DFS Test Report

Applicant	:	Phorus, Inc.
Address	:	16255 Ventura Boulevard, Encino,California, 91436 United States
Product Type	:	Play-Fi Module
Trade Name	:	DTS
Model Number	:	CAPRICA2L
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART E ANSI C63.10:2013
Receive Date	:	Nov. 25, 2015
Test Period	:	Nov. 27 ~ Dec. 06, 2015
Issue Date	:	Dec. 15, 2015

Issue by

A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
Taoyuan City 33465, Taiwan (R.O.C)
Tel：+86-3-2710188 / Fax：+86-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330

Revision History

Rev.	Issue Date	Revisions	Revised By
00	Dec. 15, 2015	Initial Issue	

Verification of Compliance

Issued Date: 12/15/2015

Product Type	:	Play-Fi Module
Applicant	:	Phorus, Inc.
Address	:	16255 Ventura Boulevard, Encino,California, 91436 United States
Trade Name	:	DTS
Model Number	:	CAPRICA2L
FCC ID	:	2AAWQ-CAPRICA2L
EUT Rated Voltage	:	DC 5V / DC 3.3V / DC 1.8V / DC 1.1V
Test Voltage	:	120 Vac / 60 Hz
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART E ANSI C63.10:2013
Test Result	:	Complied
Performing Lab.	:	A Test Lab Techno Corp. No. 140-1, Changan Street, Bade District, Taoyuan City 33465, Taiwan (R.O.C) Tel：+86-3-2710188 / Fax：+86-3-2710190 Taiwan Accreditation Foundation accreditation number: 1330 http://www.atl-lab.com.tw/e-index.htm

A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By	:	Fly Lu	Reviewed By	: Eric Ou Yang
(Manager)		(Fly Lu)	(Testing Engineer)	(Eric Ou Yang)

TABLE OF CONTENTS

1 EUT Description

Applicant	Phorus, Inc. 16255 Ventura Boulevard, Encino,California, 91436 United States				
Manufacturer	LITE-ON Technology (Changzhou) Co., Ltd A9 Building, No. 88, Yanghu Road, Wujin Hi-Tech Industrial Development Zone, Changzhou City, Jiangsu Province, P.R. China				
Product Type	Play-Fi Module				
Trade Name	DTS				
Model Number	CAPRICA2L				
FCC ID	2AAWQ-CAPRICA2L				
Class II Permissive Change	Adding new type antenna.				
Frequency Range	Freq. Band		Freq. Range (MHz)	Number of Channels	
	IEEE 802.11a	U-NII Band II-A	5260 – 5320	4	
		U-NII Band II-C	5500 – 5700	11	
	IEEE 802.11n 5GHz 20 MHz	U-NII Band II-A	5260 – 5320	4	
		U-NII Band II-C	5500 – 5700	11	
	IEEE 802.11n 5GHz 40 MHz	U-NII Band II-A	5270 – 5310	2	
		U-NII Band II-C	5510 – 5670	5	
Type of Modulation	OFDM				
Equipment Type (DFS)	Client (without radar detection function)				
Antenna Used	Manufacturer	Model Number	Type	Max. Gain	
	SUNG NAM ELECTRONICS(SHENZHEN)CO., LTD.	CSA3A020Z	Dipole Antenna	U-NII Band II-A: 2.79 dBi U-NII Band II-C: 2.12 dBi	
Antenna Delivery	1TX + 1RX				

2 Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, and FCC CFR 47 Part 15

The tests documented in this report were performed in accordance with FCC KDB request:

- FCC KDB 443999 D01 Approval of DFS UNII Devices v01r04
- FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02

3 Dynamic Frequency Selection

3.1. Limits

§15.407 (h) and FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02 Compliance measurement procedures for unlicensed-national information infrastructure devcies operating in the 5250-5350 MHZ and 5470-5725 MHZ bands incorporating dynamic frequency selection.

Table 1: Applicability of DFS Requirements Prior to Use of a Channel			
Requirement	Operational Mode		
	Master	Client (without DFS)	Client (with DFS)
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation		
Requirement	Operational Mode	
	Master Device or Client With Radar Detection	Client without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client With Radar Detection	Client without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note : Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in all 20 MHz channel blocks and a null frequencies between the bonded 20 MHz channel blocks		

Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection	
Maximum Transmit Power	Value (See Notes 1,2 and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and Power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 4: DFS Response Requirement Values	
Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

Table 5: Short Pulse Radar Test Waveforms					
Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

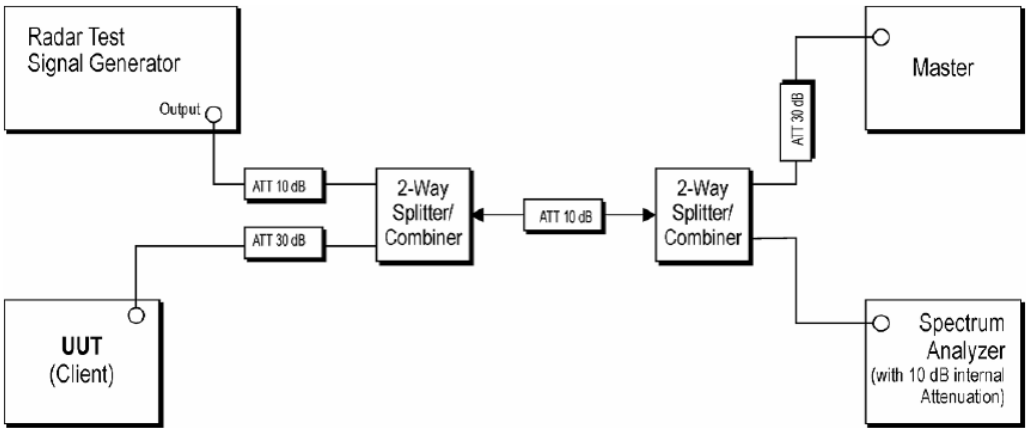
Table 5a: Pulse Repetition Intervals Values for Test A		
Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Table 6: Long Pulse Radar Test Waveform							
Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per *Burst*	Number of *Bursts*	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7: Frequency Hopping Radar Test Waveform							
Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

3.2. Test and Measurement System

3.2.1. Setup for Client with injection at the Master



3.2.2. System Calibration

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the A Test lab techno. Corp. simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution.

The short pulse types 0,1,2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time. The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Frequency Hopping Radar Waveform Generating Subsystem of FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02. The frequency of the signal generator is incremented in 1 MHz steps from FL to FH for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

The signal monitoring equipment consists of a spectrum analyzer. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

3.2.3. System Calibration

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to a horn antenna via a coaxial cable, with the reference level offset set to (horn antenna gain – coaxial cable loss). The signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of -64 dBm as measured on the spectrum analyzer.
Without changing any of the instrument settings, the spectrum analyzer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. The Reference Level Offset of the spectrum analyzer is adjusted so that the displayed amplitude of the signal is -64 dBm.
The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of -64 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

3.2.4. Adjustment of Displayed Traffic Level

A link is established between the Master and Slave and the distance between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. The video test file is streamed to generate WLAN traffic. The monitoring antenna is adjusted so that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold.

3.3. Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4408B	MY45107753	07/27/2015	(1)
Signal Generator	R&S	SMU200A	102598	04/23/2015	(1)
Test Site	ATL	TE02	TE02	N.C.R.	-----

Remark: (1) Calibration period 1 year. (2) Calibration period 2 years.

Note: N.C.R. = No Calibration Request.

4 Test Methodology

4.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: IEEE 802.11n 5GHz 40MHz link mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

IEEE 802.11n 5GHz (40MHz) mode:
Unless otherwise noted, all tests were performed with the radar burst at the channel center frequency of 5310 MHz and 5510 MHz.

Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

	Product	Manufacturer	Model No.	Serial No.	Power Cord
1.	Cisco Aironet IOS Access Point	Cisco	AIR-AP1252AG-A-K9	AIR-RM1252A-A-K9 FCC ID:LDK102061 IC:24618-102061	---

4.2. EUT Exercise Software

1.	Setup the EUT shown on 3.3.
2.	Turn on the power of all equipment.
3.	Turn on Wi-Fi function link to Notebook.
4.	EUT run test program.

Measurement Software	
1	DFS Test System V6.9.2

4.3. Test Site Environment

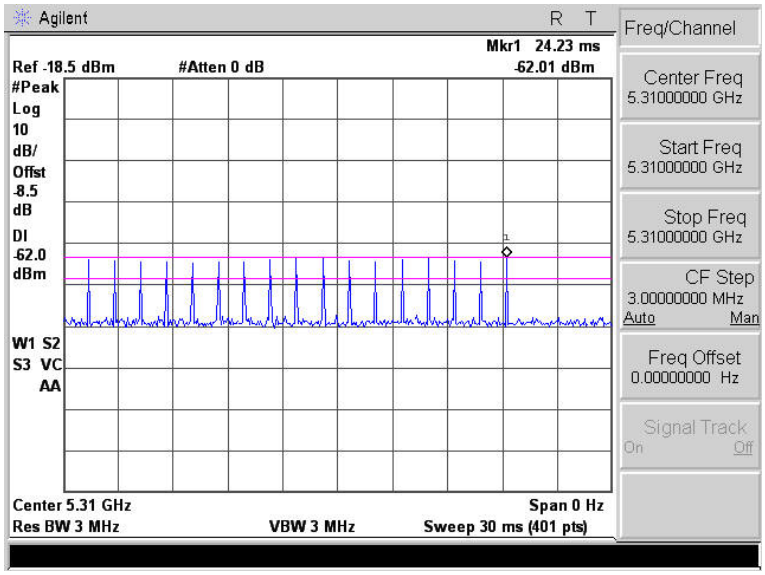
Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	950

5 Results for 40 MHz Bandwidth

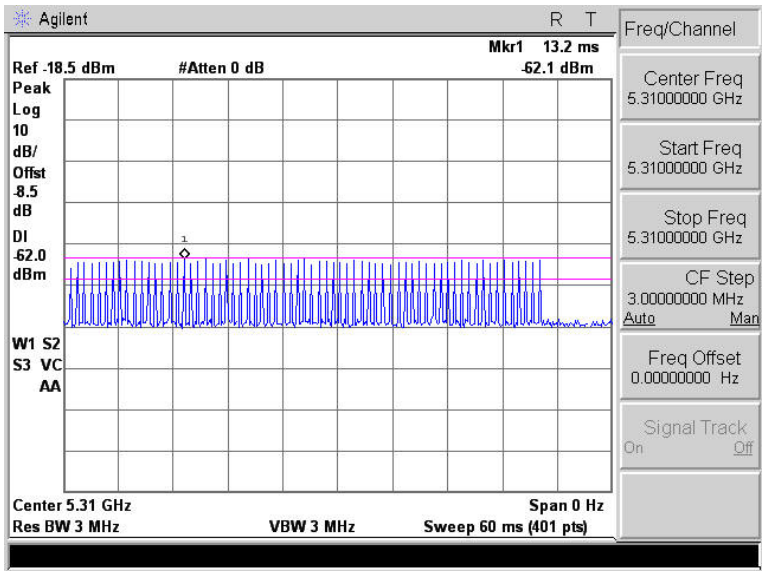
5.1. Radar Waveforms and Traffic

5.1.1. Results

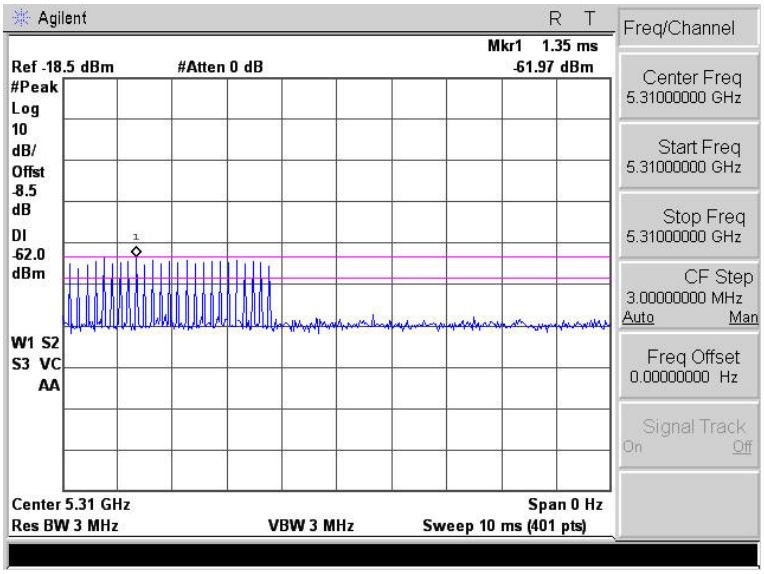
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz
Radar Type 0



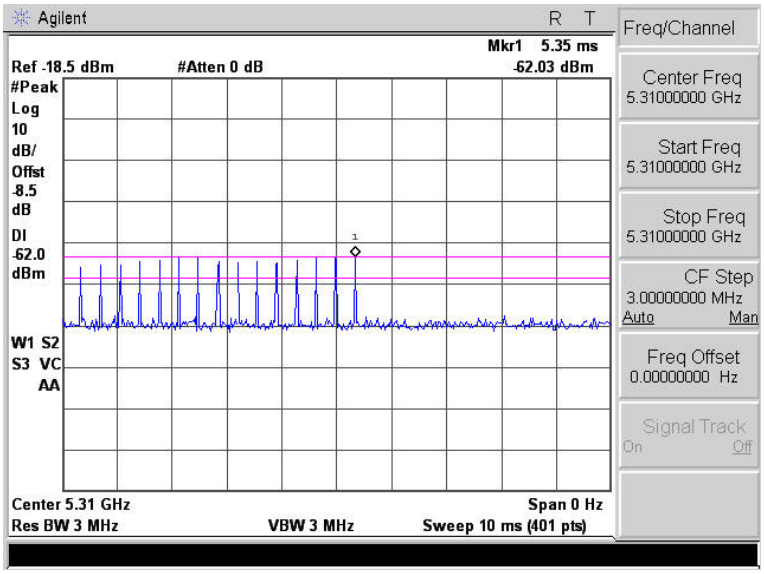
Radar Type 1



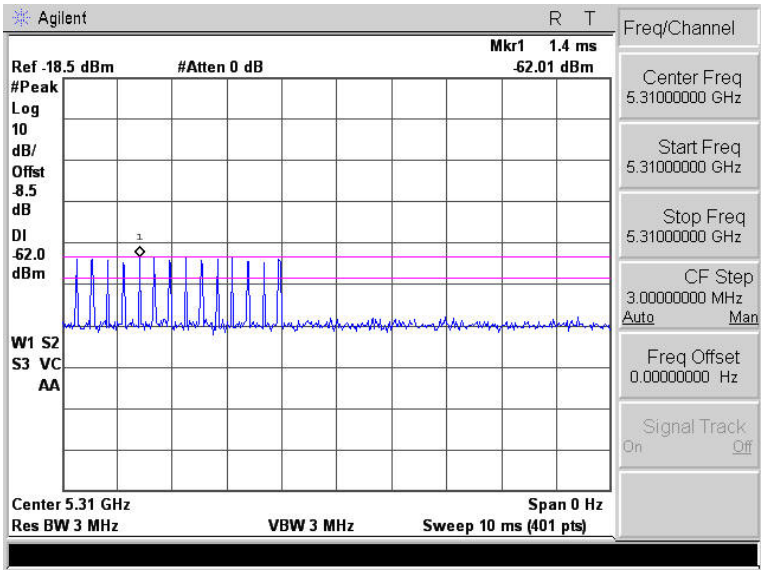
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz
Radar Type 2



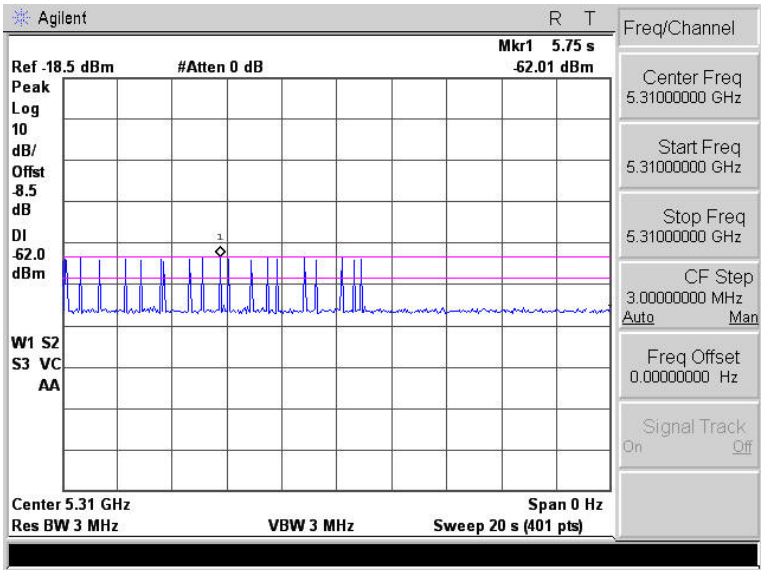
Radar Type 3



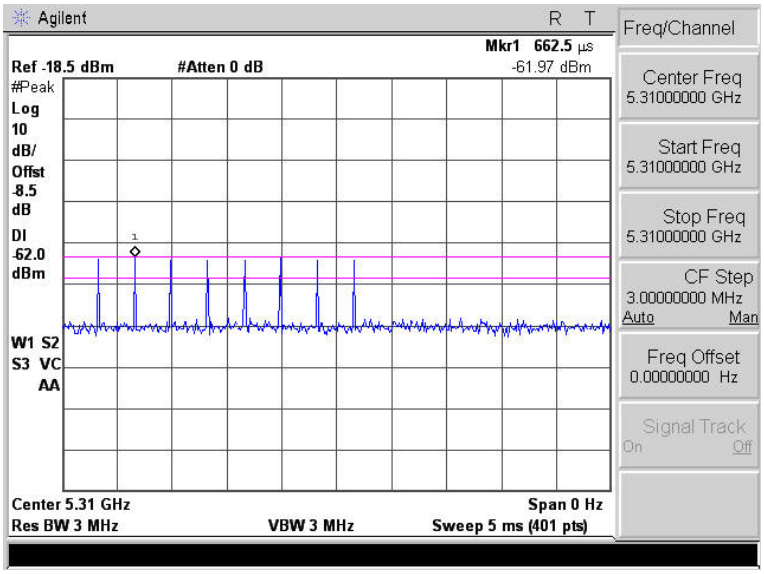
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz
Radar Type 4



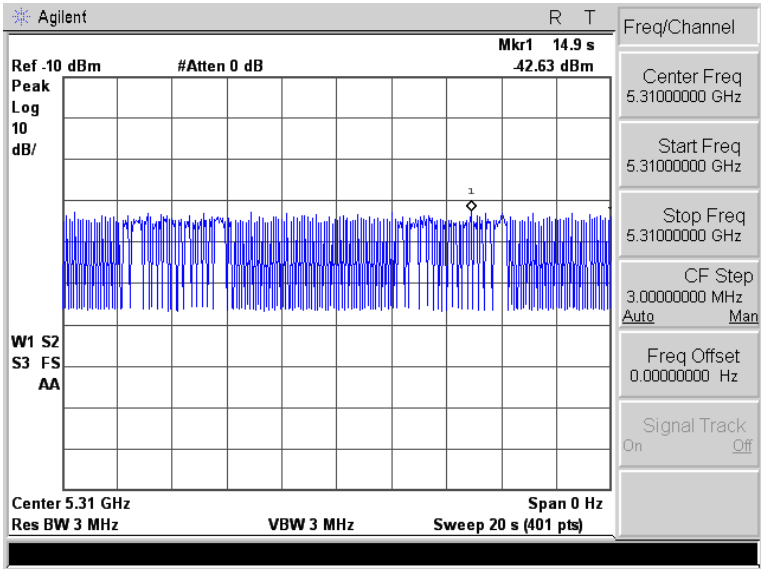
Radar Type 5



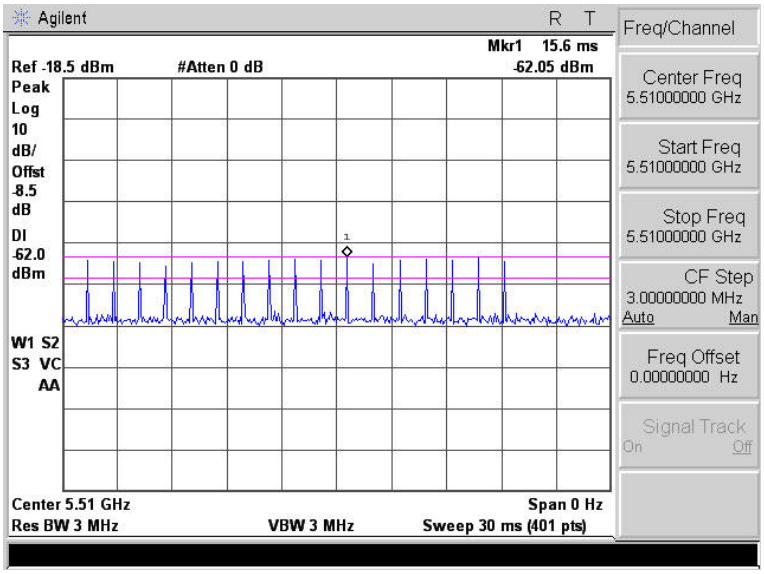
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz
Radar Type 6



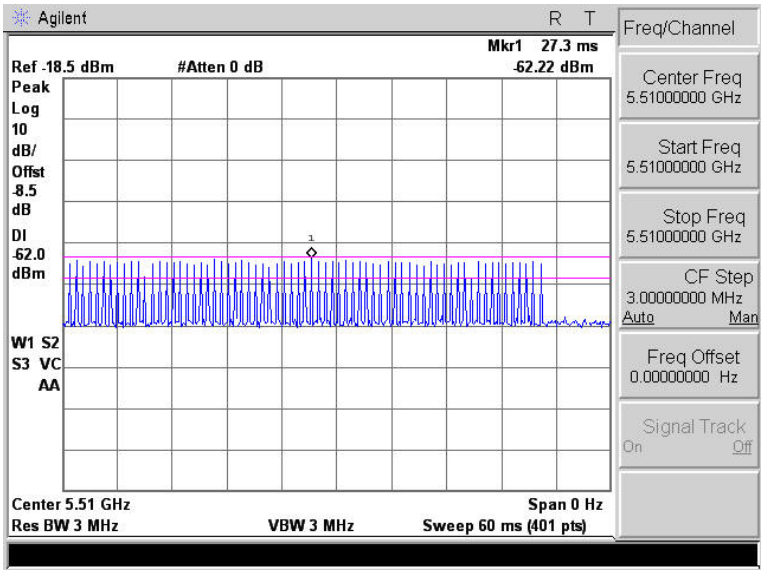
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz
Traffic



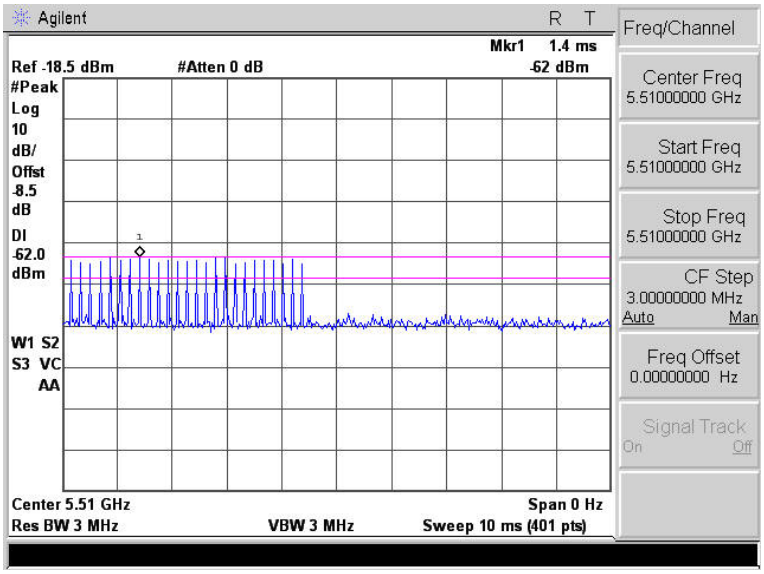
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Radar Type 0



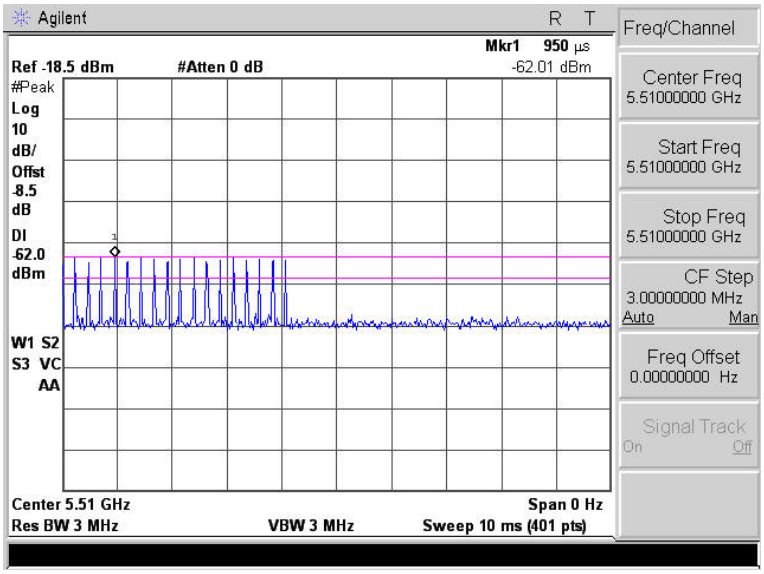
Radar Type 1



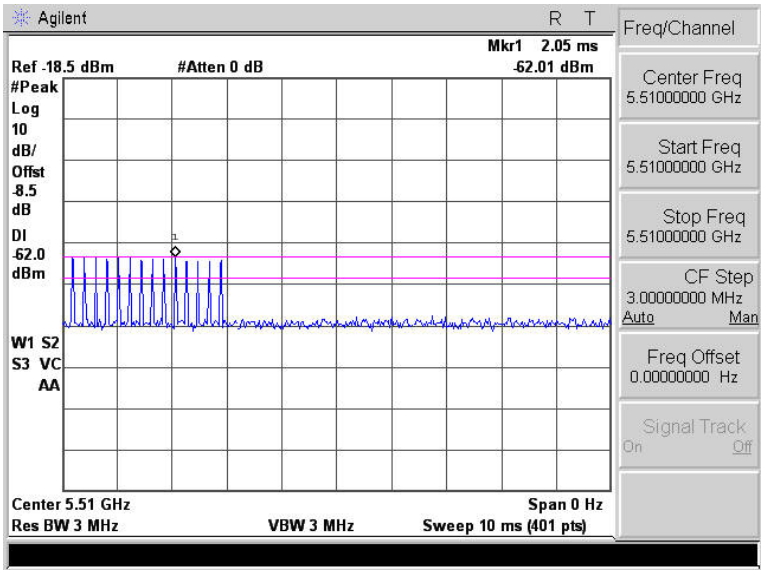
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Radar Type 2



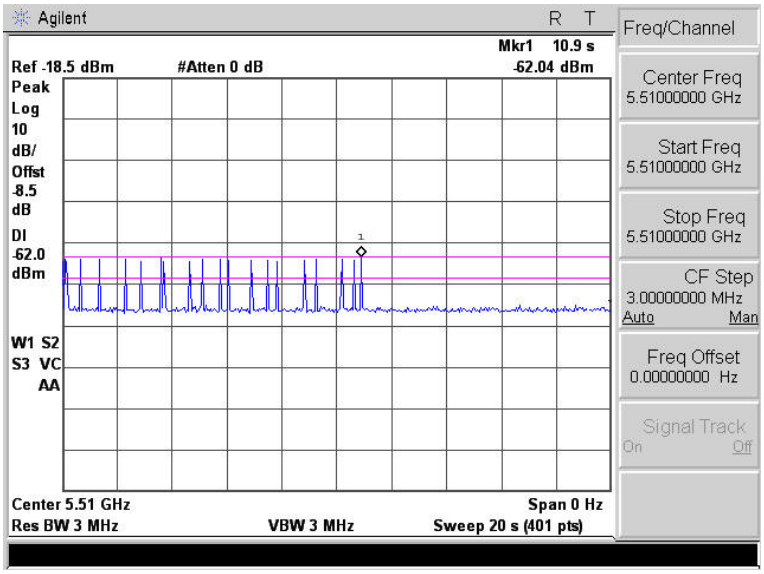
Radar Type 3



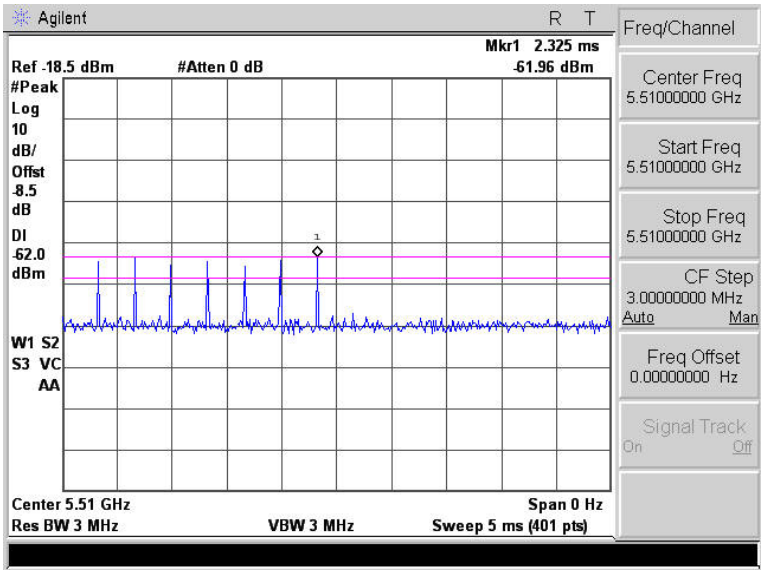
Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Radar Type 4



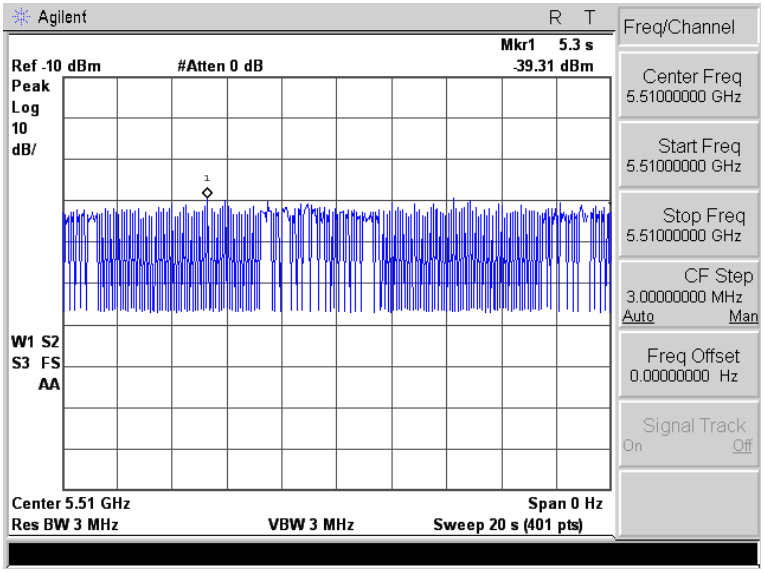
Radar Type 5



Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Radar Type 6



Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Traffic



5.2. Channel Availability Check Time

5.2.1. Procedure to Determine Initial Power-Up Cycle Time

A link was established on channel then the EUT was rebooted. The time from the cessation of traffic to the re-initialization of traffic was measured as the time required for the EUT to complete the total power-up cycle. The time to complete the initial power-up period is 60 seconds less than this total power-up time.

5.2.2. Procedure for Timing Of Radar Burst

With a link established on channel, the EUT was rebooted. A radar signal was triggered within 0 to 6 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

The Non-Occupancy list was cleared. With a link established on channel, the EUT was rebooted. A radar signal was triggered within 54 to 60 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

5.2.3. Quantitative Results

These tests are not applicable.

5.3. Overlapping Channel Tests

These tests are not applicable.

5.4. Move and Closing Time

5.4.1. Reporting Notes

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse.

This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = (Number of analyzer bins showing transmission) * (dwell time per bin)

The observation period over which the FCC aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

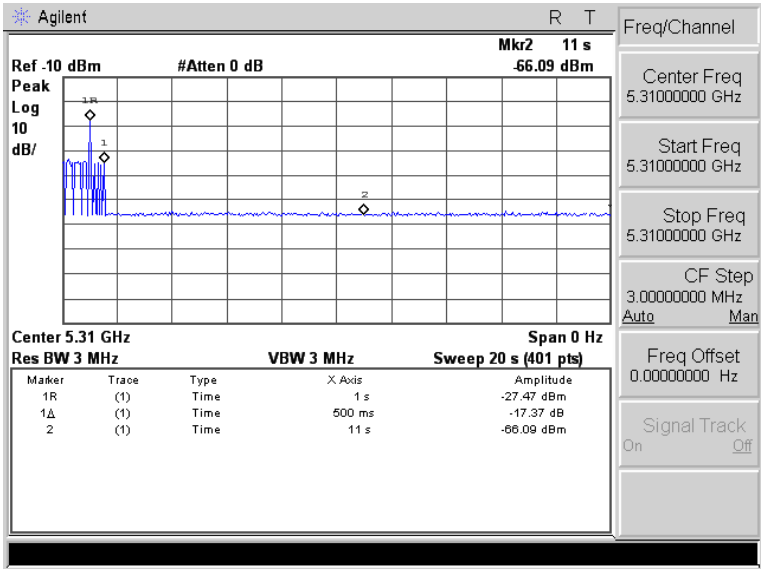
5.4.2. Results

Frequency (MHz)	Radar Type	Channel Move Time (msec)	Limit (sec)
5310	Type 0	500	10
5510	Type 0	500	10

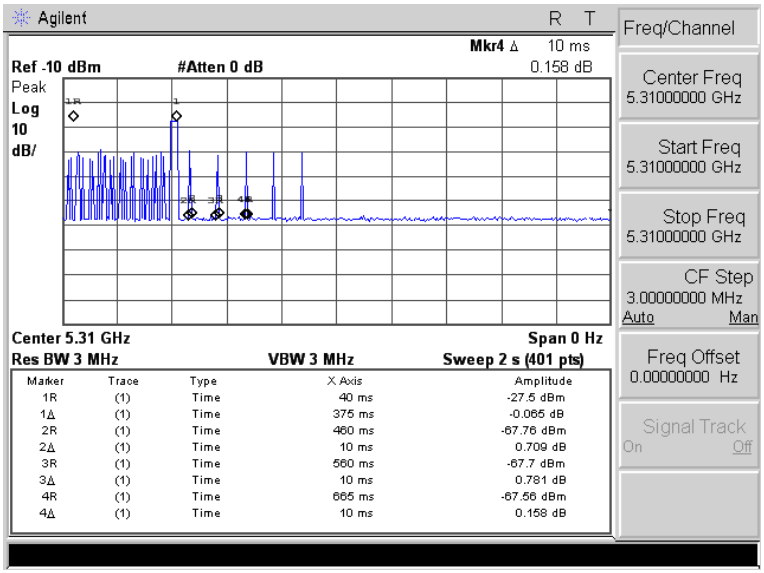
Frequency (MHz)	Radar Type	Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
5310	Type 0	50	260
5510	Type 0	50	260

Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz

Move Time



Channel Closing Time-1



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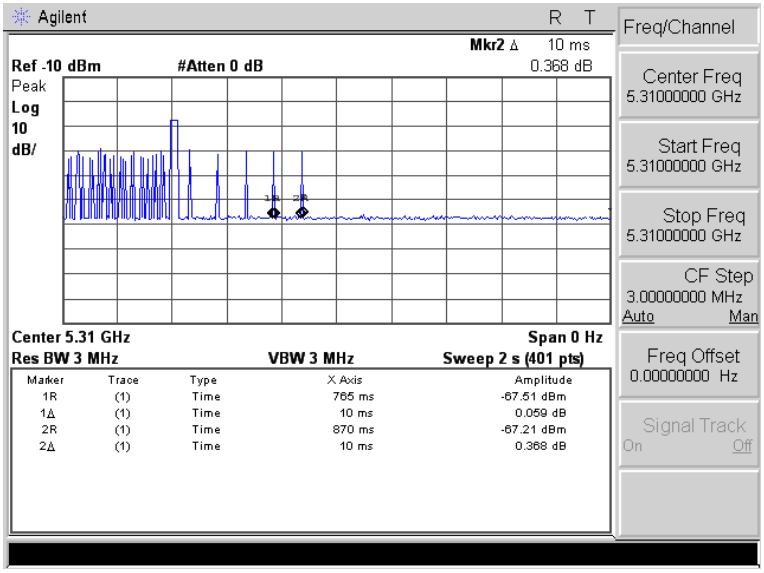
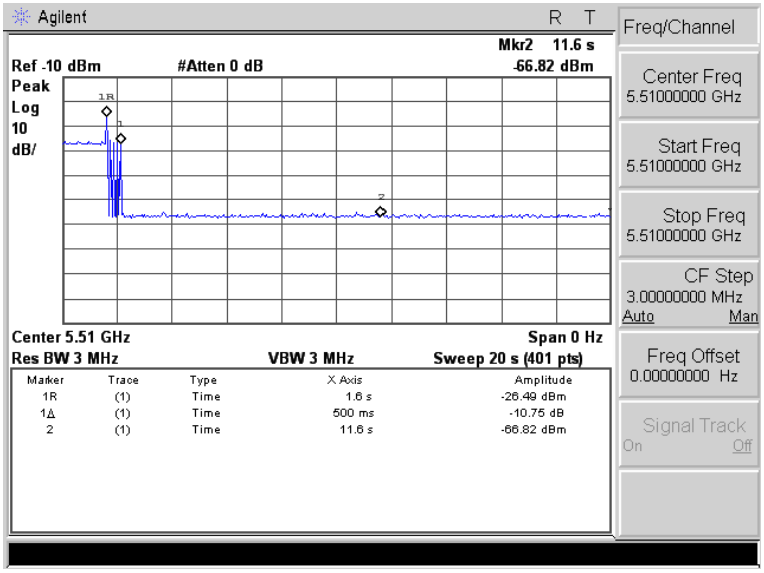
Channel Closing Time-2

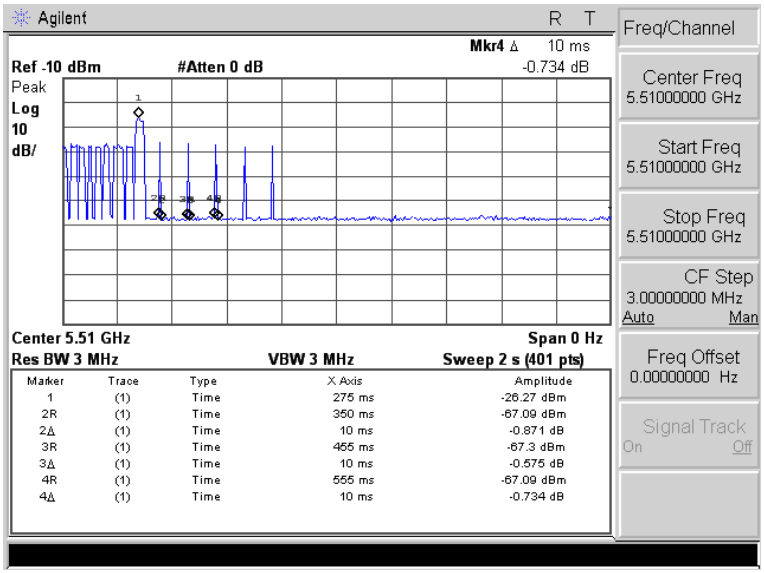


Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz

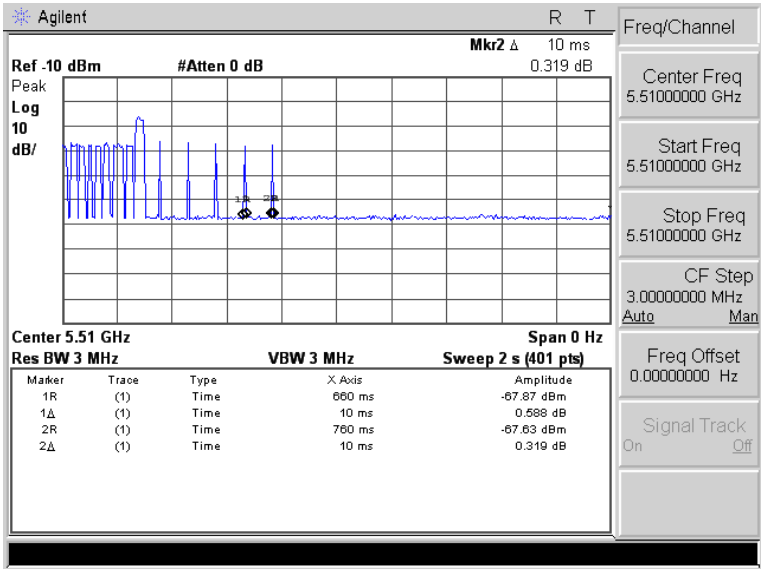
Move Time



Channel Closing Time-1



Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Channel Closing Time-2

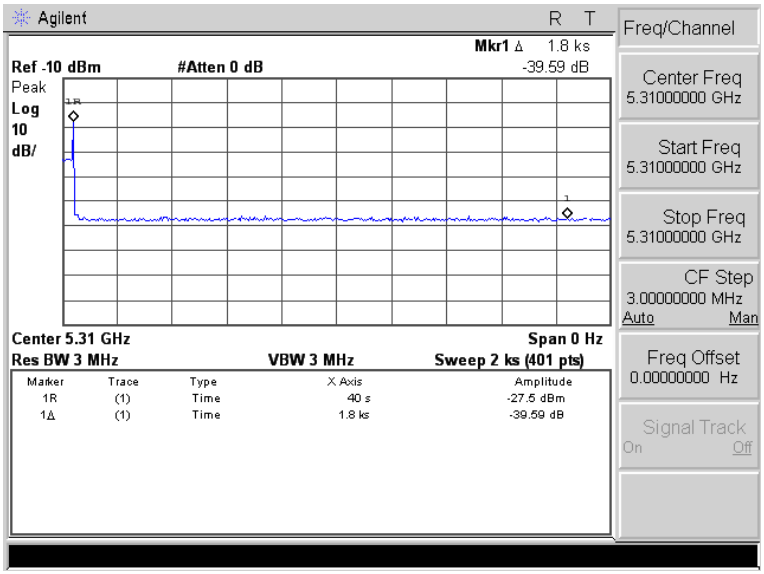


5.5. Non-Occupancy Period

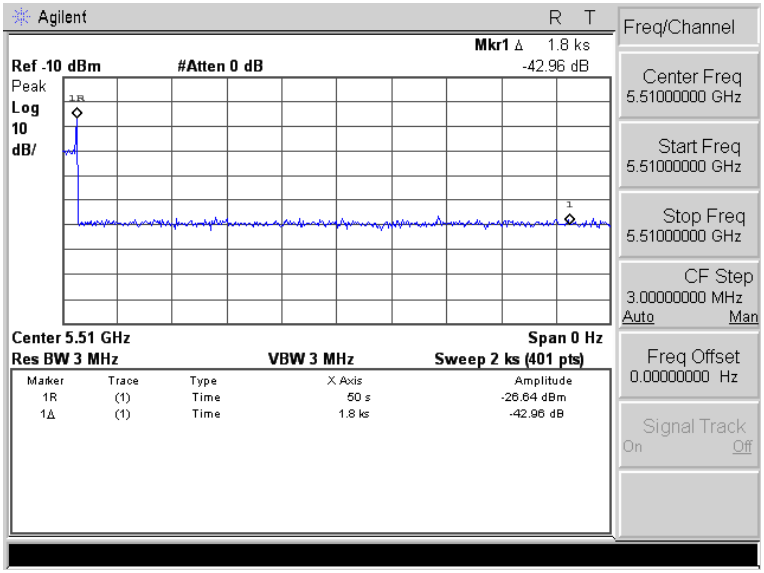
5.5.1. Results

No EUT transmissions were observed on the test channel during the 30-minute observation time.

Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5310MHz
Non-Occupancy Period



Mode 1: IEEE 802.11n 5GHz (40MHz) link mode _ 5510MHz
Non-Occupancy Period



5.6. Detection Bandwidth

These tests are not applicable.

5.7. In-Service Monitoring

These tests are not applicable.