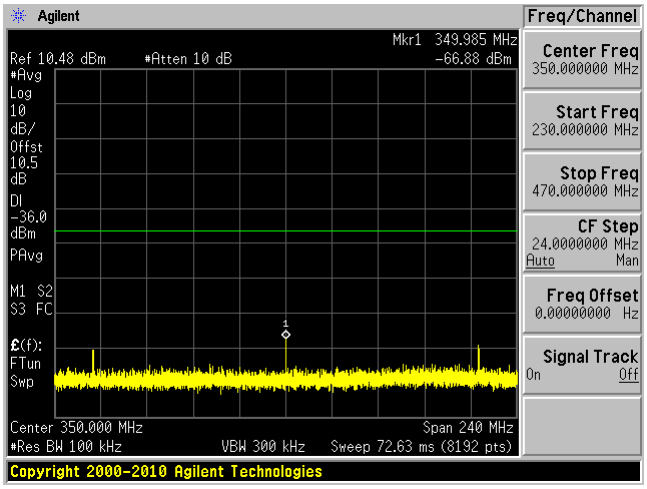
118MHz to 174MHz



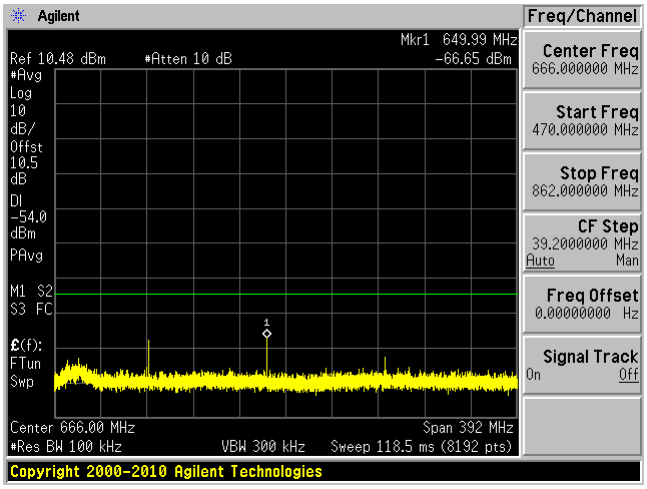
174MHz to 230MHz



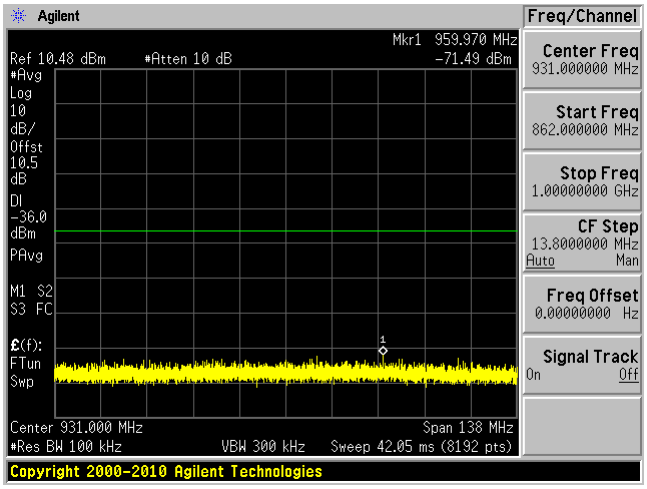
230MHz to 470MHz



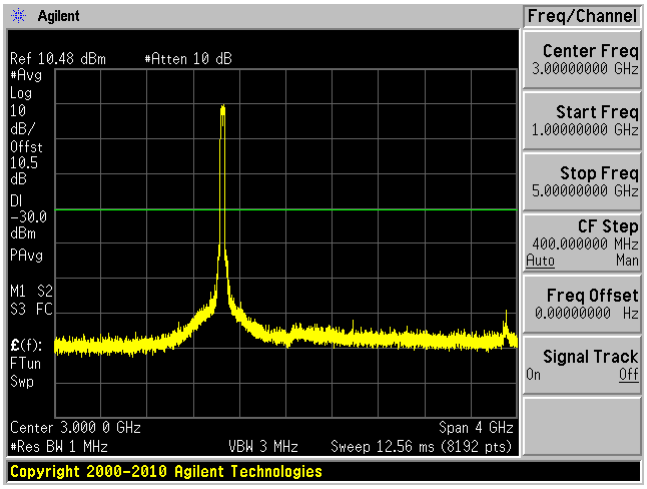
470MHz to 862MHz



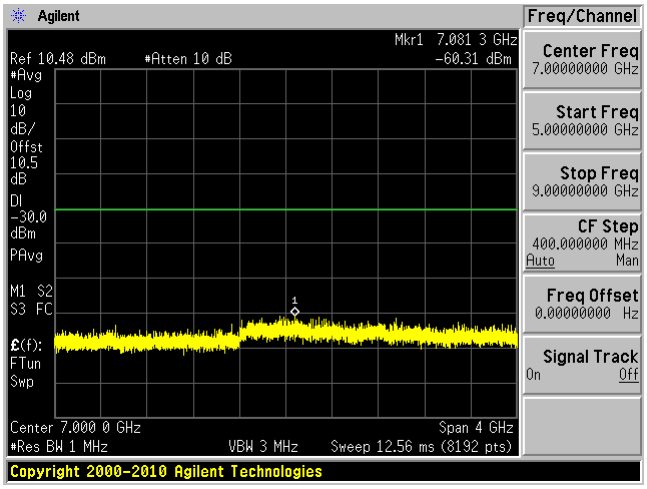
862MHz to 1GHz



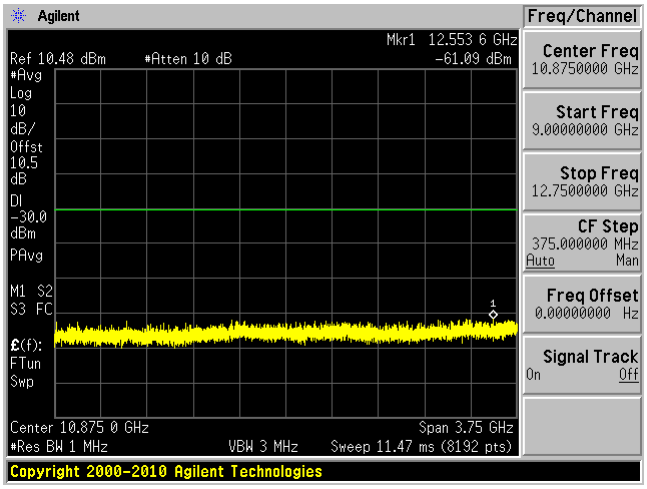
1GHz to 5GHz



5GHz to 9GHz

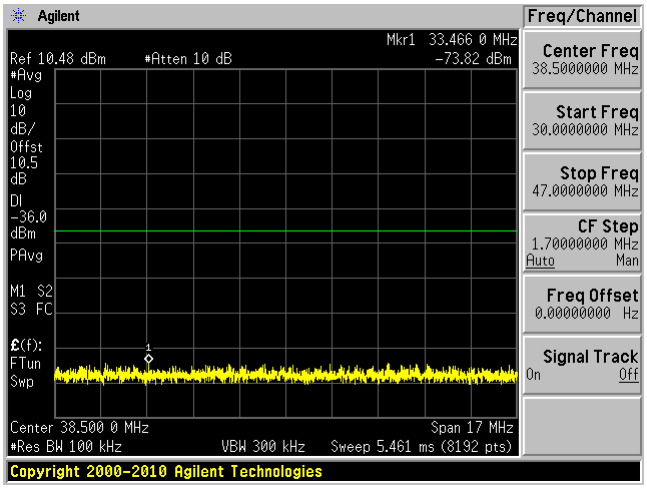


9GHz to 12.75GHz

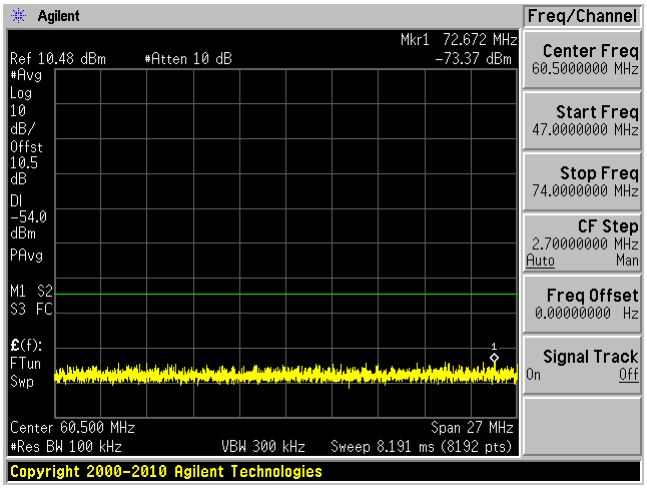


BLE, Low Channel

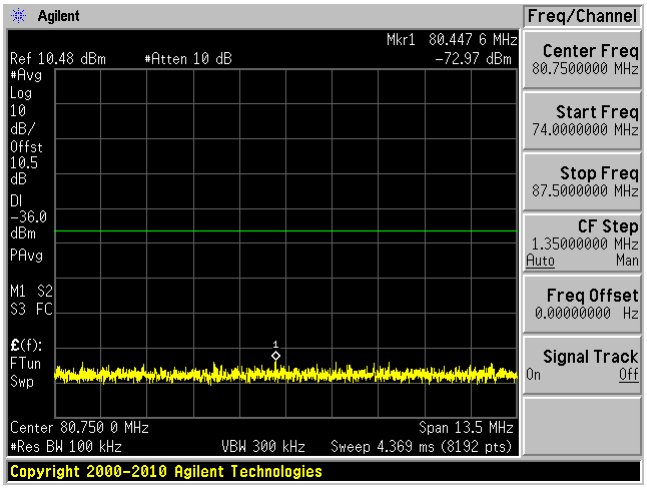
30MHz to 47MHz



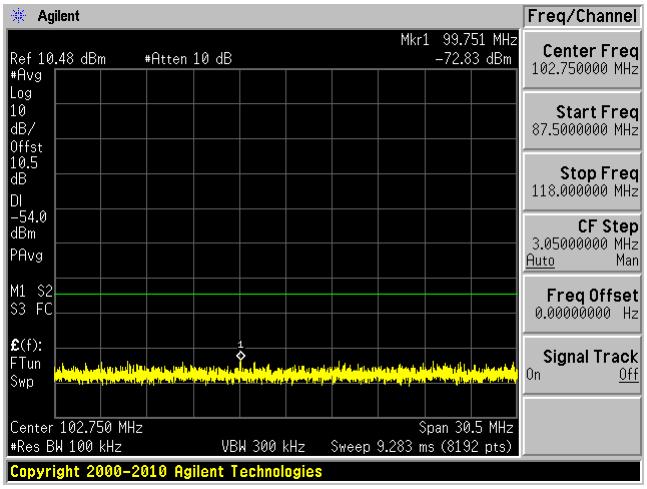
47MHz to 74MHz



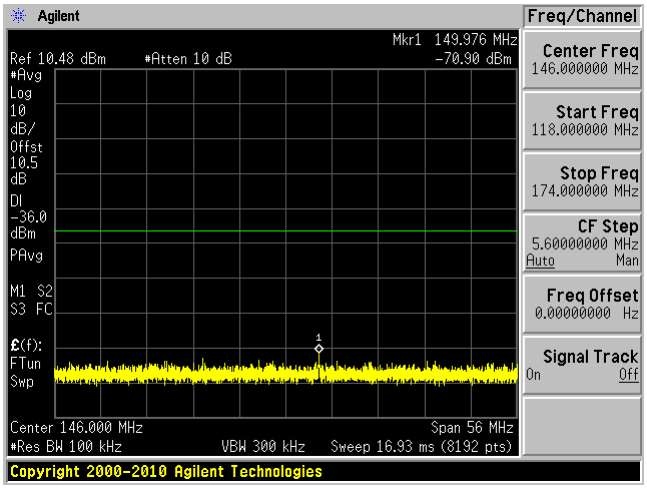
74MHz to 87.5MHz



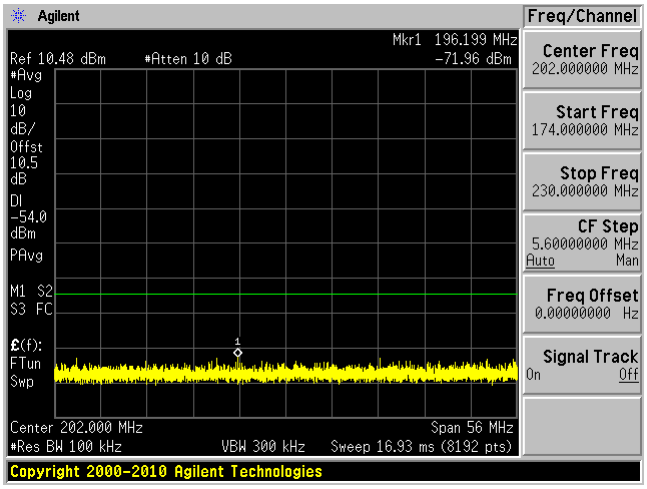
87.5MHz to 118MHz



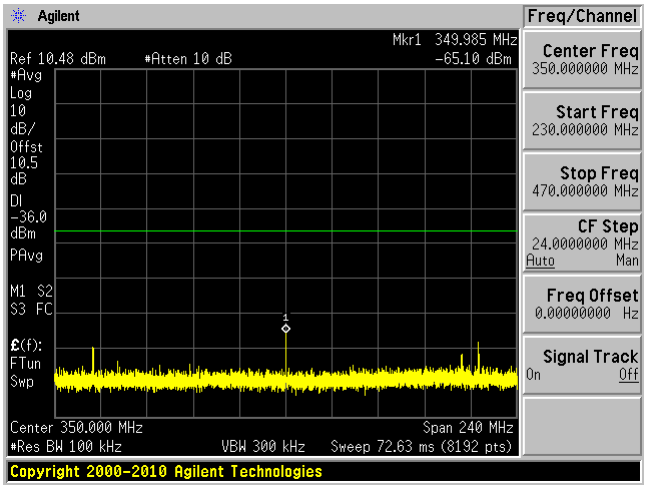
118MHz to 174MHz



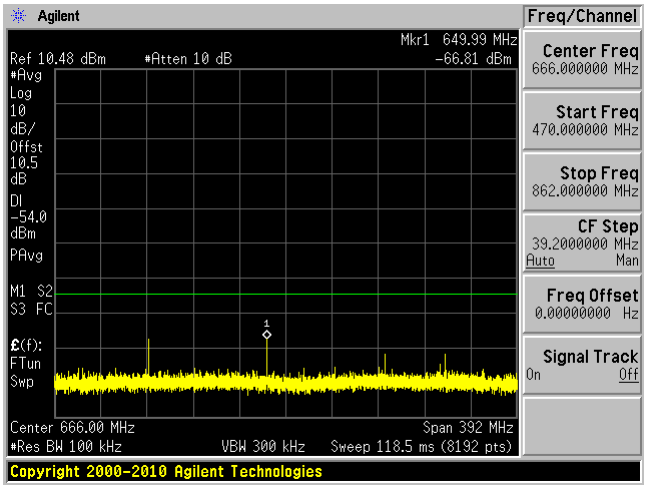
174MHz to 230MHz



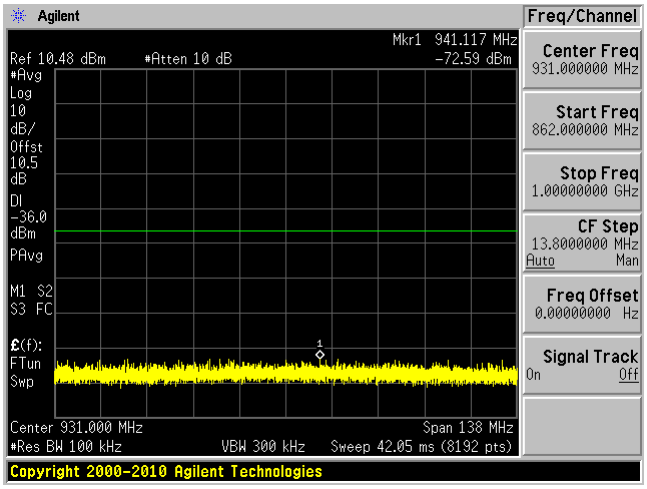
230MHz to 470MHz



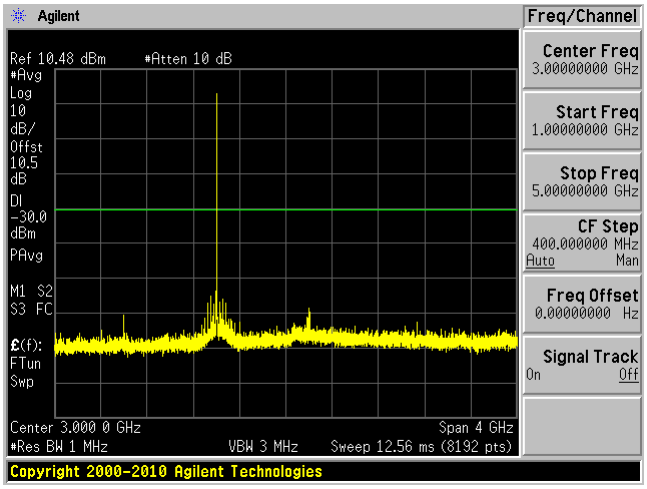
470MHz to 862MHz



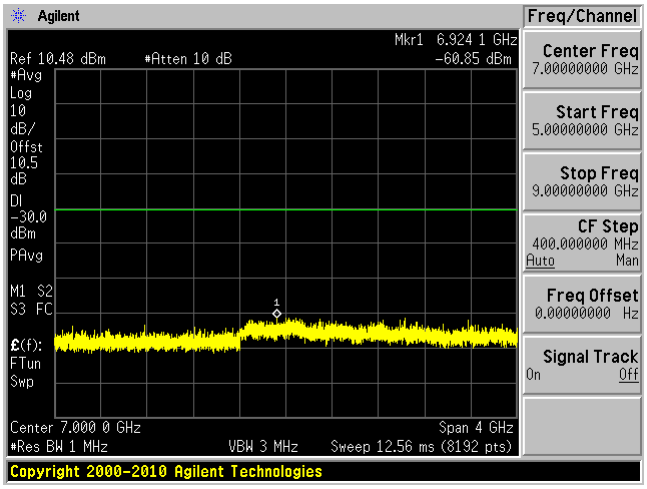
862MHz to 1GHz



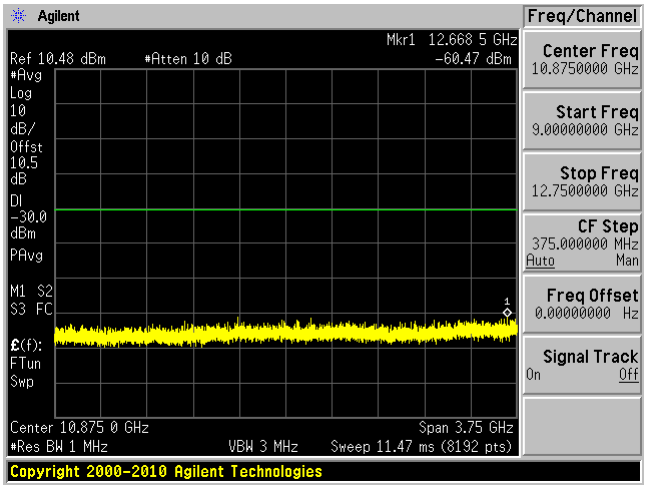
1GHz to 5GHz



5GHz to 9GHz

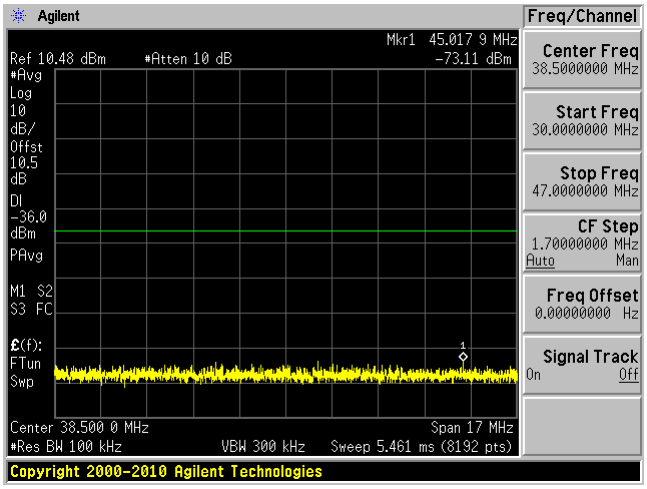


9GHz to 12.75GHz

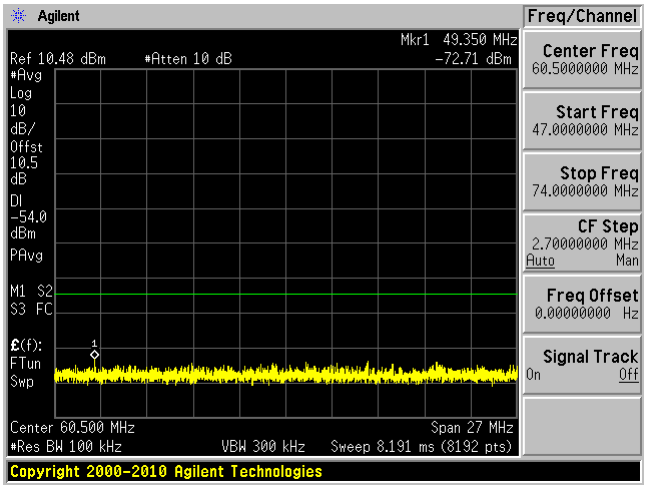


BLE, High Channel

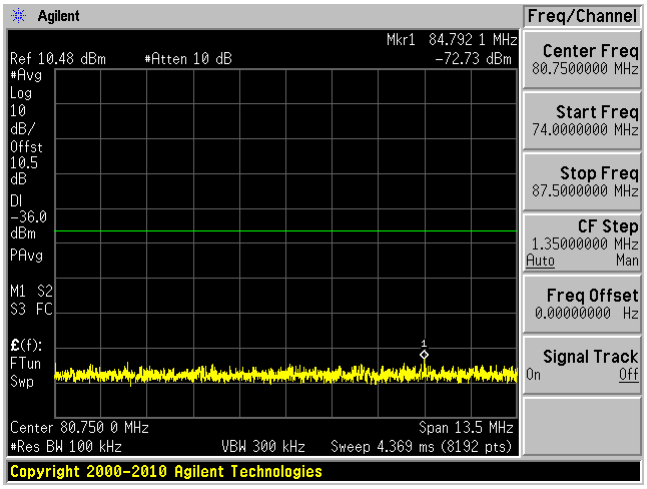
30MHz to 47MHz



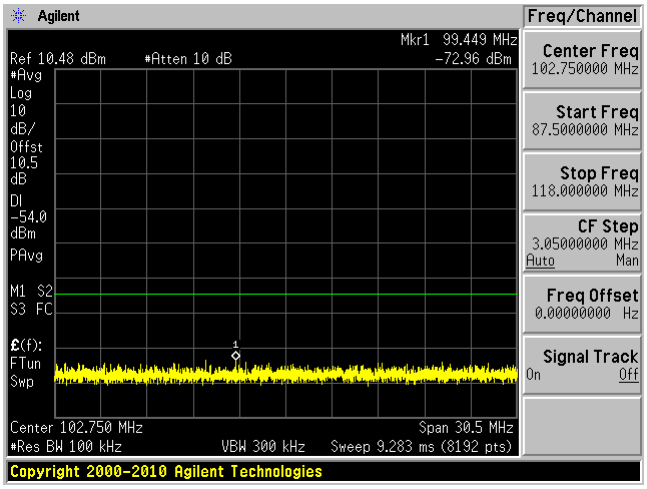
47MHz to 74MHz



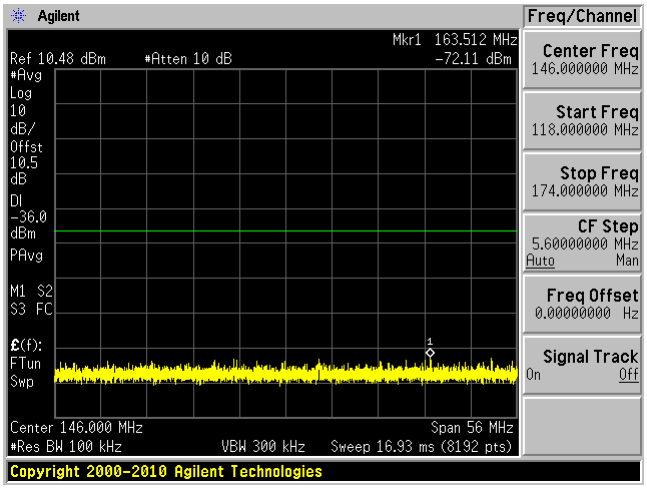
74MHz to 87.5MHz



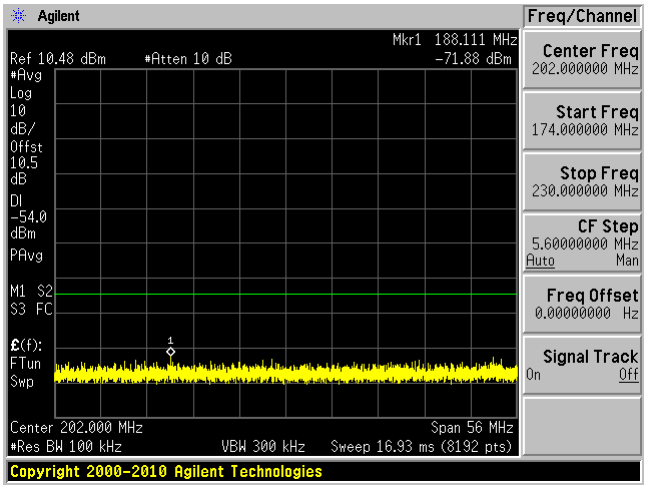
87.5MHz to 118MHz



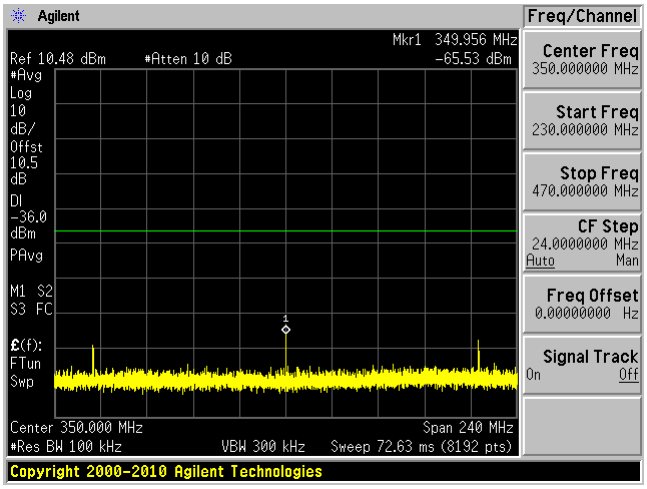
118MHz to 174MHz



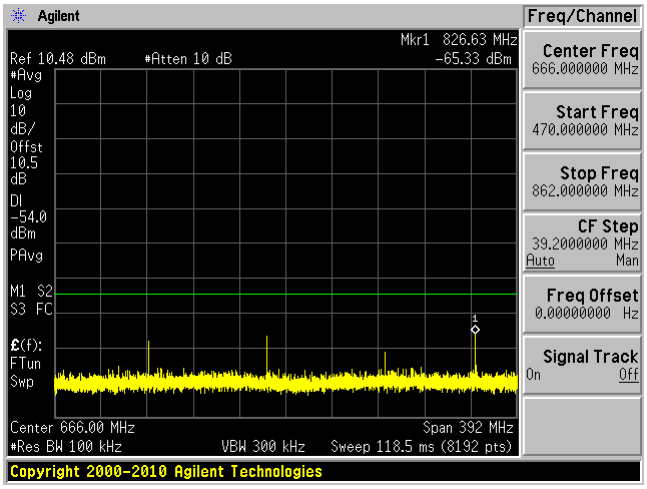
174MHz to 230MHz



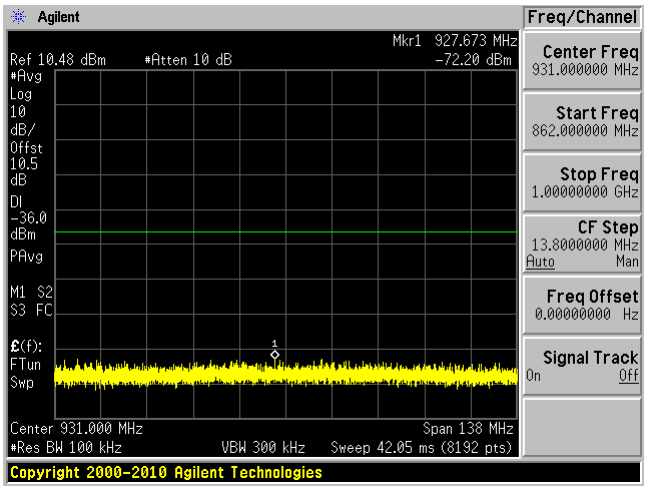
230MHz to 470MHz



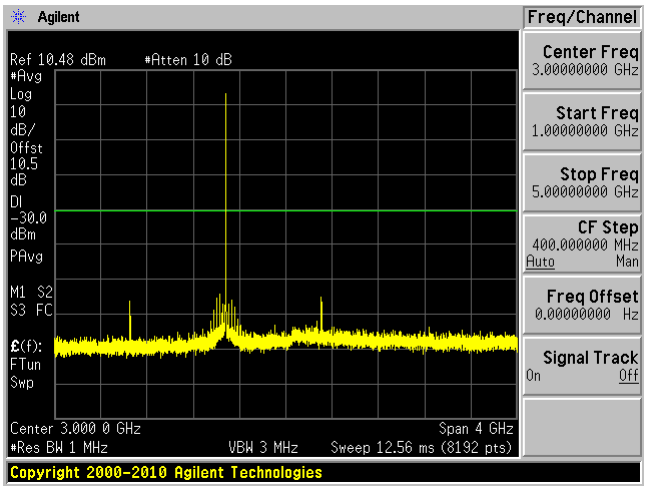
470MHz to 862MHz



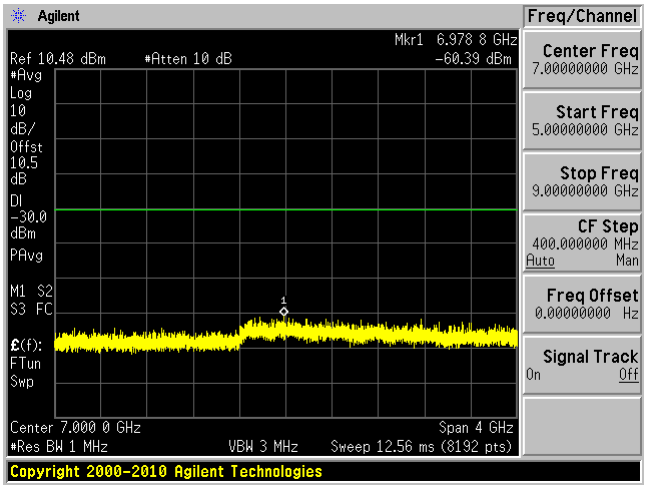
862MHz to 1GHz



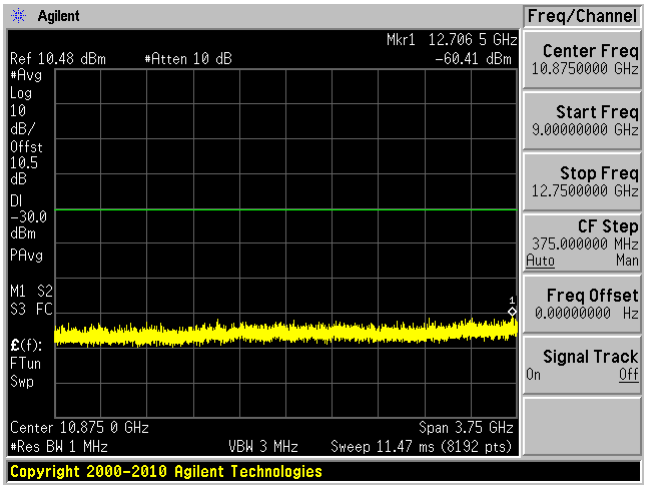
1GHz to 5GHz



5GHz to 9GHz



9GHz to 12.75GHz



9 EN 300 328 § 4.3.2.10 Receiver spurious emissions

9.1 Applicable Standard

According to EN 300 328 V1.9.1, spurious emissions of the receiver shall not exceed the values in following table:

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
Above 1 GHz to 12.75 GHz	- 47 dBm

9.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in 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.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

9.3 EUT Setup

The radiated emissions tests were performed in a shield room, using the setup accordance with the EN 300 328 V1.9.1. The specification used was the EN 300 328 V1.9.1 limits.

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

9.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBµV means the emissions are 7dBµV below the maximum limit for EN 300 328 V1.9.1. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Standard Limit

9.5 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	46 %
ATM Pressure:	102kPa

Testing was performed by Jin Yang on 2015-10-23 on RF site.
The radiated testing was performed by Jin Yang on 2015-10-29 at 5 meter chamber #3.

9.6 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2015-07-11	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2015-03-20	1 year
HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A0113	2015-03-11	1year
Sunol	Horn antenna	DRH-118	A052704	2015-03-09	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
HP	Signal Generator	83650B	18485-91	2015-08-19	1 year
COM-POWER	Antenna, Dipole	AD-100	721033DB1,721033DB2,721033DB3,721033DB4,	2014-11-03	2 year

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

9.7 Measurement Procedure

For the radiated emissions test, the EUT and all support equipment power cords were connected to the AC floor outlet since the power supply used in the EUT did not provide an accessory power outlet.

Maximization procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "**QP**" in the data table.

9.8 Summary of Test Results

According to the recorded data, the EUT complied with the EN 300 328 V1.9.1 standards' limits and had the worst margin of:

-1.247 dB at 4545 **MHz** in the Vertical polarization

Please refer to the following table and plots for detailed test results

Radiated spurious emission:

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
802.11 20MHz Bandwidth Low Channel											
4545	43.29	0	100	H	4545	-58.97	11.007	1.24	-49.203	-47	-2.203
4545	43.72	0	100	V	4545	-58.15	11.103	1.24	-48.287	-47	-1.287
550	36.86	242	100	H	550	-58.61	0	0.5	-59.11	-57	-2.11
550	36.51	124	105	V	550	-58.28	0	0.5	-58.78	-57	-1.78
650	30.17	252	113	H	650	-63.47	0	0.58	-64.05	-57	-7.05
650	28.06	106	121	V	650	-64.76	0	0.58	-65.34	-57	-8.34
350	32.08	238	123	H	350	-67.13	0	0.4	-67.53	-57	-10.53
350	30.67	145	100	V	350	-68.01	0	0.4	-68.41	-57	-11.41
802.11 20MHz Bandwidth High Channel											
4500	43.85	0	100	H	4500	-58.91	11.007	1.24	-49.143	-47	-2.143
4500	43.52	0	100	V	4500	-58.35	11.103	1.24	-48.487	-47	-1.487
550	36.83	112	130	H	550	-58.64	0	0.5	-59.14	-57	-2.14
550	35.74	88	100	V	550	-59.05	0	0.5	-59.55	-57	-2.55
650	28.6	241	100	H	650	-65.04	0	0.58	-65.62	-57	-8.62
650	28.31	97	100	V	650	-64.51	0	0.58	-65.09	-57	-8.09
350	31.74	156	100	H	350	-67.47	0	0.4	-67.87	-57	-10.87
350	29.86	138	110	V	350	-68.82	0	0.4	-69.22	-57	-12.22

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
802.11 40MHz Bandwidth Low Channel											
4420	43.88	0	100	H	4420	-58.29	10.954	1.21	-48.546	-47	-1.546
4420	43.8	0	100	V	4420	-58.16	10.965	1.21	-48.405	-47	-1.405
550	36.95	239	112	H	550	-58.52	0	0.5	-59.02	-57	-2.02
550	36.71	136	100	V	550	-58.08	0	0.5	-58.58	-57	-1.58
650	30.81	248	108	H	650	-62.83	0	0.58	-63.41	-57	-6.41
650	28.51	149	100	V	650	-64.31	0	0.58	-64.89	-57	-7.89
350	31.03	283	122	H	350	-68.18	0	0.4	-68.58	-57	-11.58
350	30.12	146	107	V	350	-68.56	0	0.4	-68.96	-57	-11.96
802.11 40MHz Bandwidth High Channel											
4545	43.96	0	100	H	4545	-58.3	11.007	1.24	-48.533	-47	-1.533
4545	43.76	0	100	V	4545	-58.11	11.103	1.24	-48.247	-47	**-1.247**
550	36.87	240	100	H	550	-58.6	0	0.5	-59.1	-57	-2.1
550	36.12	145	111	V	550	-58.67	0	0.5	-59.17	-57	-2.17
650	29.66	248	100	H	650	-63.98	0	0.58	-64.56	-57	-7.56
650	28.74	149	121	V	650	-64.08	0	0.58	-64.66	-57	-7.66
350	31.49	256	112	H	350	-67.72	0	0.4	-68.12	-57	-11.12
350	30.58	168	100	V	350	-68.1	0	0.4	-68.5	-57	-11.5

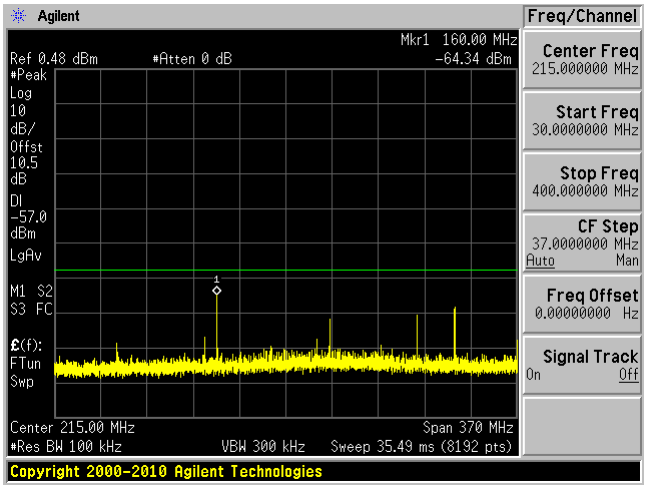
Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
BLE Low Channel											
3200	43.21	0	100	H	3200	-60.96	9.585	1.01	-52.385	-47	-5.385
3200	43.66	0	100	V	3200	-60.02	9.666	1.01	-51.364	-47	-4.364
550	37.02	241	102	H	550	-58.45	0	0.5	-58.95	-57	-1.95
550	36.81	129	100	V	550	-57.98	0	0.5	-58.48	-57	-1.48
650	28.35	238	100	H	650	-65.29	0	0.58	-65.87	-57	-8.87
650	28.81	146	113	V	650	-64.01	0	0.58	-64.59	-57	-7.59
350	29.87	233	100	H	350	-69.34	0	0.4	-69.74	-57	-12.74
350	30.76	138	105	V	350	-67.92	0	0.4	-68.32	-57	-11.32
BLE High Channel											
3304	43.71	0	100	H	3304	-60.5	9.617	1.03	-51.913	-47	-4.913
3304	43.66	0	100	V	3304	-59.93	9.61	1.03	-51.35	-47	-4.35
550	36.57	247	100	H	550	-58.90	0	0.5	-59.40	-57	-2.40
550	36.36	135	111	V	550	-58.43	0	0.5	-58.93	-57	-1.93
650	28.39	242	100	H	650	-65.25	0	0.58	-65.83	-57	-8.83
650	28.47	152	121	V	650	-64.35	0	0.58	-64.93	-57	-7.93
350	30.23	237	112	H	350	-68.98	0	0.4	-69.38	-57	-12.38
350	30.37	142	100	V	350	-68.31	0	0.4	-68.71	-57	-11.71

Conducted Receiver Spurious Emission:

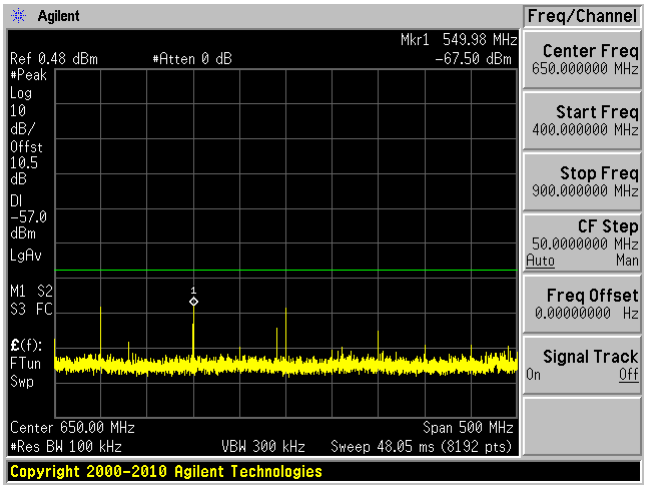
Note: all the emissions have more than 2.5 dB margin from the limits, so after adding the peak antenna gain 2.5dBi, all the emissions can still pass.

802.11 20MHz: Low Channel

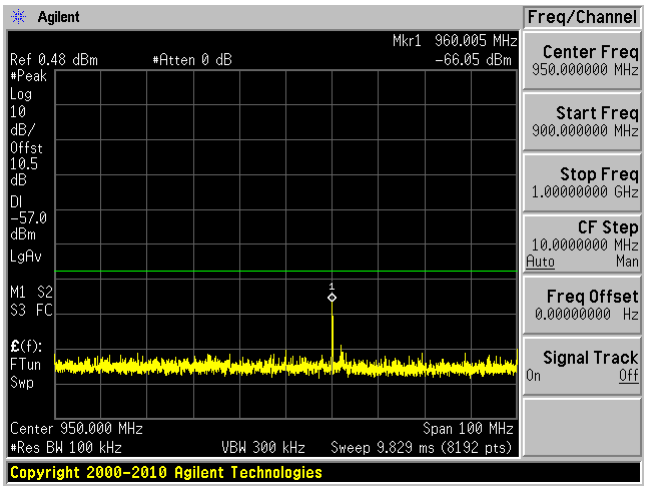
30 MHz to 400 MHz



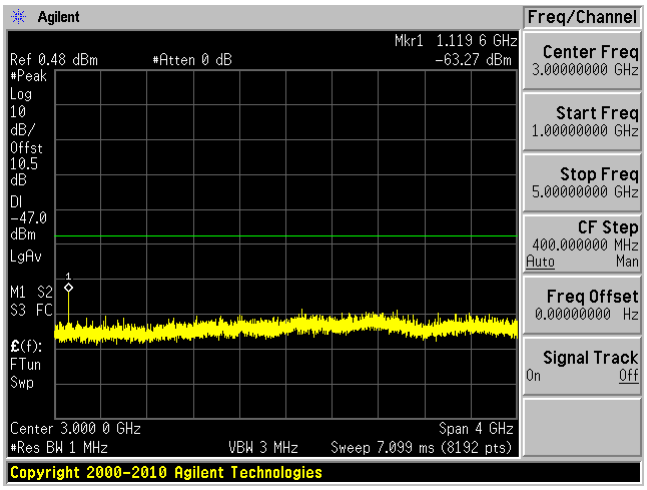
400 MHz to 900 MHz



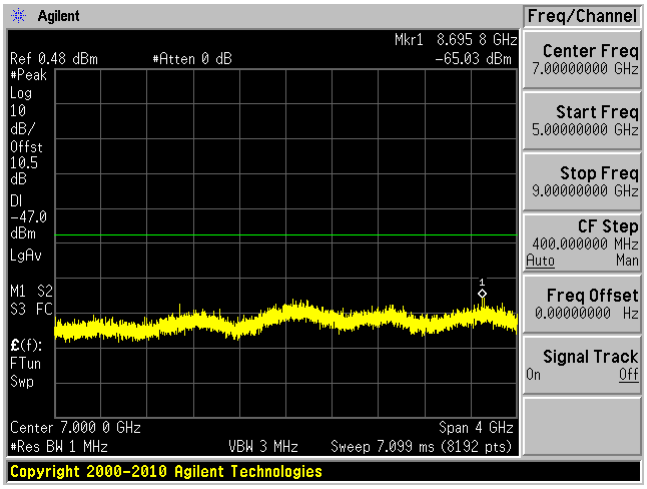
900 MHz to 1 GHz



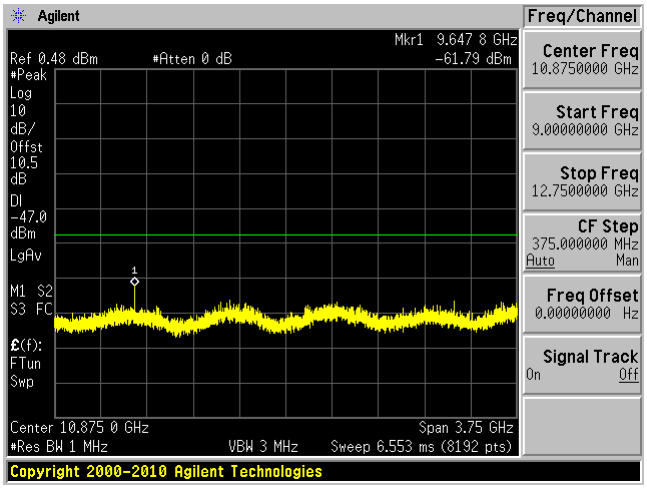
1 GHz to 5 GHz



5 GHz to 9 GHz

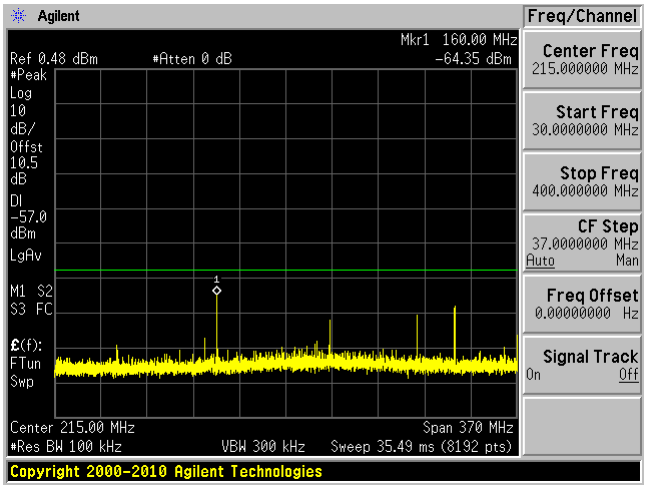


9 GHz to 12.75 GHz

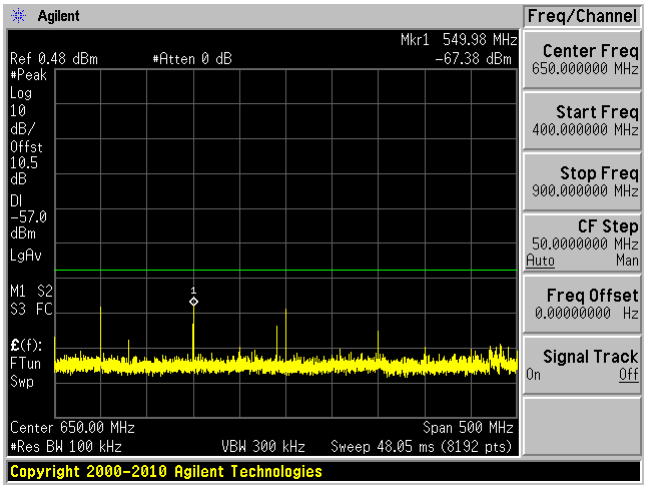


802.11 20MHz: High Channel

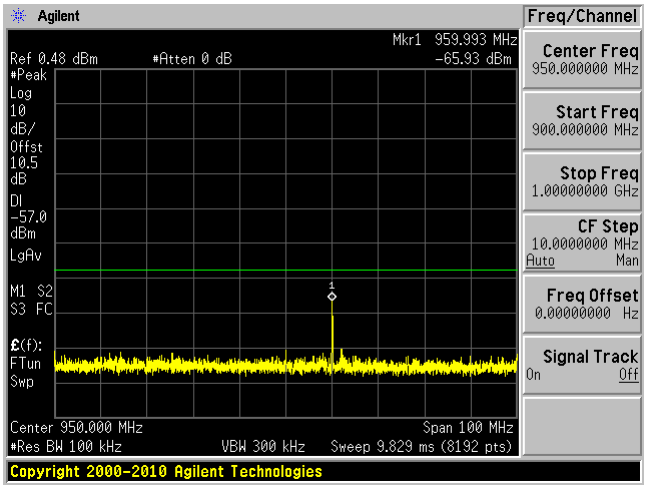
30 MHz to 400 MHz



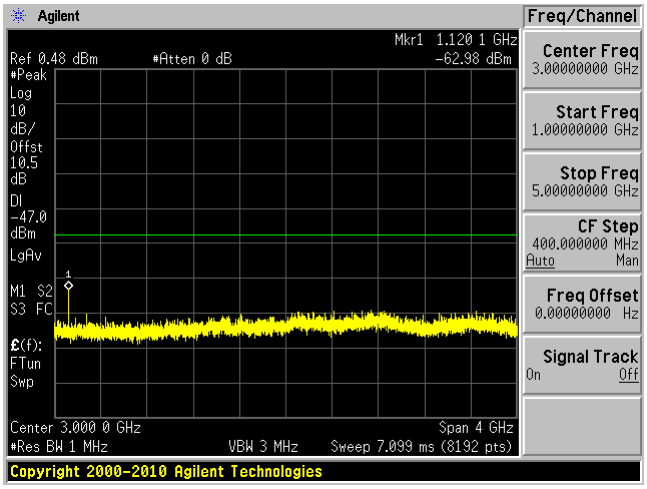
400 MHz to 900 MHz



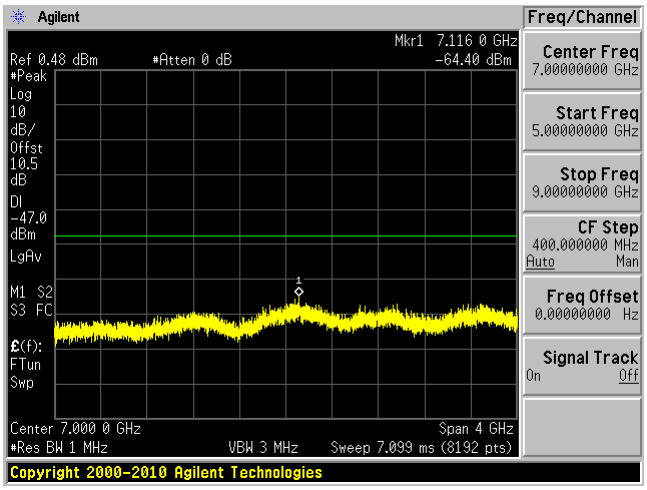
900 MHz to 1 GHz



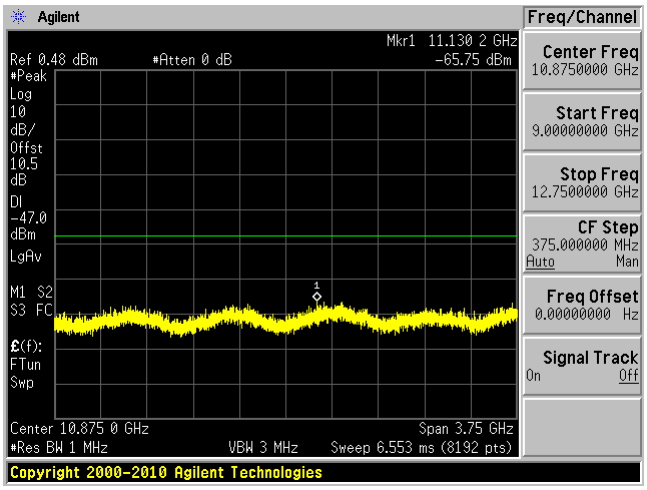
1 GHz to 5 GHz



5 GHz to 9 GHz

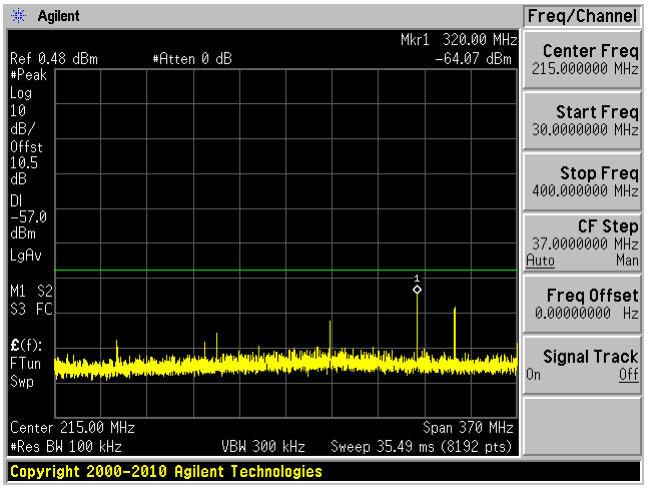


9 GHz to 12.75 GHz

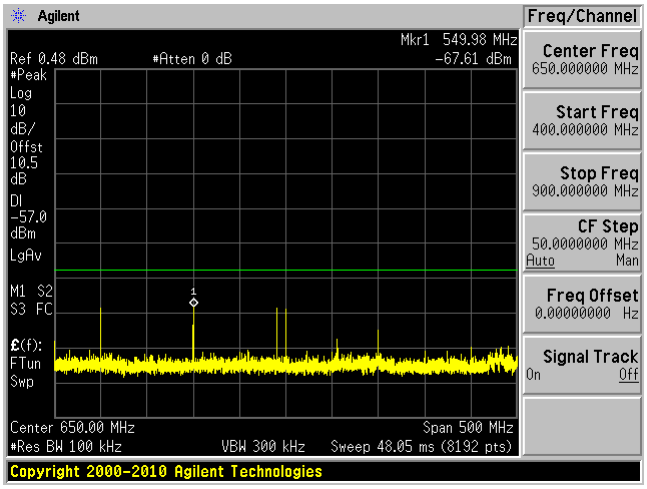


802.11 40MHz: Low Channel

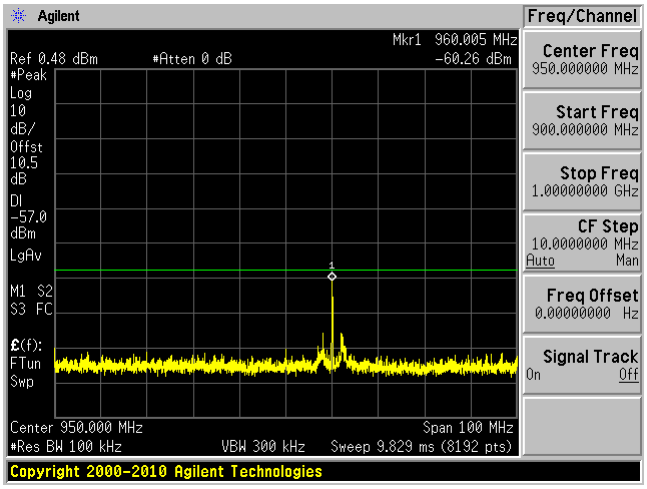
30 MHz to 400 MHz



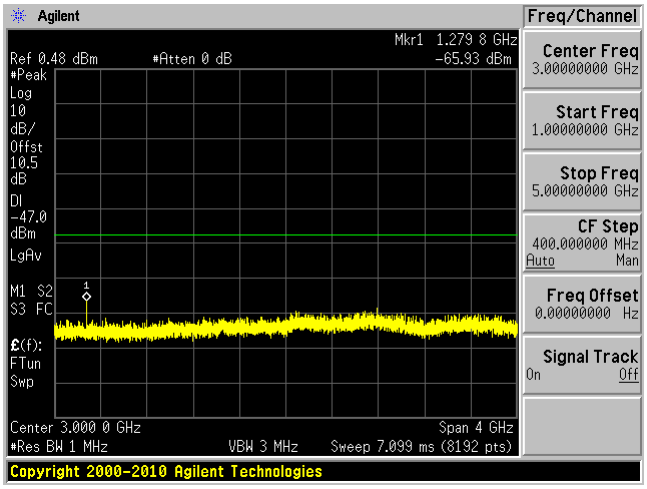
400 MHz to 900 MHz



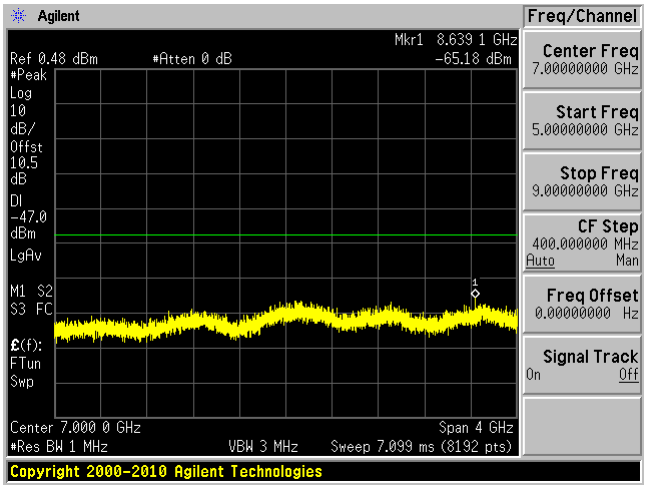
900 MHz to 1 GHz



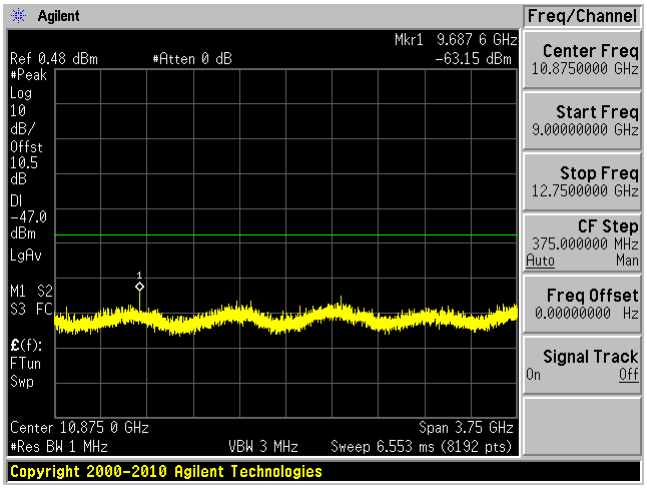
1 GHz to 5 GHz



5 GHz to 9 GHz

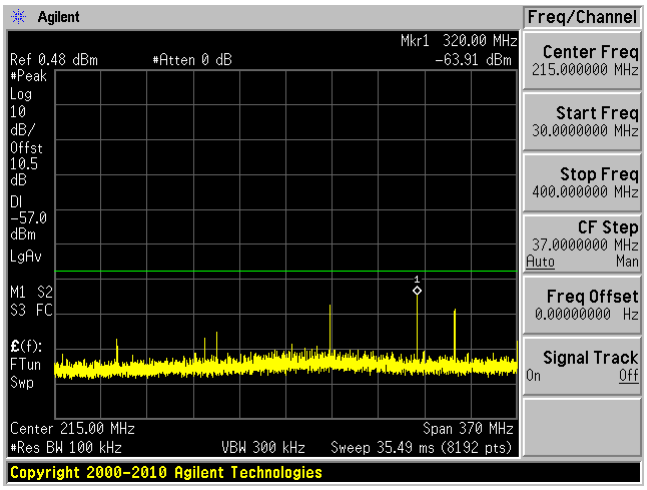


9 GHz to 12.75 GHz

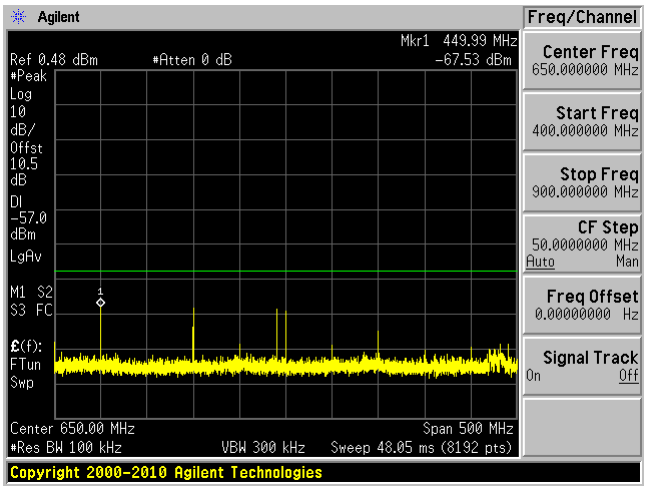


802.11 40MHz: High Channel

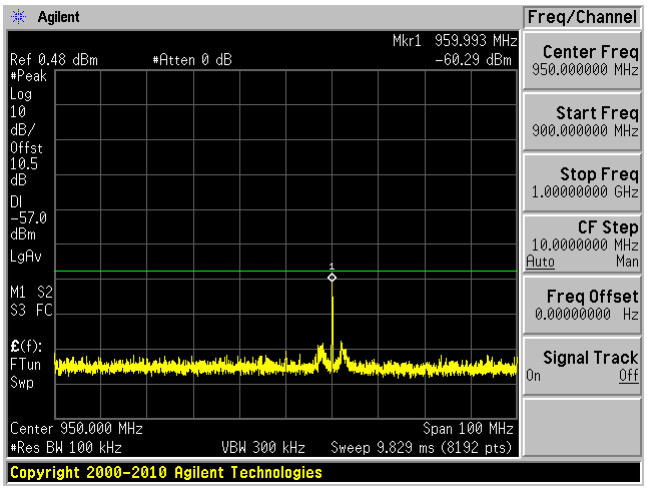
30 MHz to 400 MHz



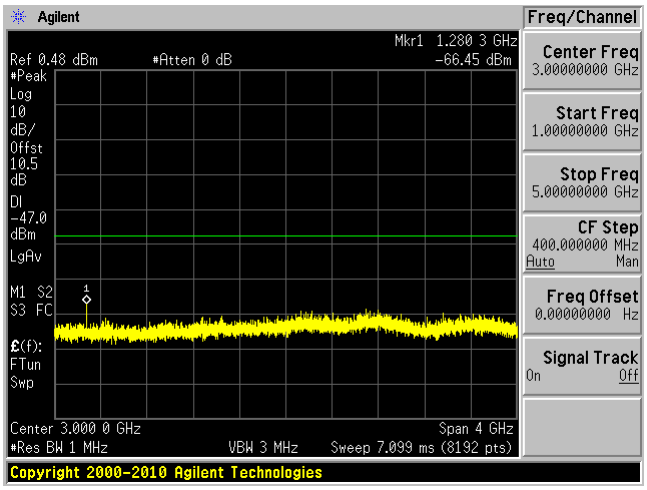
400 MHz to 900 MHz



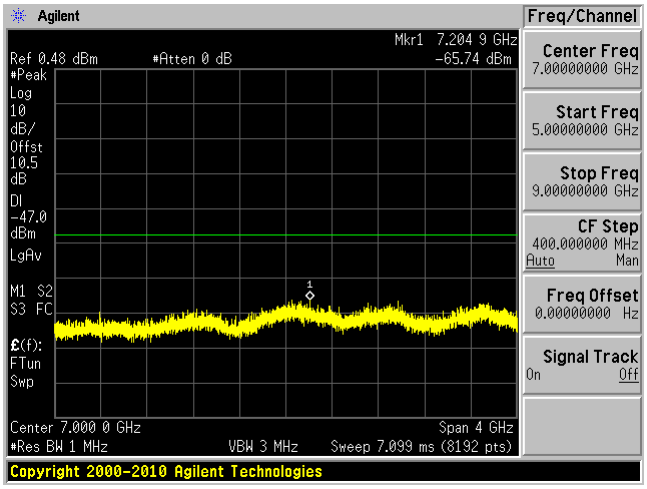
900 MHz to 1 GHz



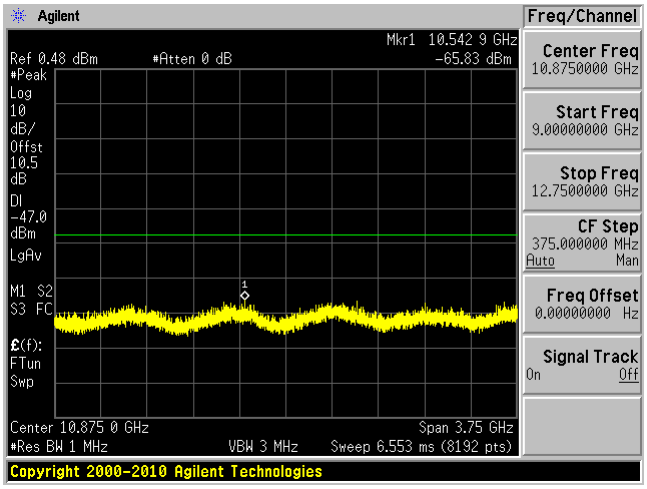
1 GHz to 5 GHz



5 GHz to 9 GHz

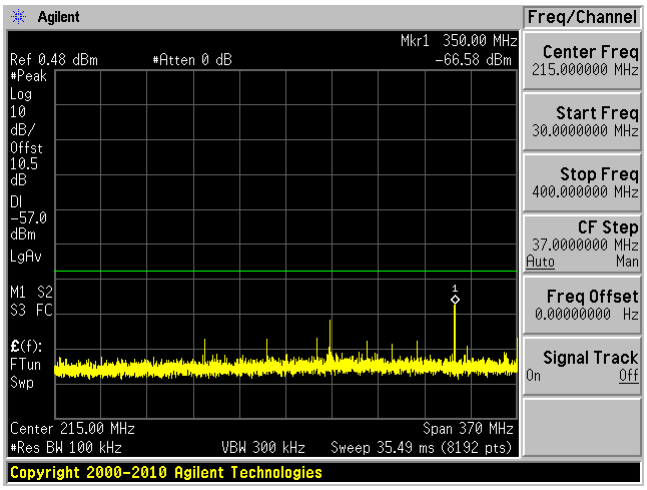


9 GHz to 12.75 GHz

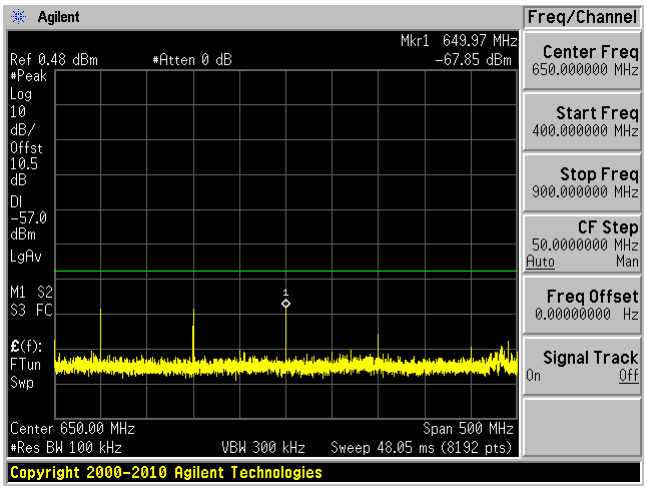


BLE: Low Channel

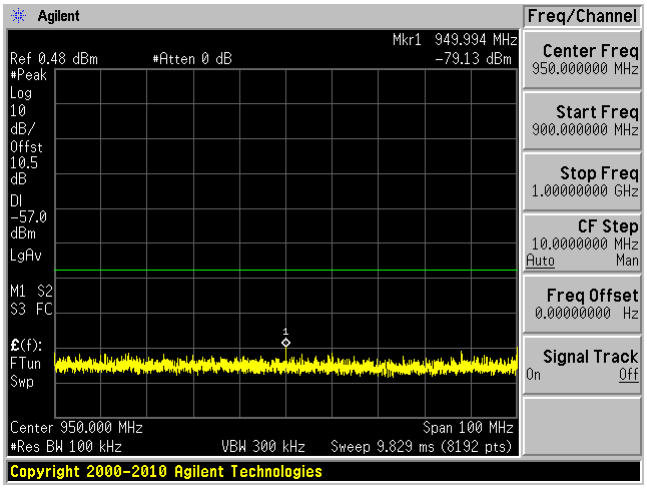
30 MHz to 400 MHz



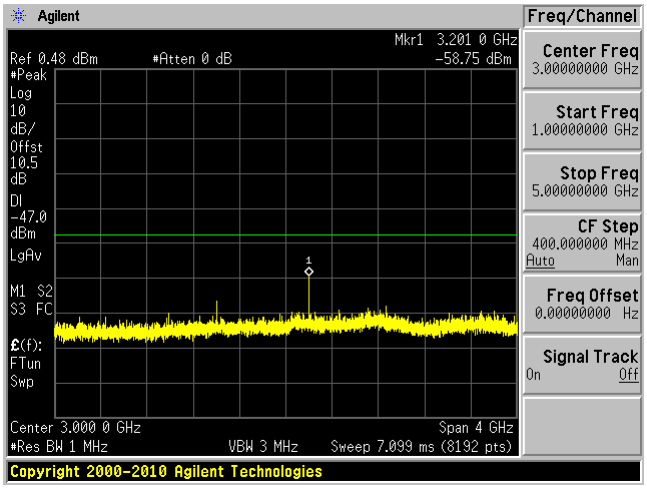
400 MHz to 900 MHz



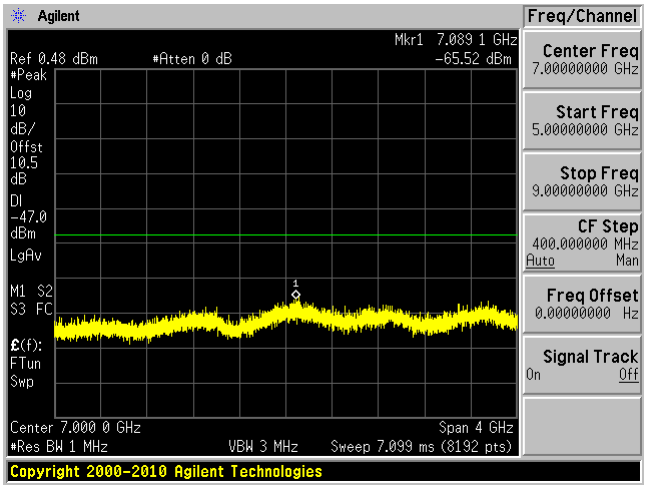
900 MHz to 1 GHz



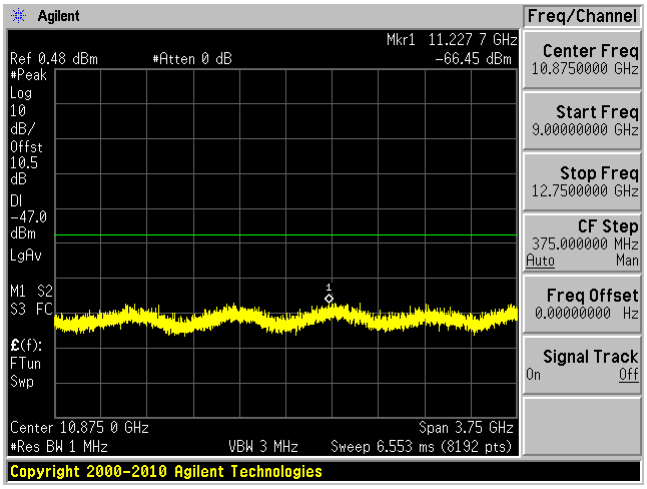
1 GHz to 5 GHz



5 GHz to 9 GHz

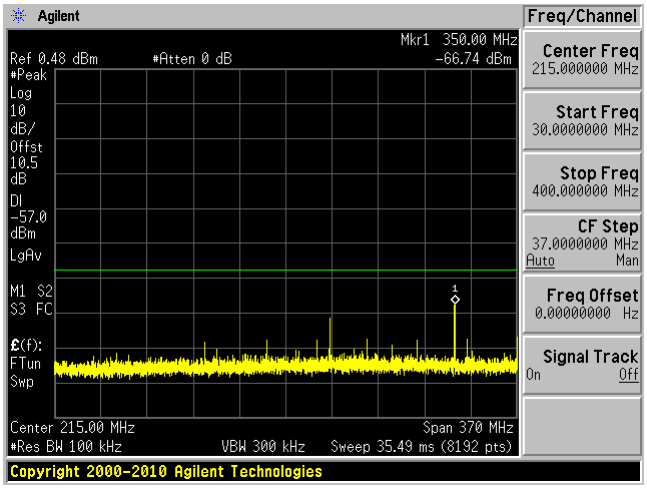


9 GHz to 12.75 GHz

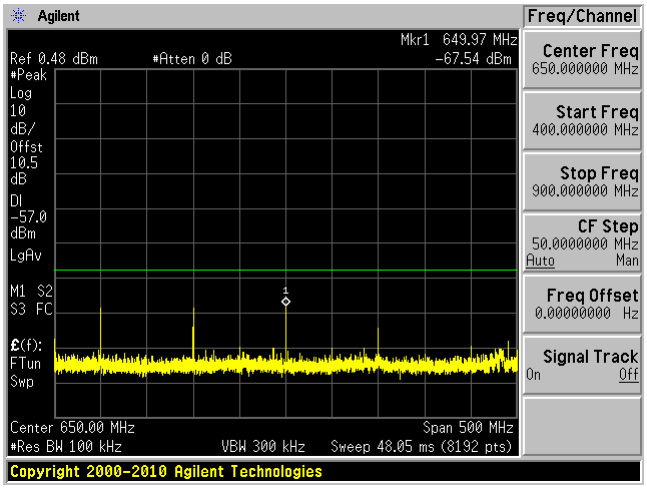


BLE: High Channel

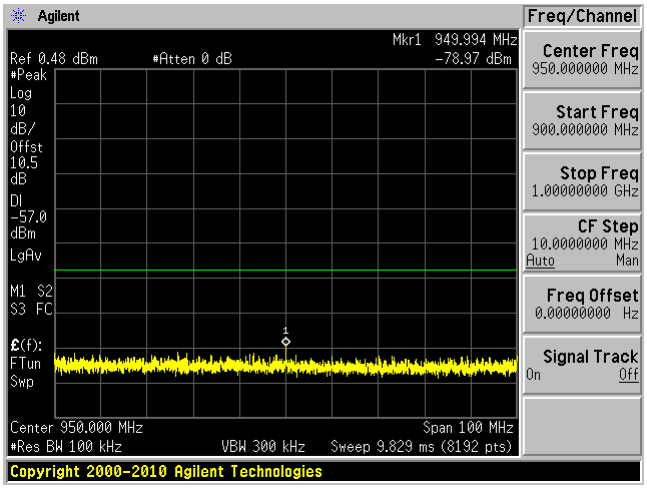
30 MHz to 400 MHz



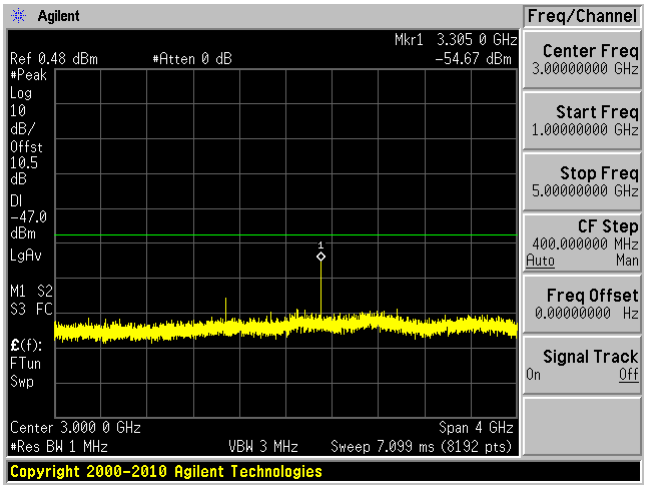
400 MHz to 900 MHz



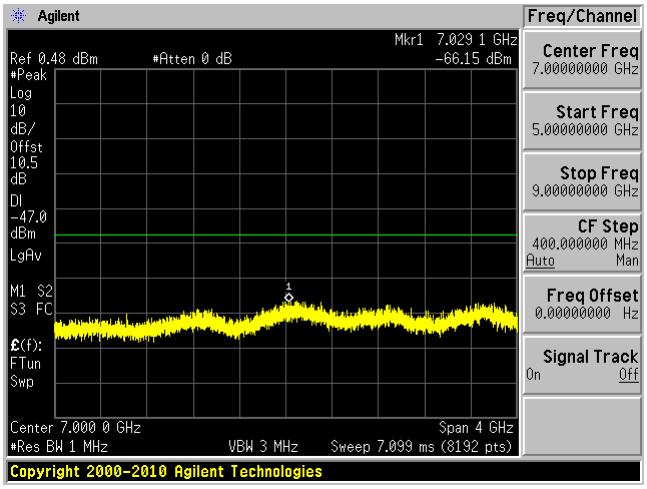
900 MHz to 1 GHz



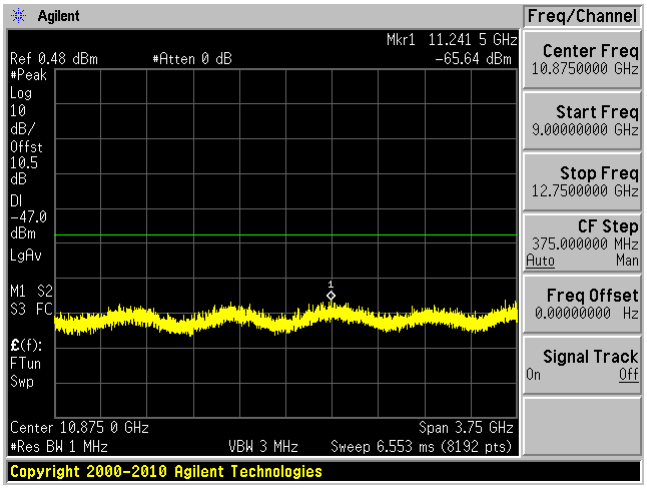
1 GHz to 5 GHz



5 GHz to 9 GHz



9 GHz to 12.75 GHz



10 EN 300 328 §4.3.2.6 – Adaptivity

10.1 Applicable Standard

EN 300 328 v1.9.1 §4.3.2.6.3.2.3: Load Based Equipment

Adaptivity is a mechanism used by equipment to automatically adapt to its environment by identifying frequencies that are being used by other equipment.

10.2 Measurement Procedure

EN 300 328 v1.9.1 §5.3.7.2.1.3: LBT based adaptive equipment using modulations other than FHSS

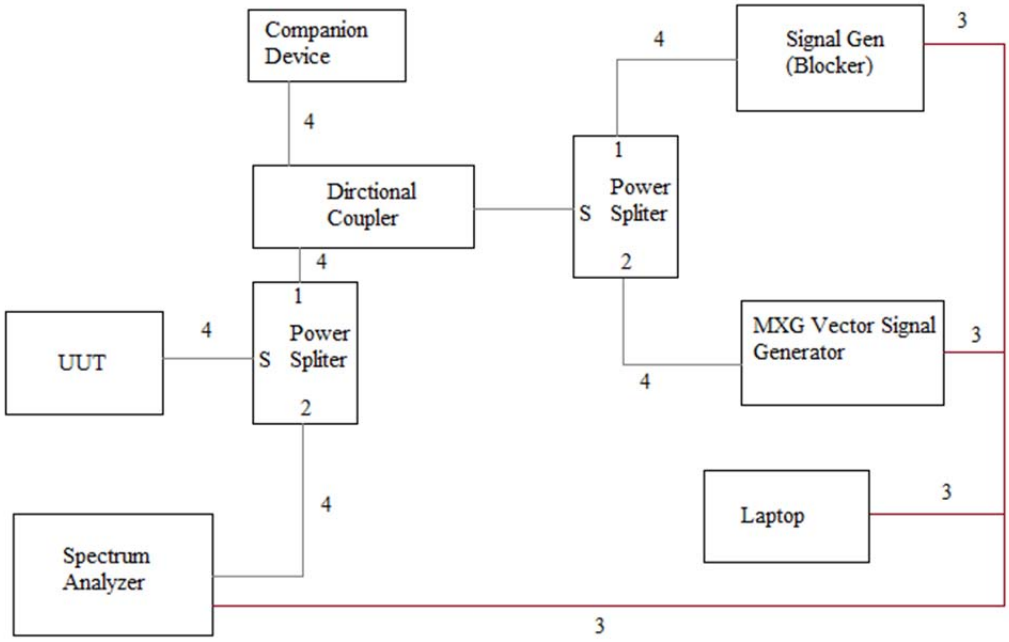
1. Set the analyzer to the following setting
   - 1.1. RBW: 8 MHz
   - 1.2. VBW: 50 MHz
   - 1.3. Detector Mode: RMS
   - 1.4. Center Frequency: Center of the Channel Operating frequency
   - 1.5. Span: 0 Hz
   - 1.6. Sweep Time: > maximum Channel Occupancy Time
   - 1.7. Trace Mode: Clear Write
2. Configure EUT to transmit on the testing channel with a sufficiently high payload
3. A 100% duty cycle interference signal shall be injected on the current operating channel. The interference signal shall have a bandwidth as wide or wider than the operating bandwidth with a flat power spectral density given by TL = -70 dBm./MHz – (20 + EUT Power e.r.i.p)
4. The Spectrum analyzer shall be used to monitor the transmission of the EUT once the interference signal is injected. It shall be verified that
   - 4.1. The EUT stops transmissions on the current channel
   - 4.2. Apart from short control signals no other transmissions are allowed while interference signal is on
   - 4.3. The EUT is also allowed to switch to non-adaptive mode if applicable.
5. With the interference signal on a CW blocking signal shall be injected outside the allocated bands of the EUT. The frequencies and levels are given in §4.3.2.10.2
6. Step 4 shall be used to verify the blocker response
7. Upon removal of the interference signal and blocker the EUT may resume transmission but is not a requirement
8. This procedure shall be used to test Low and High channels of the EUT and in all operating bandwidths (20 MHz and 40 MHz)

10.3 Environmental Conditions

Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	101.56 kPa

The testing was performed by Jin Yang on 2015-11-6 at RF site.

10.4 Test Setup Block Diagram



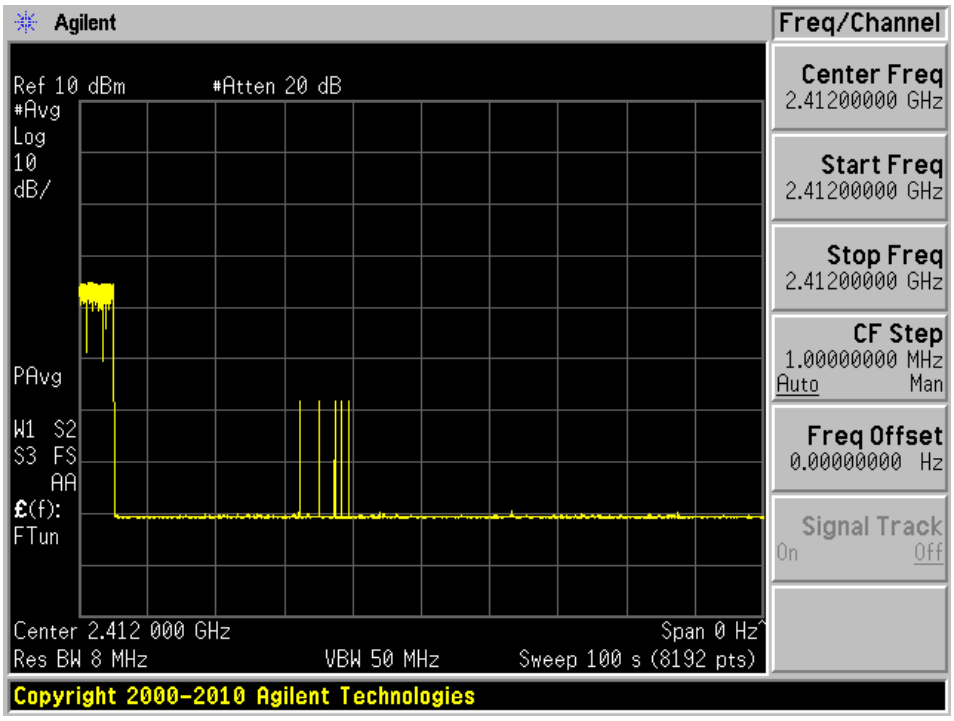
10.5 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year
Agilent	Signal Generator	8648C	3847M00143	2014-12-03	1 year
Agilent	Vector Signal Generator	N5182B	MY53050716	2014-09-18	14 months
HP	Directional Coupler	779D	01702	N/A	N/A
Mini-Circuits	Power Splitter	ZFSC-2-10G	N/A	N/A	N/A
Mini-Circuits	Power Splitter	ZFSC-2-10G	N/A	N/A	N/A

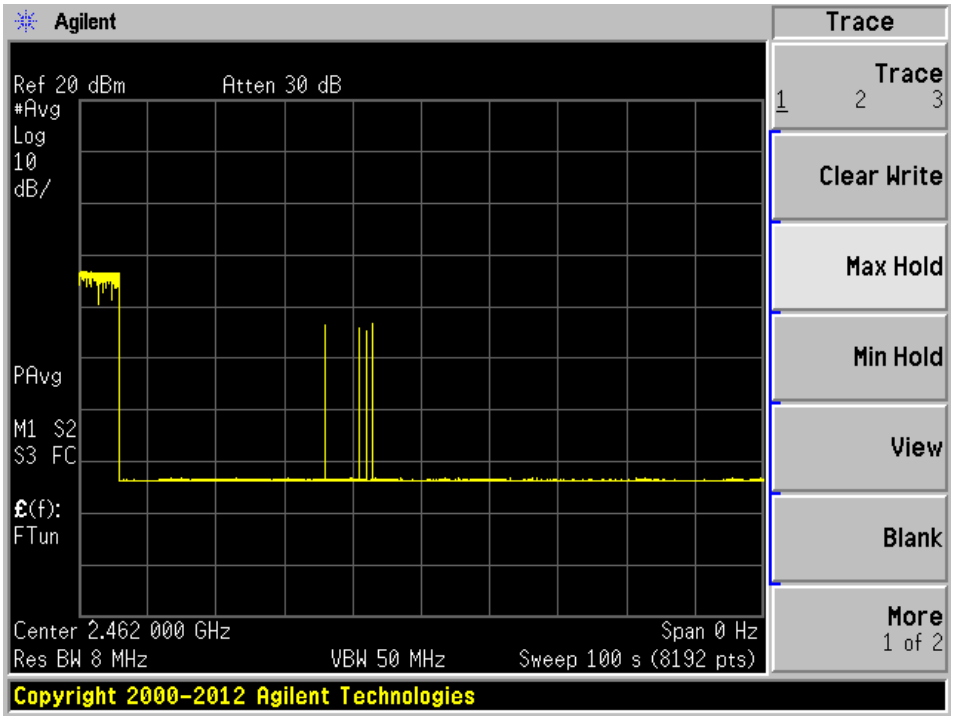
Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

10.6 Test Results

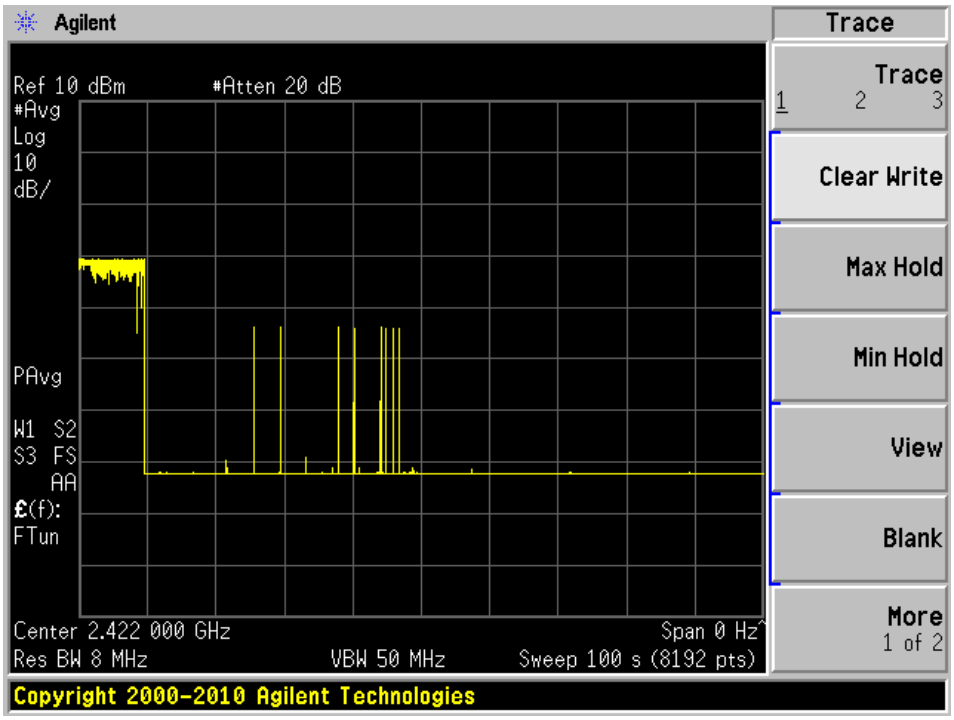
802.11 20MHz Bandwidth, 2412 MHz



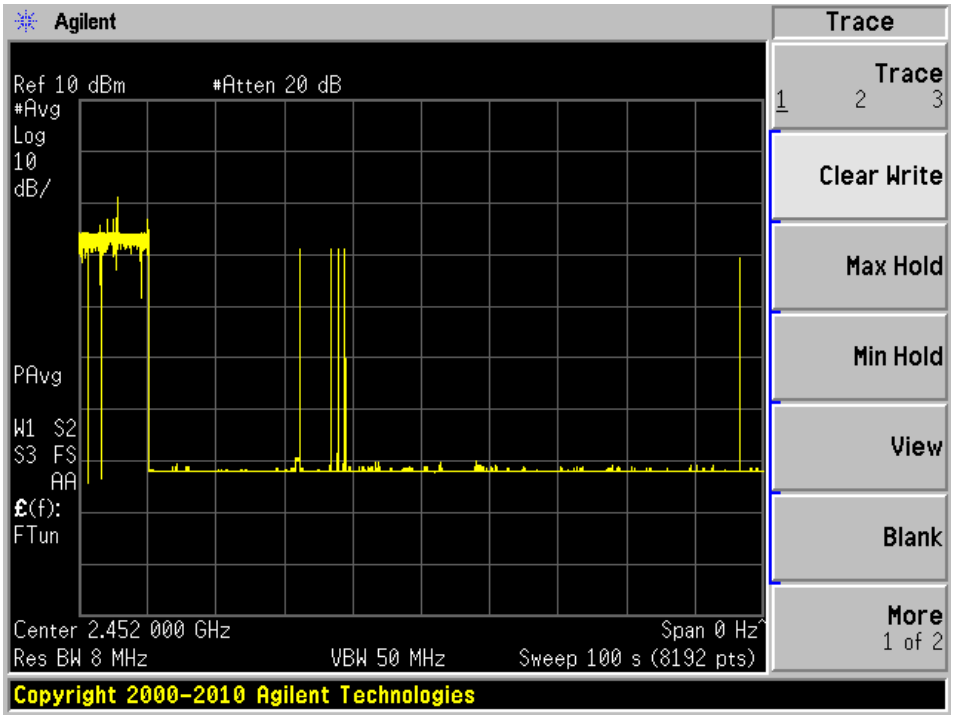
802.11 20MHz Bandwidth, 2462 MHz



802.11 40MHz Bandwidth, 2422 MHz



802.11 40MHz Bandwidth, 2452 MHz



11 EN 300 328 §4.3.2.11 – Receiver Blocking

11.1 Applicable Standard

Adaptive equipment using wide band modulations other than FHSS, shall comply with the requirements defined in clause 4.3.2.6.2 (non-LBT based DAA) or clause 4.3.2.6.3 (LBT based DAA) in the presence of a blocking signal with characteristics as provided in table 6.

11.2 Measurement Procedure

Step 1:

- The UUT may connect to a companion device during the test. The interference signal generator, the blocking signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and blocking signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the blocking signals.
- Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 6 (clause 4).

NOTE 1: Testing of Unidirectional equipment does not require a link to be established with a companion device.

- The analyzer shall be set as follows:
  - RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)
  - VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall be used)
  - Detector Mode: RMS
  - Centre Frequency: Equal to the centre frequency of the operating channel
  - Span: 0 Hz
  - Sweep time: > maximum Channel Occupancy Time
  - Trace Mode: Clear Write
  - Trigger Mode: Video

Step 2:

- Configure the UUT for normal transmissions with a sufficiently high payload to allow demonstration of compliance of the adaptive mechanism on the channel being tested.

- For Frame Based Equipment, using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.5.2.2.1.

- For Load Based equipment, using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that the UUT complies with the maximum Channel Occupancy Time defined in clause 4.3.2.5.2.2.2. It shall also be verified (if necessary by repeating the test) that the Idle Period varies between CCA and q × CCA as defined in clause 4.3.2.5.2.2.2.

NOTE 2: For Load Based Equipment referred to in the first paragraph of clause 4.3.2.5.2.2.2 (IEEE 802.11 [i.3] or IEEE 802.15.4 [i.5] equipment), the minimum Idle Period and the maximum Channel Occupancy Time are as defined for other types of Load Based Equipment (see clause 4.3.2.5.2.2.2 points 2 and 3). The CCA observation time is declared by the supplier (see clause 5.3.1 d).

Step 3: Adding the interference signal

- A 100 % duty cycle interference signal is injected on the current operating channel of the UUT. This interference signal shall be a band limited noise signal which has a flat power spectral density, and shall have a bandwidth greater than the Occupied Channel Bandwidth of the UUT. The maximum ripple of this interfering signal shall be ±1,5 dB within the Occupied Channel Bandwidth and the power spectral density (at the input of the UUT) shall be as defined in clause 4.3.2.5.2.2.1 step 5 (frame based equipment) or clause 4.3.2.5.2.2.2 step 5 (load based equipment).

Step 4: Verification of reaction to the interference signal

- The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

- Using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that:

  i) The UUT shall stop transmissions on the current operating channel.

NOTE 3: The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clauses 4.3.2.5.2.2.1 (frame based equipment) or 4.3.2.5.2.2.2 (load based equipment).

  ii) Apart from Short Control Signalling Transmissions, there shall be no subsequent transmissions while the interfering signal is present.

  iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.5.3.2.

NOTE 4: The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

  iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the blocking signal

- With the interfering signal present, a 100 % duty cycle CW signal is inserted as the blocking signal. The frequency and the level are provided in table 6 of clause 4.3.2.10.2.

- Repeat step 4 to verify that the UUT does not resume any normal transmissions.

Step 6: Removing the interference and blocking signal

- On removal of the interference and blocking signal the UUT is allowed to start transmissions again on this channel however this is not a requirement and therefore does not require testing.

Step 7:

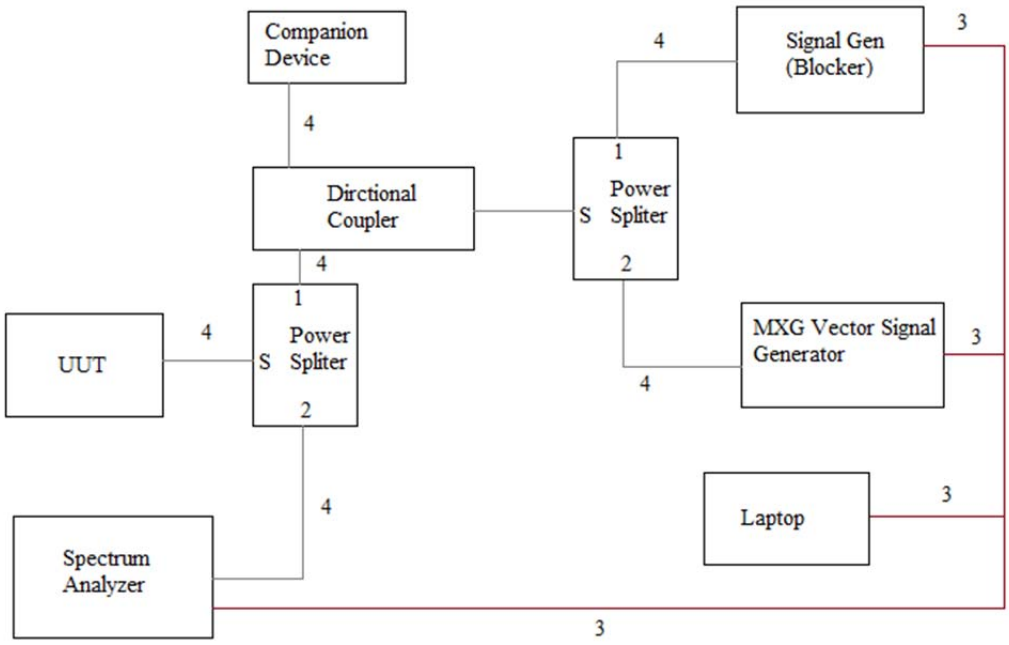
- The steps 2 to 6 shall be repeated for each of the frequencies to be tested.

11.3 Environmental Conditions

Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	101.56 kPa

The testing was performed by Jin Yang on 2015-11-6 at RF site.

11.4 Test Setup Block Diagram



11.5 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year
Agilent	Signal Generator	8648C	3847M00143	2014-12-03	1 year
Agilent	Vector Signal Generator	N5182B	MY53050716	2014-09-18	14 months
HP	Directional Coupler	779D	01702	N/A	N/A
Mini-Circuits	Power Splitter	ZFSC-2-10G	N/A	N/A	N/A
Mini-Circuits	Power Splitter	ZFSC-2-10G	N/A	N/A	N/A

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

11.6 Test Results

Test Frequency (MHz) Test mode	Blocking Signal Frequency (MHz)	Blocking signal Power (dBm)	EUT Performance	Result
2412MHz 802.11 20MHz Bandwidth	2488.5	-35	Transmitting keep off	Pass
2462MHz 802.11 20MHz Bandwidth	2395	-35	Transmitting keep off	Pass
2422MHz 802.11 40MHz Bandwidth	2488.5	-35	Transmitting keep off	Pass
2452MHz 802.11 40MHz Bandwidth	2395	-35	Transmitting keep off	Pass

12 Exhibit A – Proposed Product Labeling

12.1 Label Information

1. The CE conformity marking must consist of the initials 'CE' taking the form below. If the CE marking is reduced or enlarged the proportions must be respected.

2. The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.

   The EMC Directive recognizes that there are circumstances where it is "not possible or warranted on account of the nature of the product" to have the marking affixed to the apparatus or to its data plate. In such cases it is allowed to have the CE marking' affixed on the packaging, refer to the Blue Guide when such exemptions are allowed.

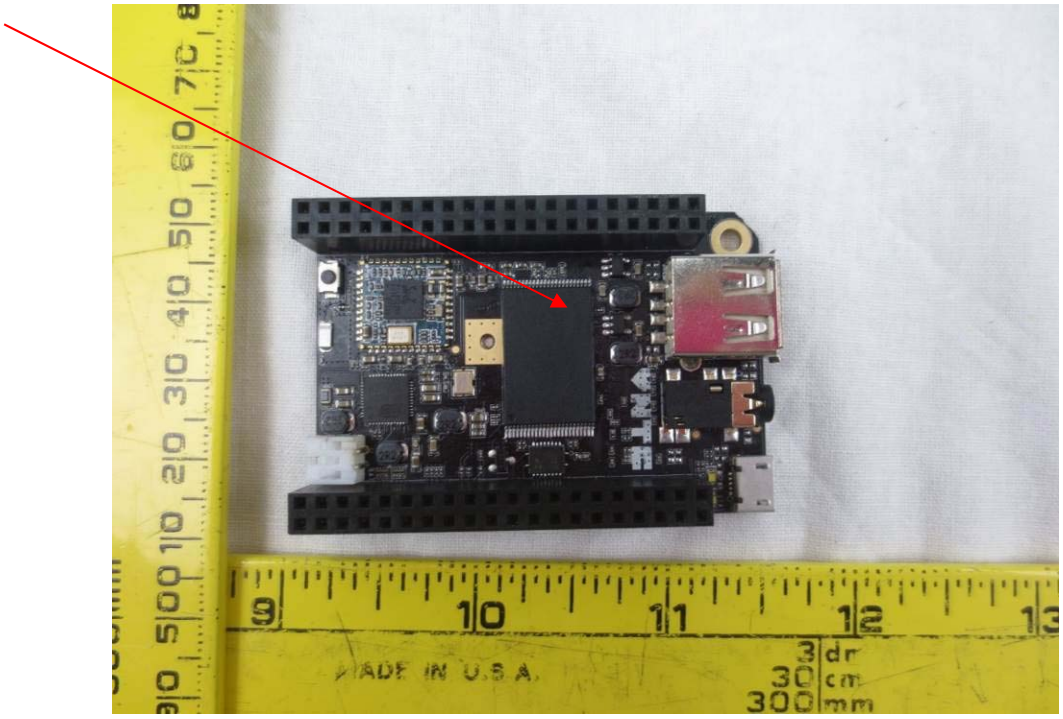
3. The CE marking must be affixed to the product or to its data plate. Additionally it must be affixed to the packaging, if any, and to the accompanying documents, where the directive concerned provides for such documents.

4. The CE marking must be affixed visibly, legibly, and indelibly.

5. Other labeling requirements maybe required if the product(s) is/are subject to several directives.

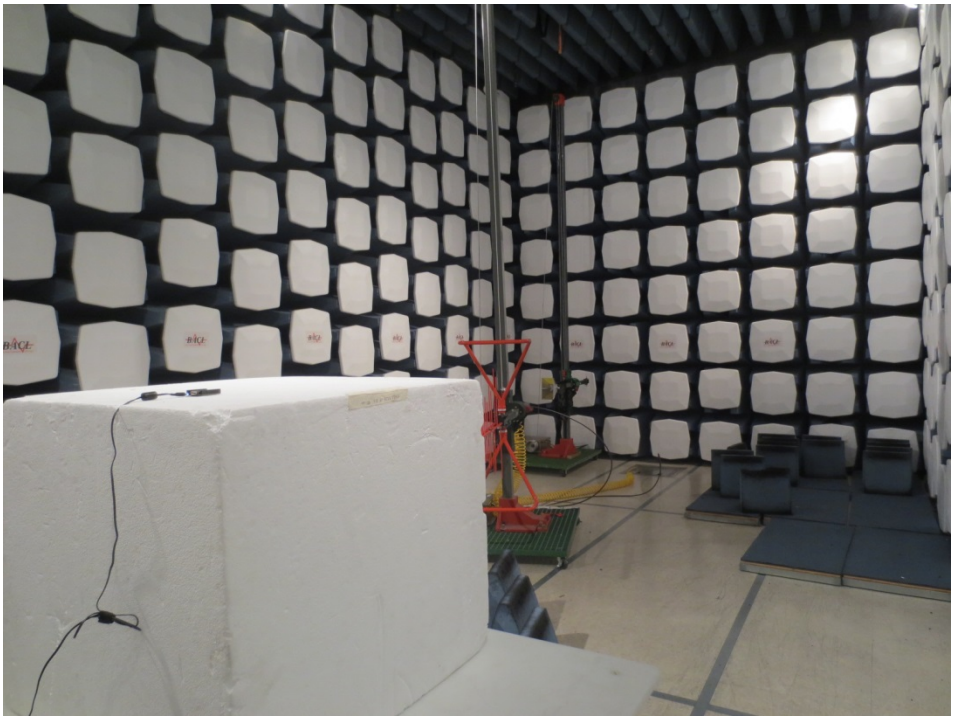
Specifications: Text is black or white in color and is left justified. Labels are printed in indelible ink on permanent adhesive backing or silk-screened and shall be affixed at a conspicuous location on the EUT. The label can not be positioned on a removable portion of the EUT (e.g. battery cover).

12.2 Suggested Label Location



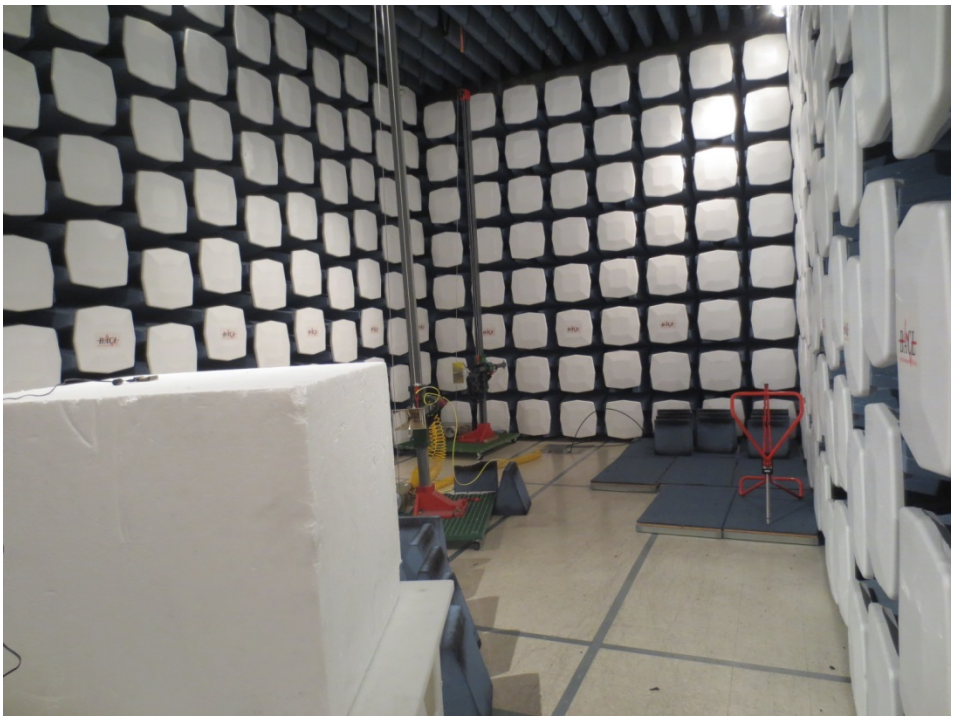
13 Exhibit B - Test Setup Photographs

13.1 Radiated Emission below 1 GHz Front View

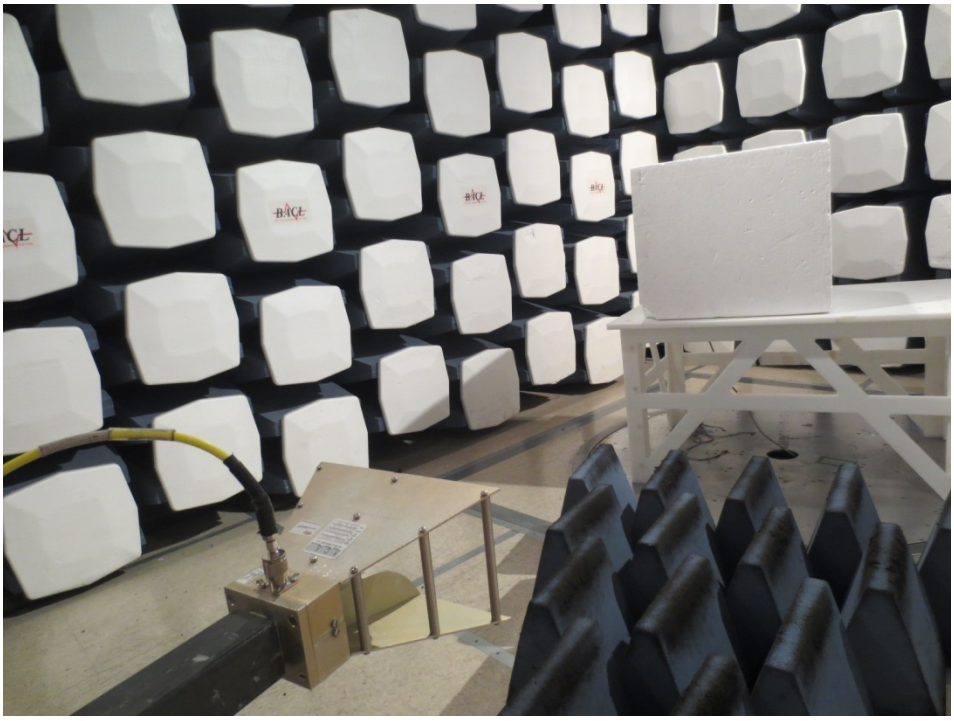


13.2 Radiated Emission below 1 GHz Rear View

13.3 Radiated Emission above 1 GHz Front View

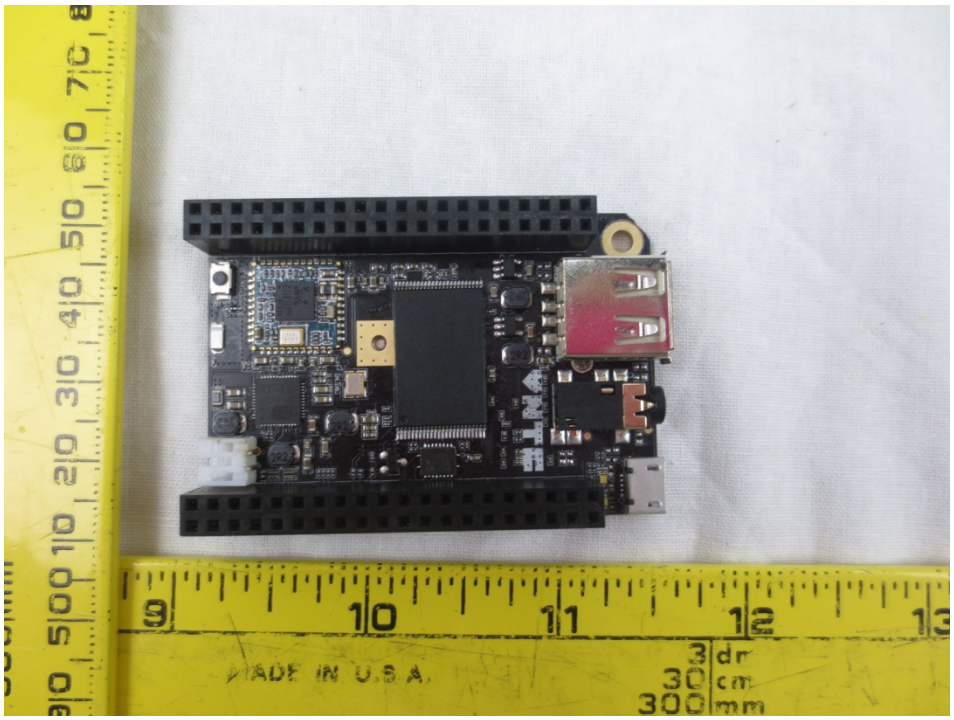


13.4 Radiated Emission above 1 GHz Rear View

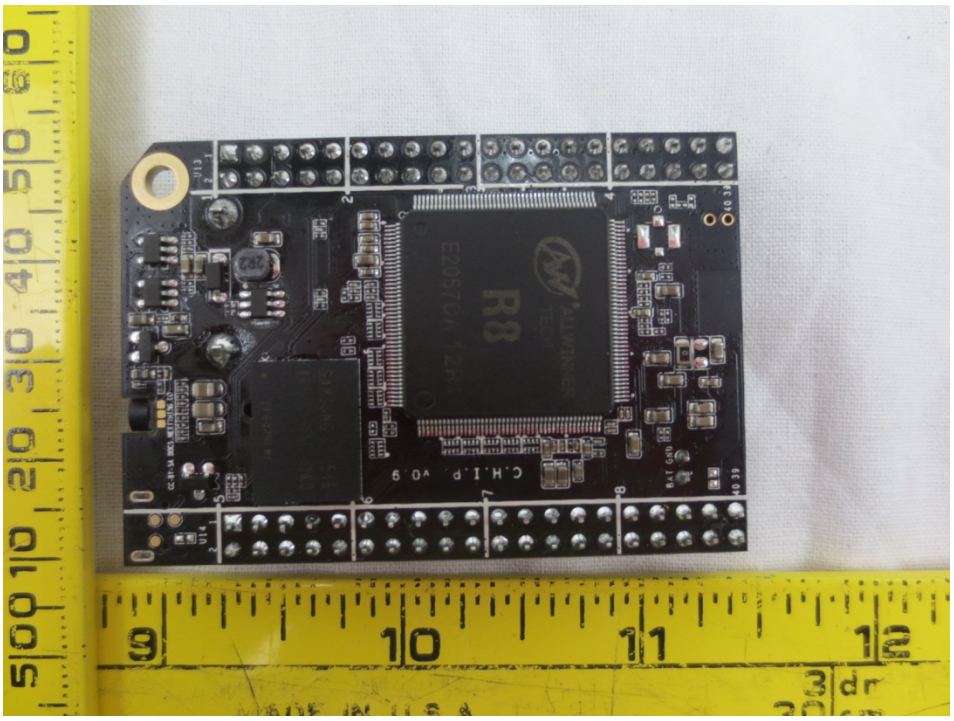


14 Exhibit C – EUT Photographs

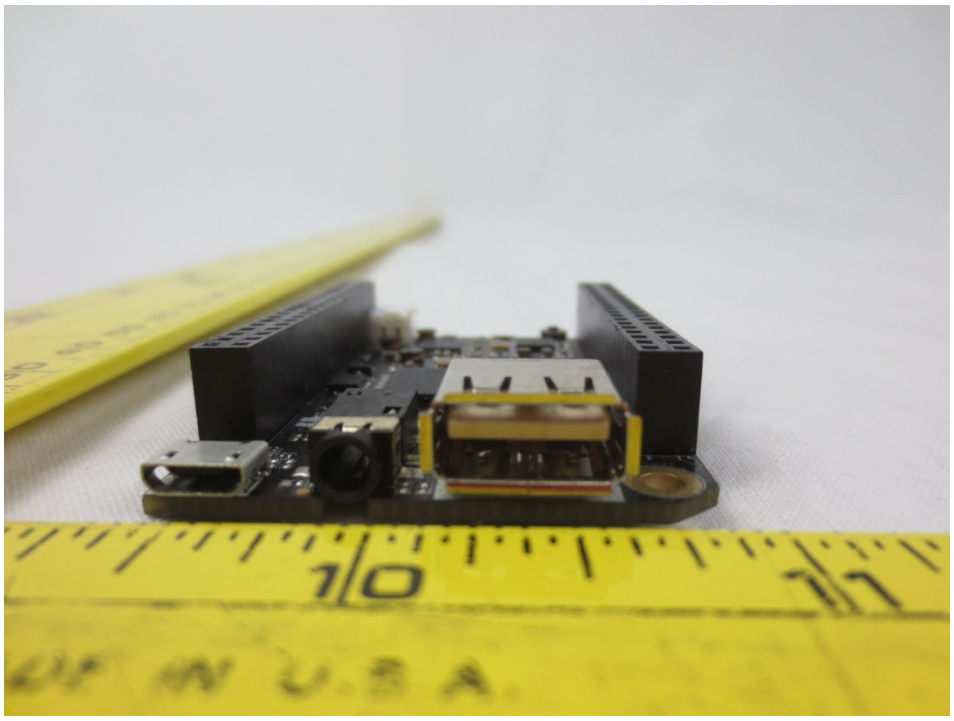
14.1 EUT Photo – Top View



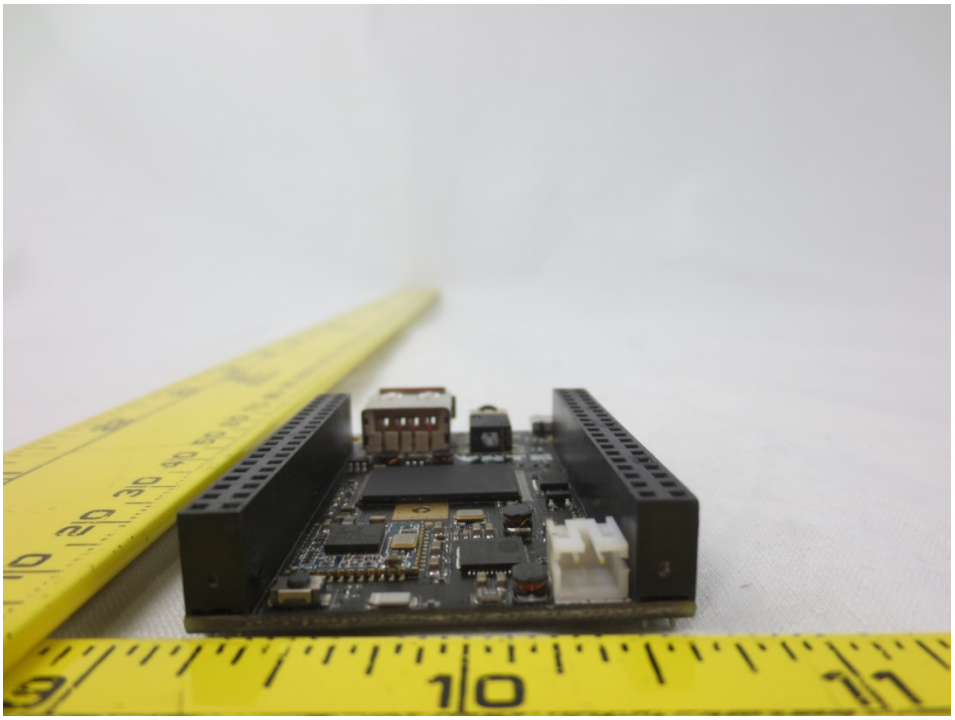
14.2 EUT Photo – Bottom View



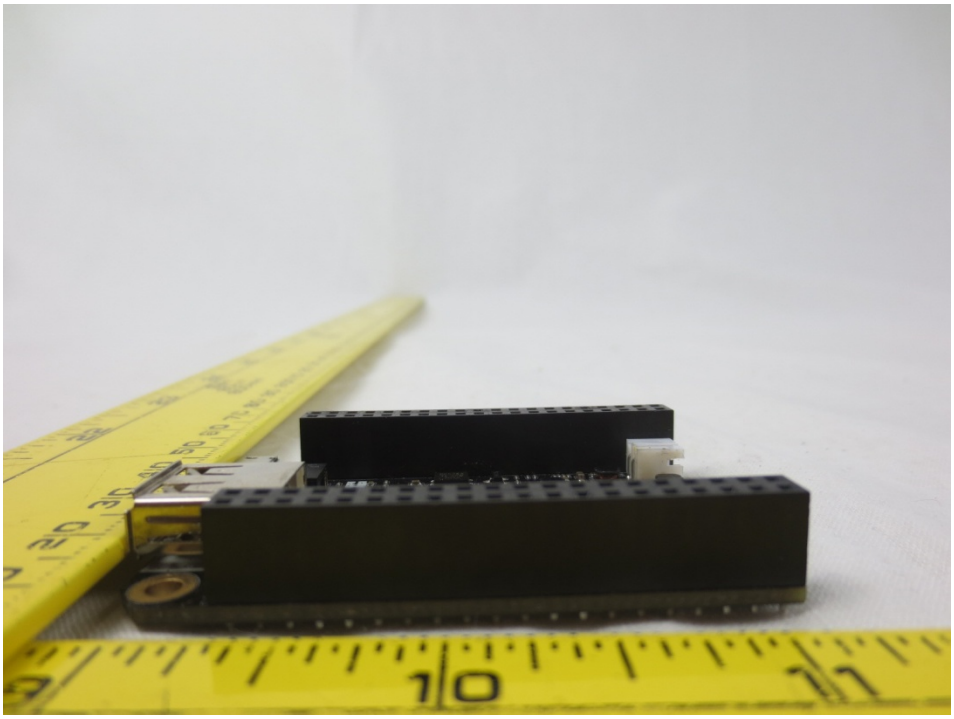
14.3 EUT Photo –Front



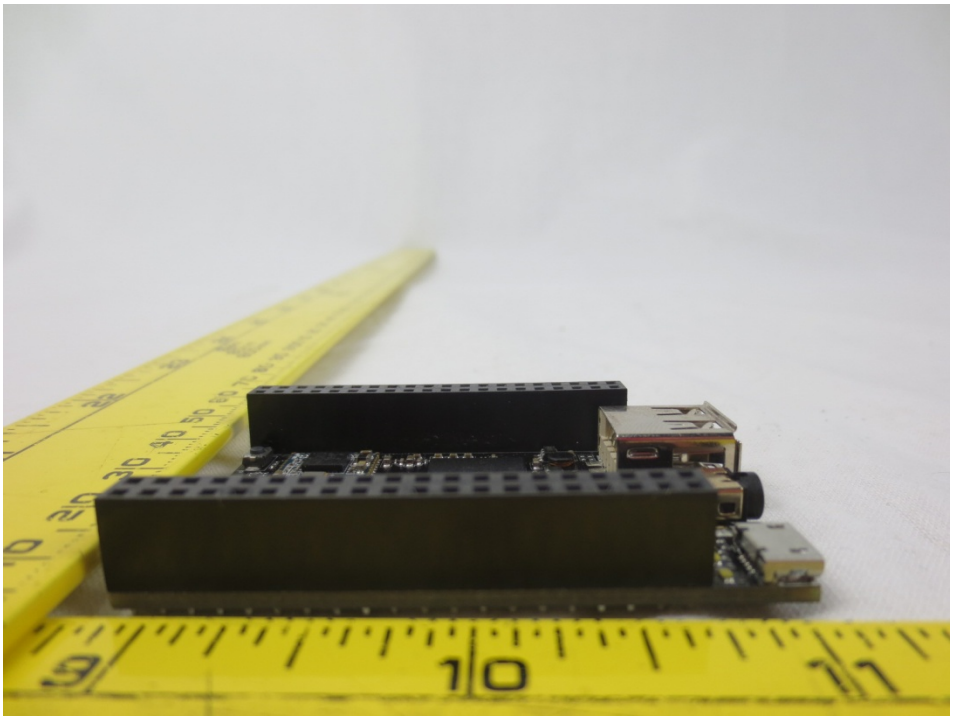
14.4 EUT Photo –Back



14.5 EUT Photo –Right Side



14.6 EUT Photo –Left Side



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