TÜVRheinland®
Precisely Right.

Dynamic Frequency Selection Test Report

EUT Name: IPTV WIFI SET TOP BOX

Model No.: VIP5662W

RSS 247: 2015

Prepared for:

Chris Rubis
ARRIS Group
6450 Sequence Drive
San Diego, CA 92121
Tel: (858) 404 3570

Prepared by:

TUV Rheinland of North America, Inc.
1279 Quarry Lane
Pleasanton, CA 94566
Tel: (925) 249-9123
Fax: (925) 249-9124
http://www.tuv.com/

Report/Issue Date: 30 Jan 2016
Report Number: 31563164.001Rev 3

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	10/24/2015	Original Document	N/A
1	11/02/2015	Updated to revise Power table on page 39	SK
2	12/17/2015	Changed Beamforming condition and added notes about channel monitoring.	SK
3	01/30/2016	Added plots for 30 min Non- Occupancy	SK

Note: Latest revision report will replace all previous reports.

This report is prepared by:

Suresh Kondapalli

Test Engineer
Date: Jan 30, 2016

David Spencer

Lab Manager
Date: Jan 30, 2016.

Table of Contents

1.0 Dynamic Frequency Selection 4

1.1 DFS Applicability 4

1.2 DFS Requirements 5

1.3 Test Setup Protocol 8

1.4 Radar Waveform Verifications 9

1.5 In-Service Monitoring 11

1.5.1 Bandwidth of 20 MHz 30

1.5.2 Bandwidth of 40 MHz 30

1.5.3 Bandwidth of 80 MHz 31

1.5.4 Bandwidth of 20 MHz 5500MHz 32

1.5.5 Bandwidth of 40 MHz 5500MHz 32

1.5.6 Bandwidth of 80 MHz 5500MHz 33

2 Test Equipment Use List 34

3.0 Photos 35

3.1 EUT Photos 35

3.2 Setup Photos 40

4 EMC Test Plan 42

4.1 Introduction 42

4.2 Manufacturer 42

4.3 Equipment Under Test (EUT) 43

4.4 Configuration(s) 46

1.0 Dynamic Frequency Selection

Testing was performed in accordance with CFR47 Part 15.407 (h). These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures and verifies the characteristics and probability of EUT to switch to different operating channel, once the radar signal is detected. Procedures described in FCC-06-96A1 were used.

1.1 DFS Applicability

All devices operated in the frequency range of 5250 MHz-5350 MHz and 5470 MHz-5725MHz must equip with the DFS mechanism. Base on the operational mode of VIP5662W the following requirements shall apply per FCC-06-96A1procedures.

Table 1: Applicability of DFS Requirements Prior to Use of a Channel

Requirement	**Operational Mode**		
	Master	**Client Without Radar Detection**	**Client With Radar Detection**
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
Uniform Spreading	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	**Client w/o Radar Detection**	**Client With Radar Detection**
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required	Yes

1.2 DFS Requirements

Base on the applicability of VIP5662W*, the following parameters and probability must be tested for conformance.*

Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 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.	

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 80% of the U-NII 99% transmission power Bandwidth. See Note 3.

Note 1: The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:

- For the Short Pulse Radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar Burst generated.
- For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the Radar Waveform.

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 is used and 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	See
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	Roundup {(1/360)x (19x10E6/PRI uS	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

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

Details are available in 905462 D02 UNII DFS Compliance Procedures New Rules v01r02

Table 6: Long Pulse Radar Test Waveform

Radar 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

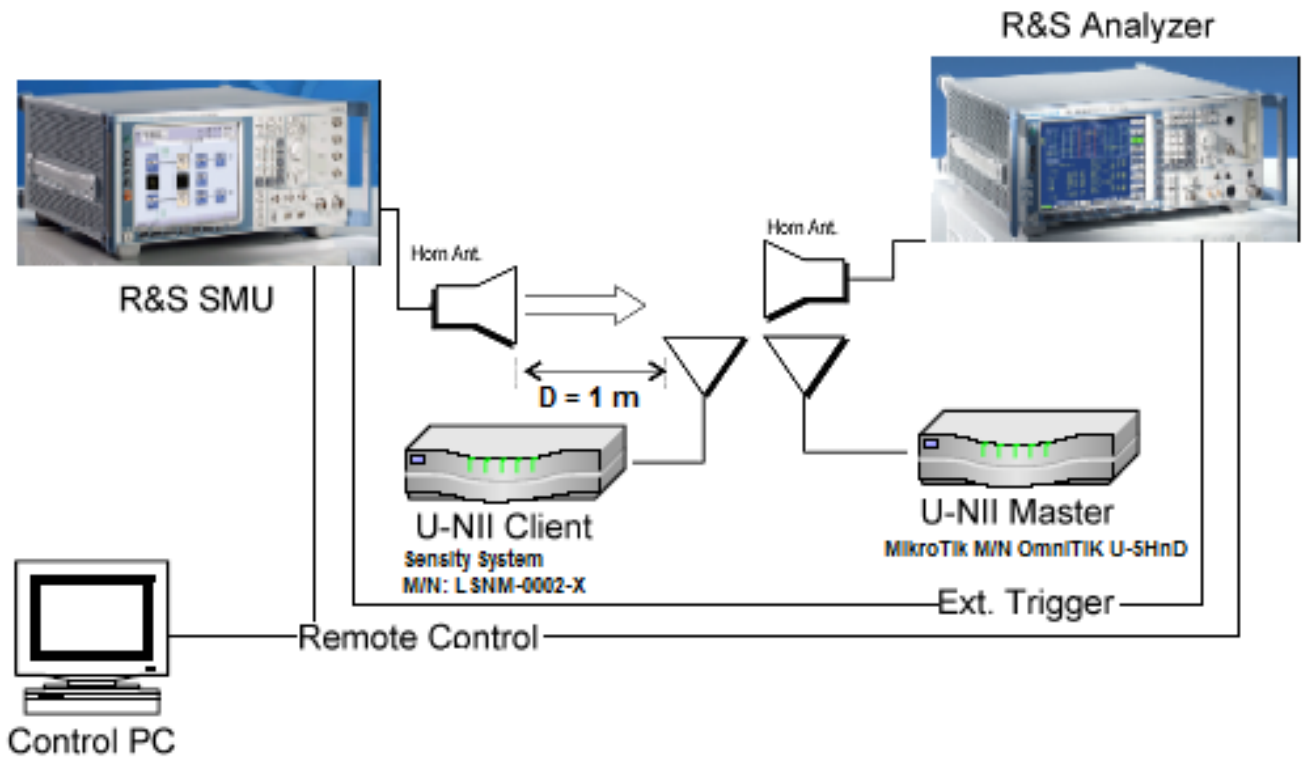
Table 7: Frequency Hopping Radar Test Waveform

Radar 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

1.3 Test Setup Protocol

The following test setup was used to evaluate the IPTV WIFI SET TOP BOX *for DFS conformance.*

Dynamic Frequency Selection in Block Diagram: Radiated Setup



Simplified Block diagram of Dynamic Frequency Selection Testing

1.4 Radar Waveform Verifications

The radar signal level must be -60 dBm (-64 dBm+ 3dB +1dB).

Note:

3dB is added for minimum antenna gain for Host Device to insure that the Radar-Injection-Level is above the AP-Detection-Threshold-Level

These waveforms were compensated for the path loss as offset on spectrum analyzer.

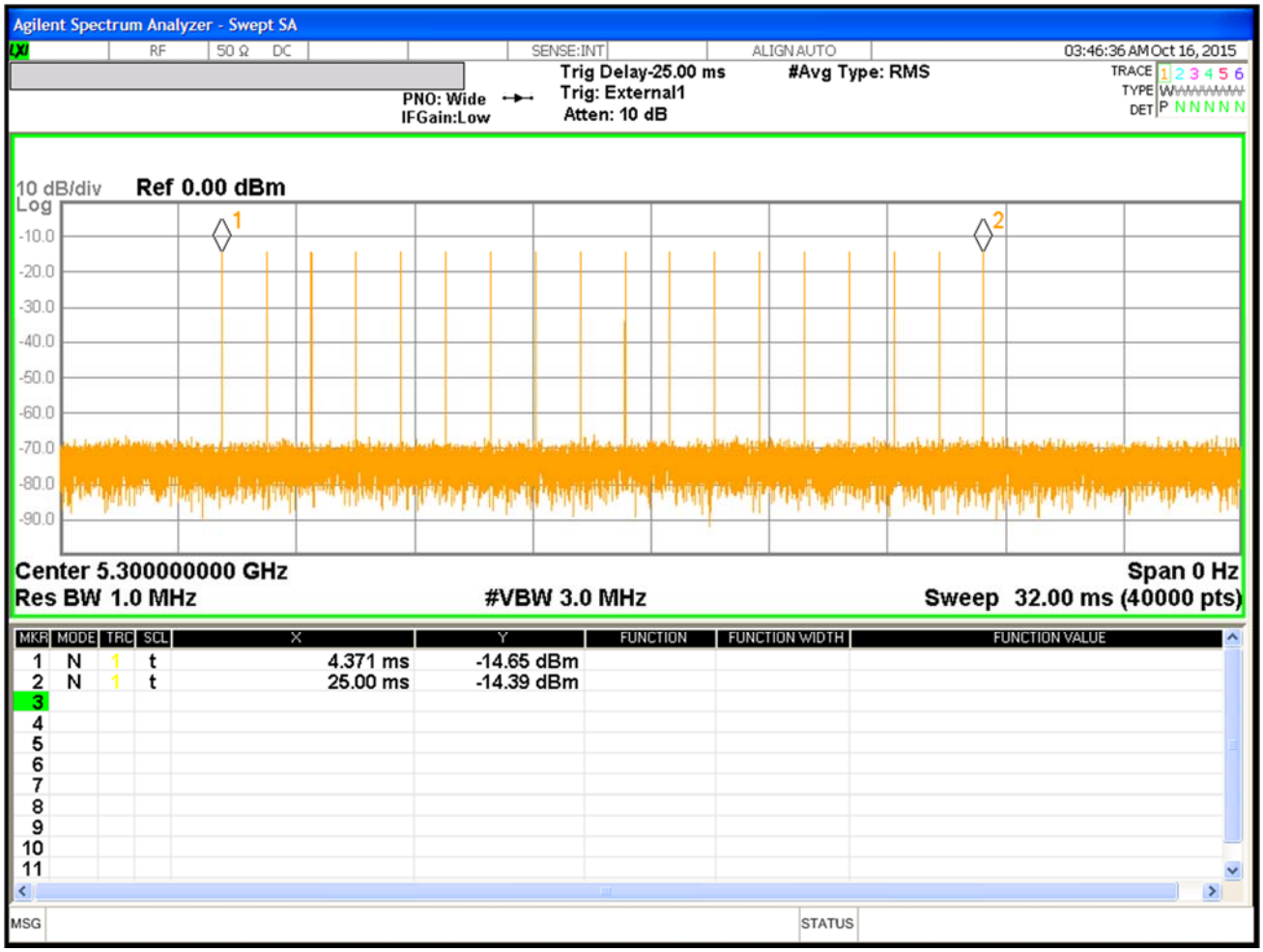


Figure 1: 5300 MHz Radar Pulse Type 0 at Master

Figure 2: 5500 MHz Radar Pulse Type 0 at Master

1.5 In-Service Monitoring

In-service monitoring performance checks consist of the channel move time, channel Closing transmission time, and non-occupancy period. These parameters of the IPTV WIFI SET TOP BOX *is verified to give the radar system the priority of the frequency Band and minimize the interference with nearby radar systems when the* IPTV WIFI SET TOP BOX *is being used.*

The IPTV WIFI SET TOP BOX is a client device without any radar detection.

The verified Pulse #0 was conductively injected to the above test circuit. Since Arris VAP3400 series Wireless Access Point was qualified for DFS, the IPTV WIFI SET TOP BOX was evaluated with the Arris VAP3400 series Wireless Access Point as a whole network system for conformance to the channel move time and channel closing transmission time.

As originally tested, the IPTV WIFI SET TOP BOX was found to be compliant to the requirements of the test standard(s).

Table 8: DFS Response – Test Results

Test Method: Conducted					
Center Frequency: see below.			**EUT State:** Streaming MPEG Video		
Min. Antenna Gain: 0.5dB			**Max. Transmitted Power:** nominal		
Required Threshold: -64dBm			**Detection Threshold:** -40dBm used at supporting AP		
Ambient Temperature: 21° C			**Relative Humidity:** 38 RH%		
Bandwidth (MHz)	**Channel (MHz)**	**CMT (msec)**	**CCTT (msec)**	**Figure**	**Results**
20	5300	131.9	13.2	Plot 3,4	Complies
40	5300	66.76	21.9	Plot 6, 7	Complies
80	5300	161.70	19.2	Plot 9, 10	Complies
20	5500	183.6	83.4	Plot 12, 13	Complies
40	55000	138.2	14.7	Plot 15, 16	Complies
80	5500	189.2	15.6	Plot 18, 19	Complies

Note1: One channel was evaluated as VIP5662W employs as same chip set for all bands of operation.

Note2: 30 min Non-Occupancy Plots are at 5, 8, 11, 14. 17 and 20.
CCTT= Channel Closing Transmission Time.

CMT= Channel Move Time

Figure 3: Channel move time, signal plot for 12Secs at 5300 MHz for 20MHz BW

Figure 4: Channel moving time at 5300MHz with 20MHz BW

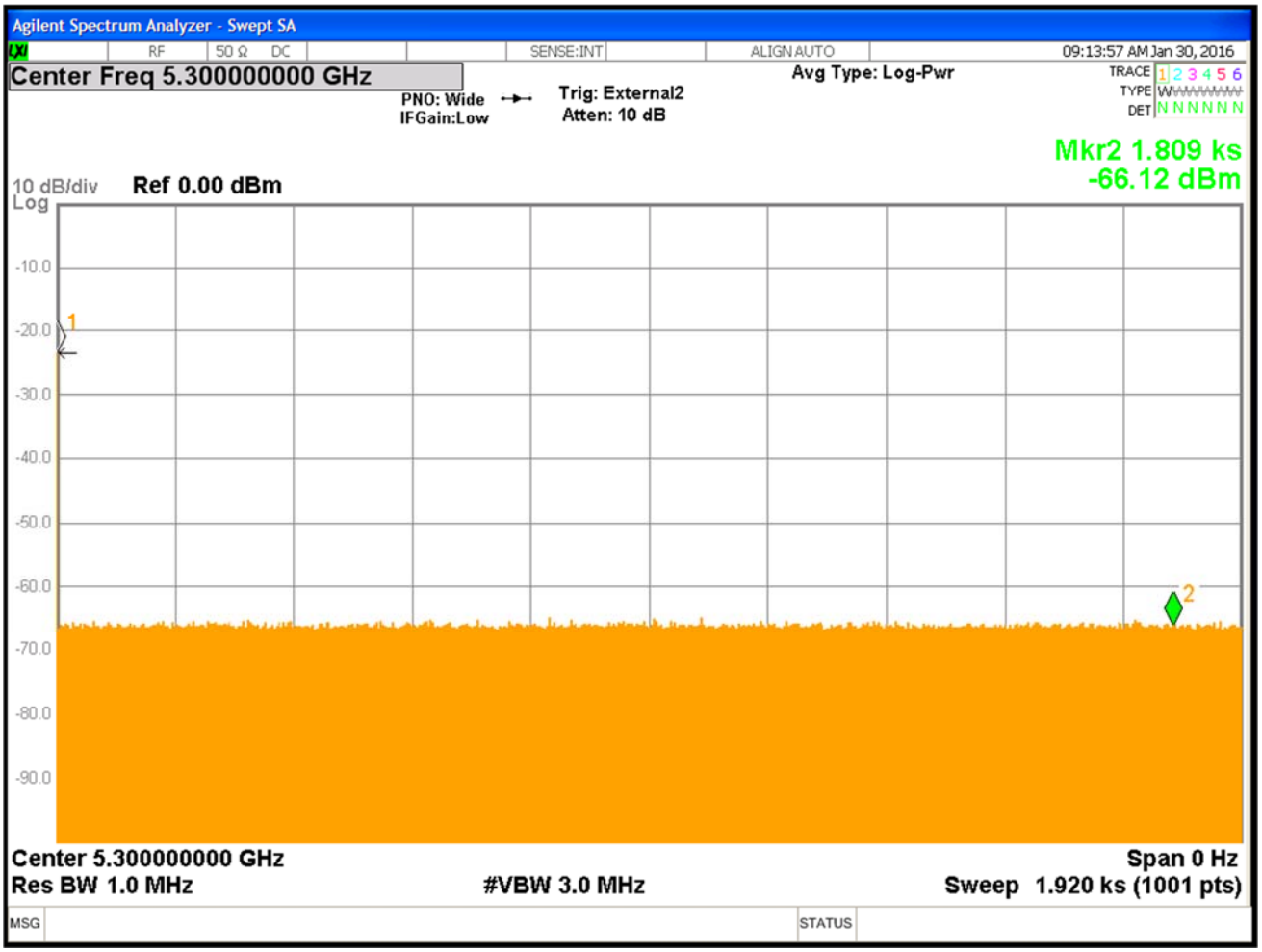


Figure 5: Channel Non–occupancy plot for 32min at 5300MHz with 20MHz BW
Master and slave moved to Ch#161

Figure 6: Channel moving time at 5300MHz with 40MHz BW

Figure 7: Channel moving time at 5300MHz Zoom in Plot with 40MHz BW

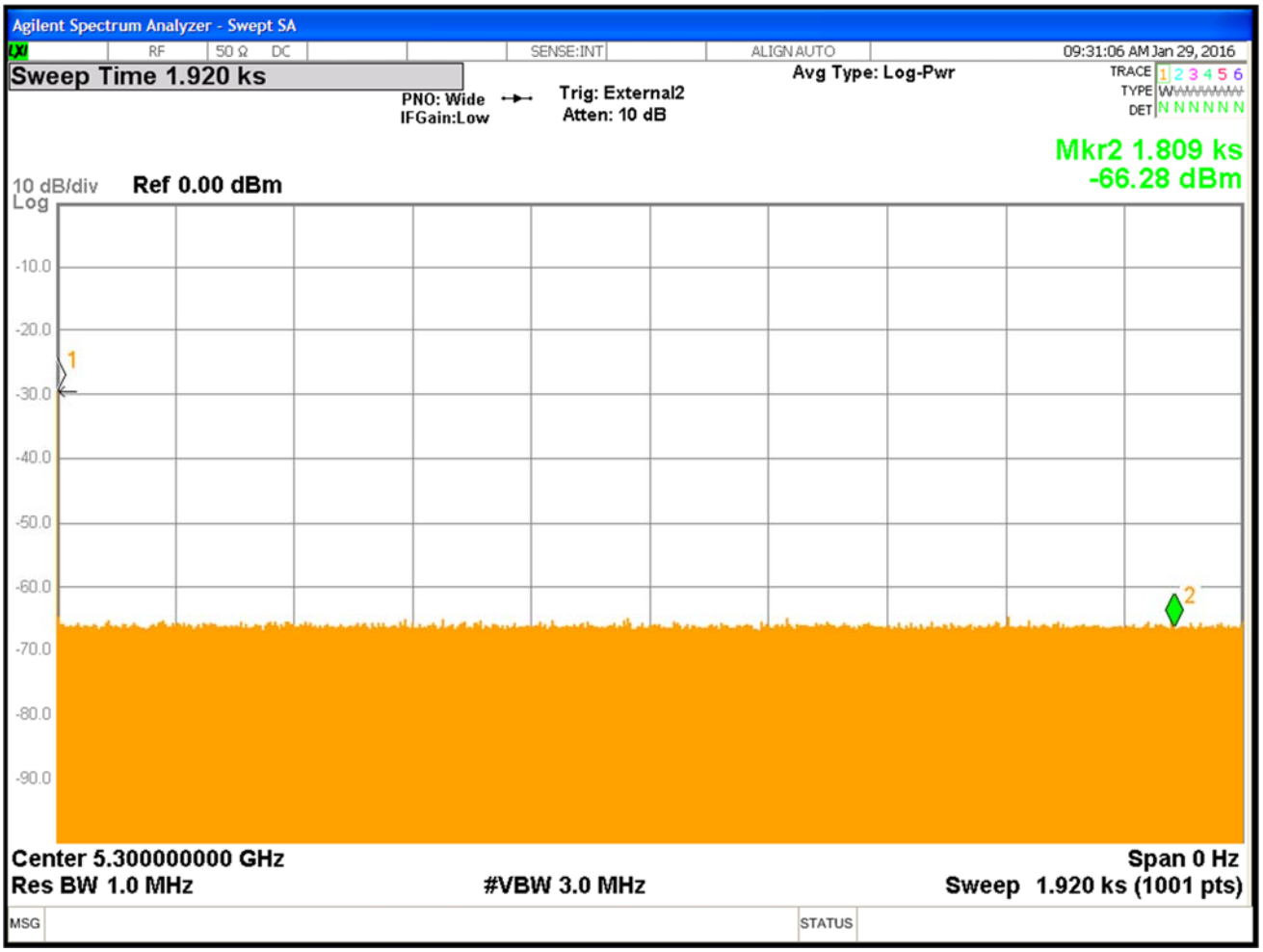


Figure 8: Channel Non–occupancy plot for 32min at 5300MHz with 40MHz BW
Master and slave moved to Ch#48

Figure 9: Channel moving time at 5300MHz with 80MHz BW

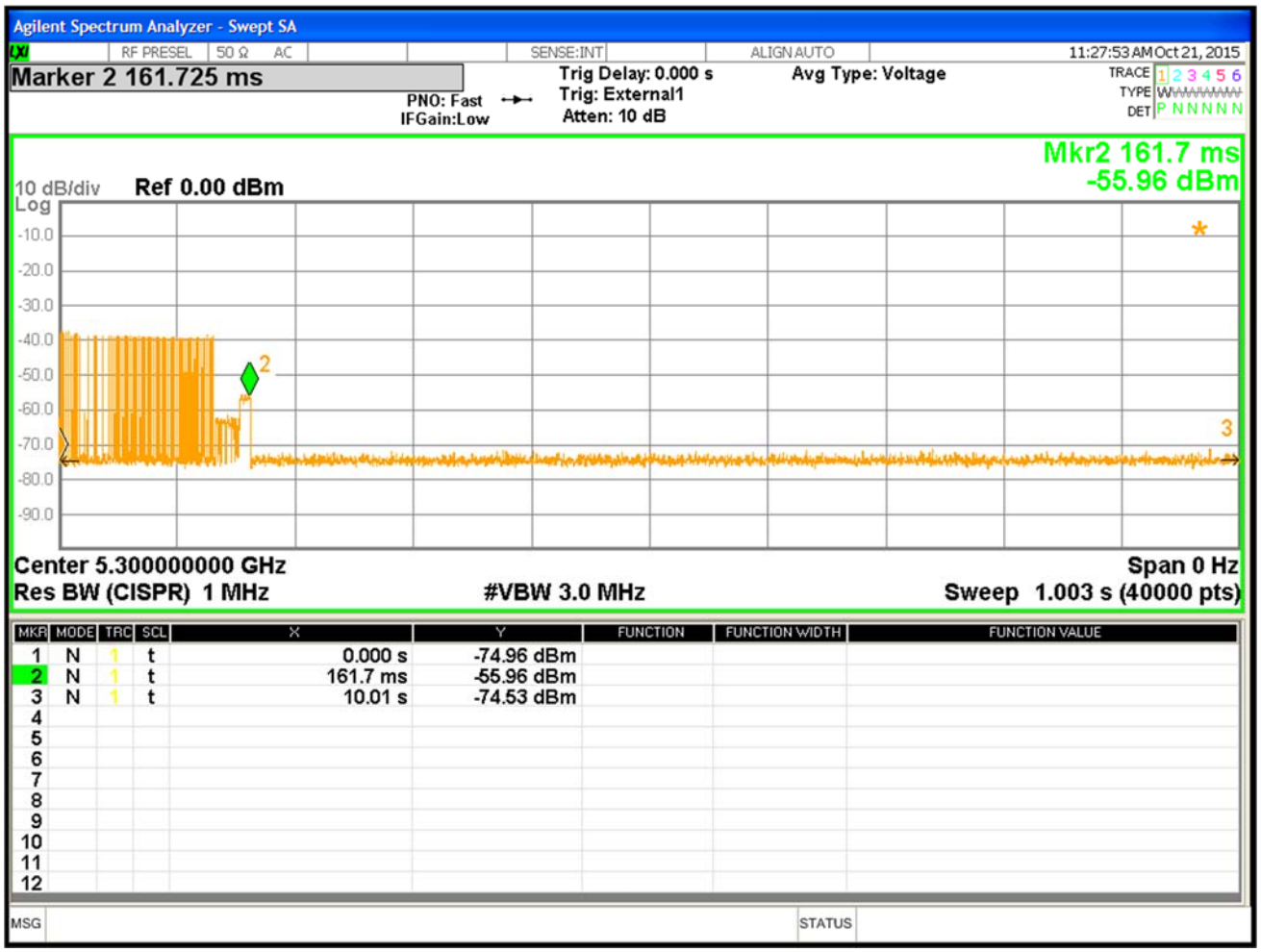


Figure 10: Channel moving time at 5300MHz, Zoom in Plot _with 80MHz BW

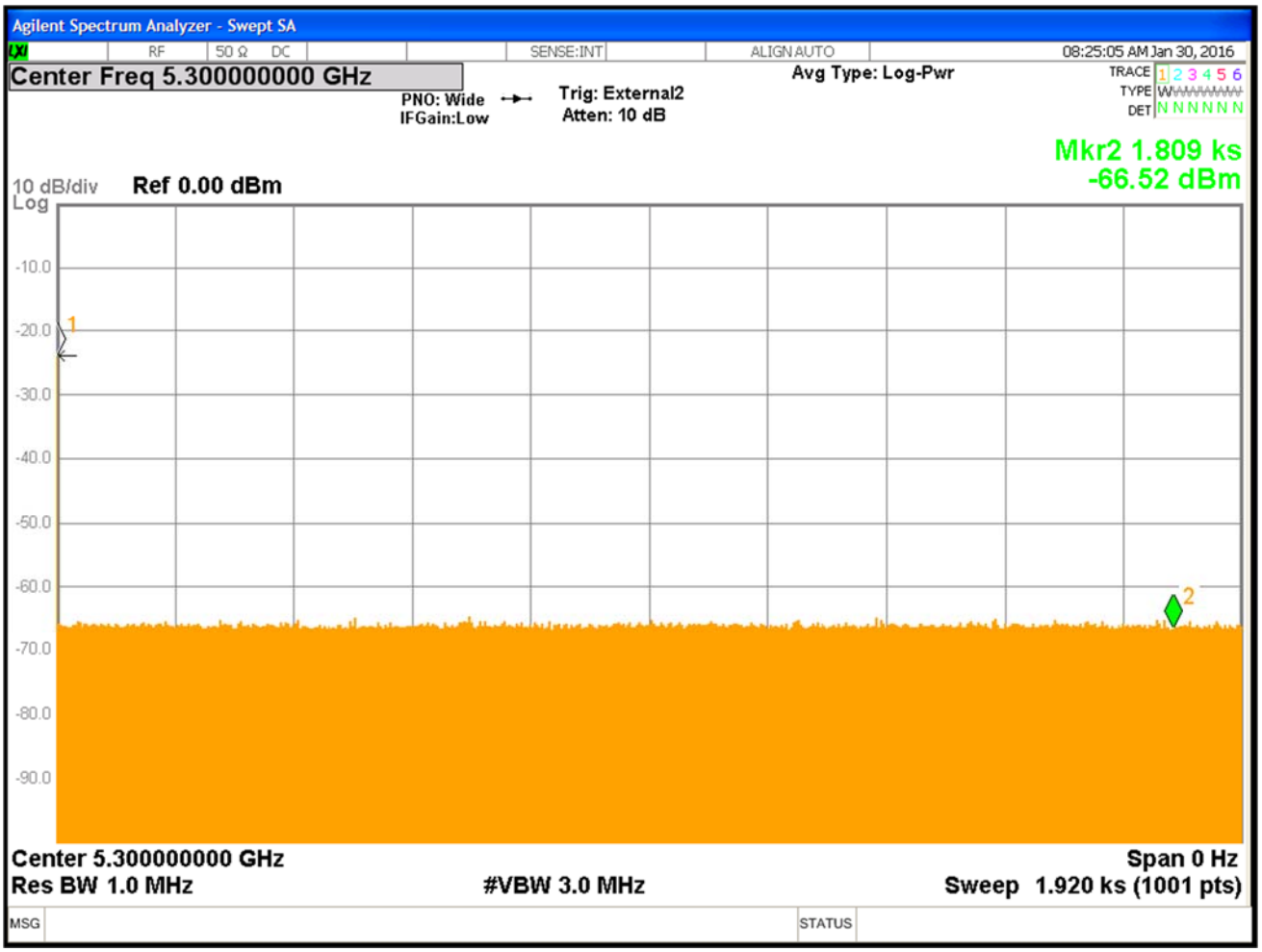


Figure 11: Channel Non–occupancy plot for 32min at 5300MHz with 80MHz BW
Master and slave moved to Ch#149

Figure 12: Channel moving time at 5500MHz in Plot _with 20MHz BW

Figure 13: Channel moving time at 5500MHz Zoom in Plot _with 20MHz BW

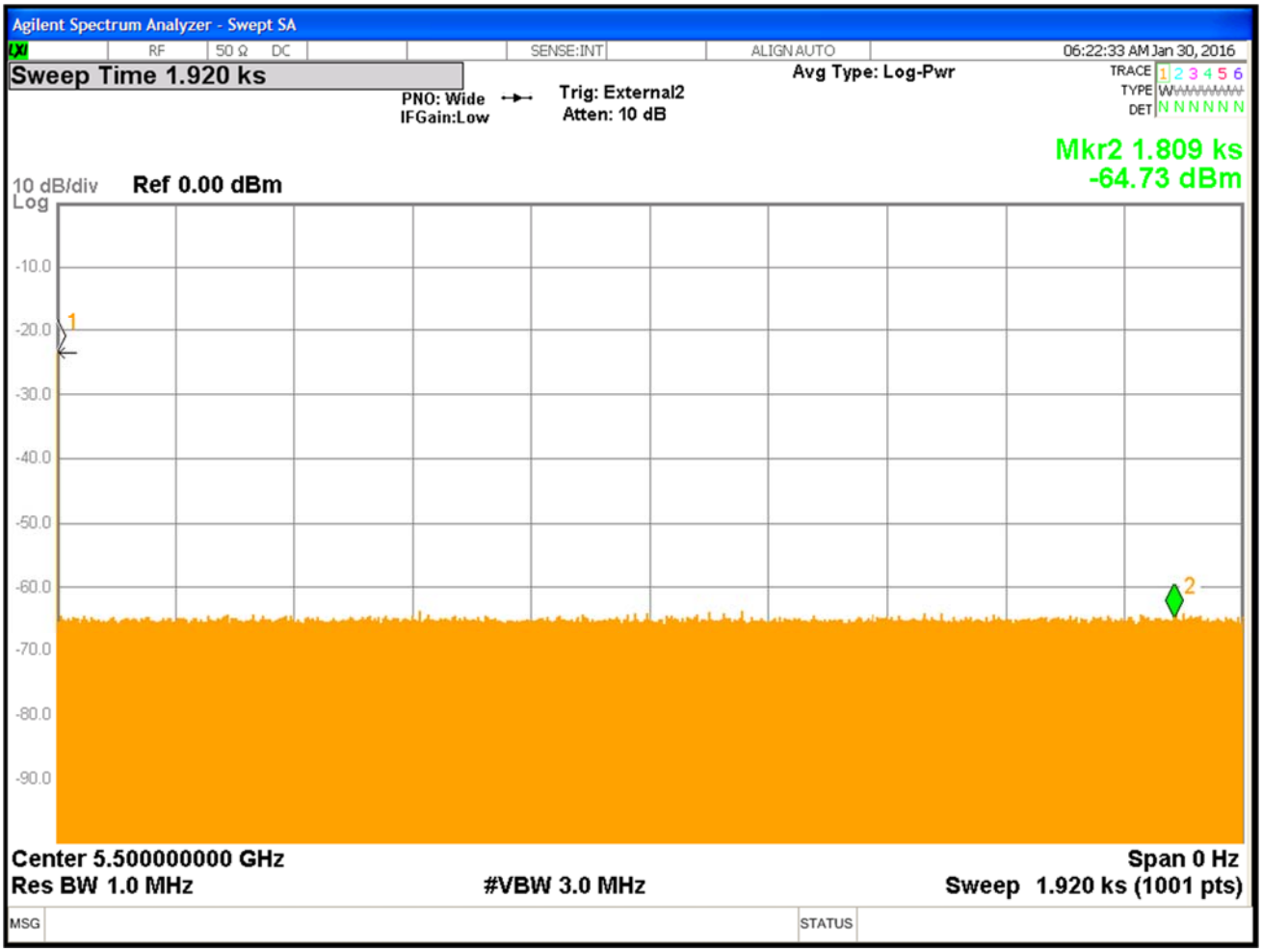


Figure 14: Channel Non–occupancy plot for 32min at 5500MHz with 20MHz BW
Master and slave moved to Ch#161

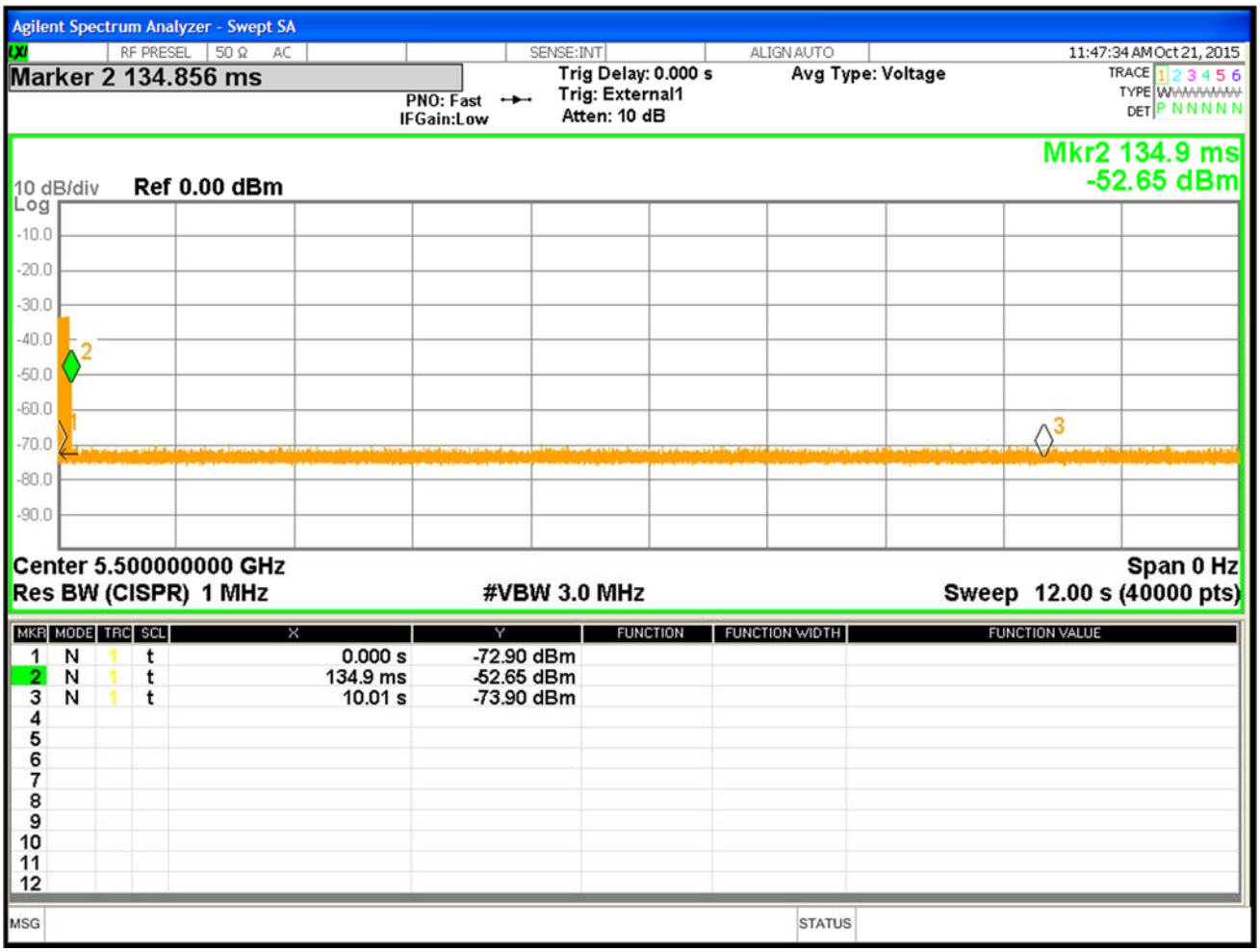


Figure 15: Channel moving time at 5500MHz Plot _with 40MHz BW

Figure 16: Channel moving time at 5500MHz Zoom in Plot _with 40MHz BW

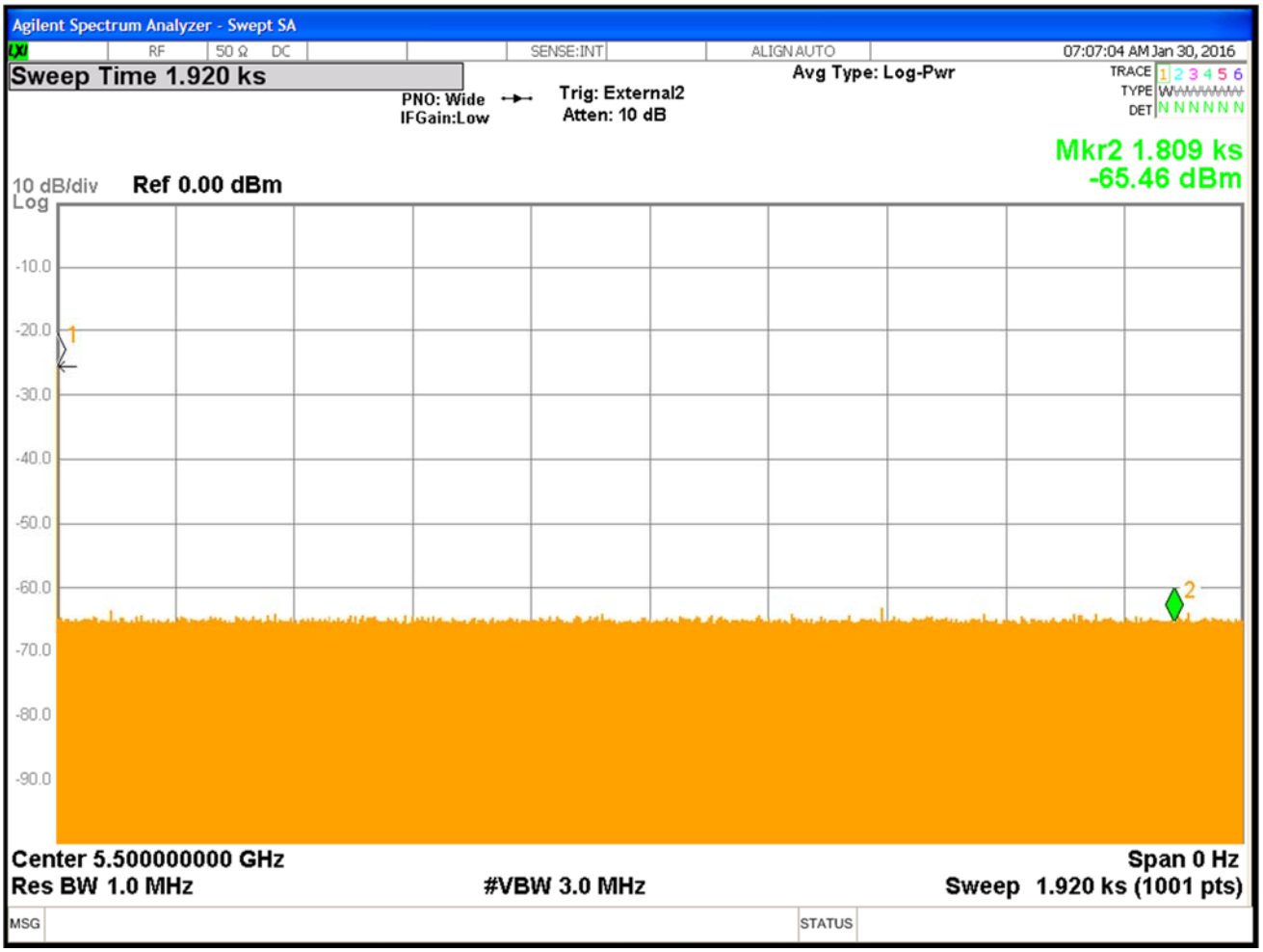


Figure 17: Channel Non–occupancy plot for 32min at 5500MHz with 40MHz BW
Master and slave moved to Ch#48

Figure 18: Channel moving time at 5500MHz Plot _with 80MHz BW

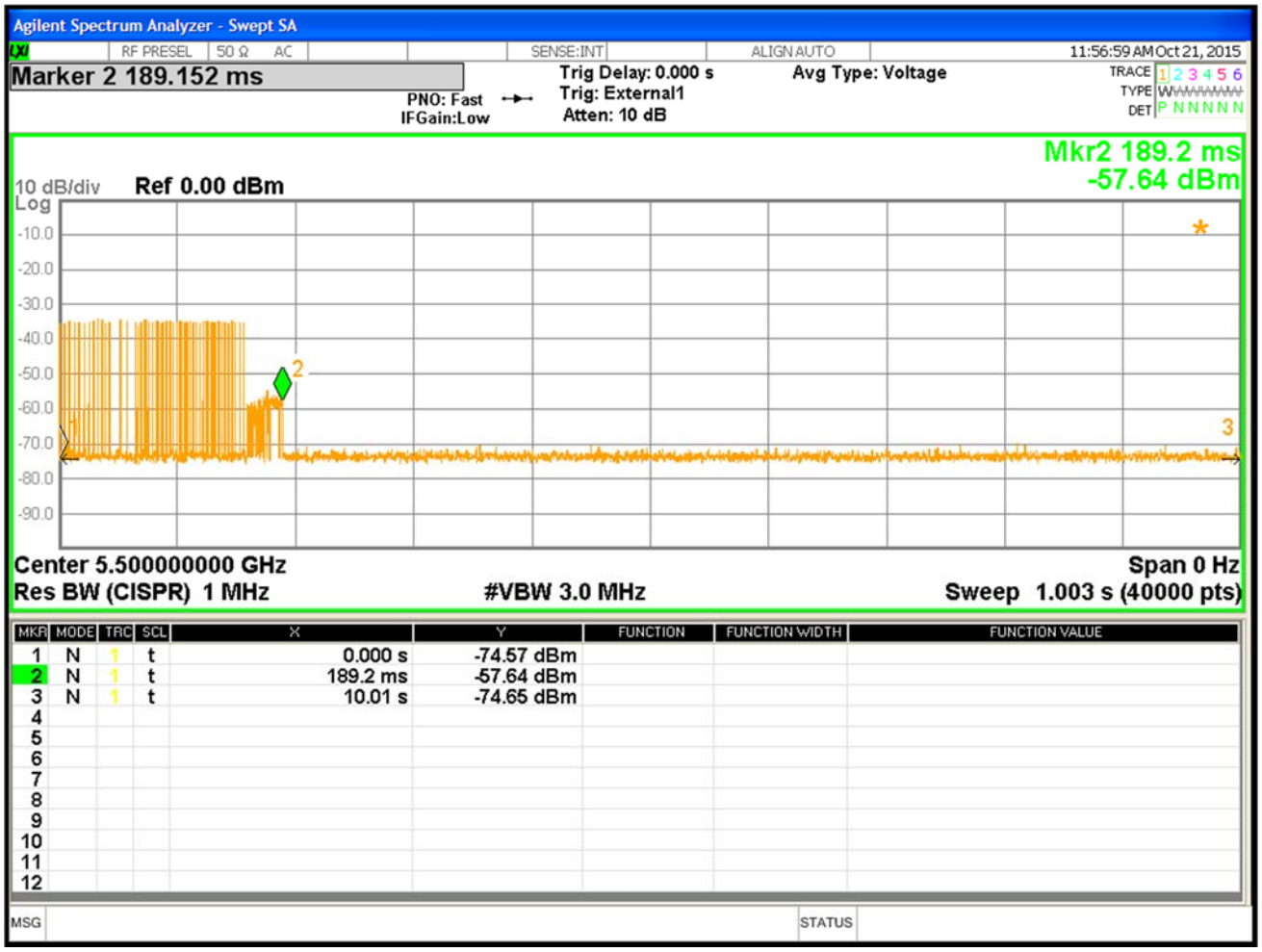


Figure 19: Channel moving time at 5500MHz Zoom in Plot _with 80MHz BW

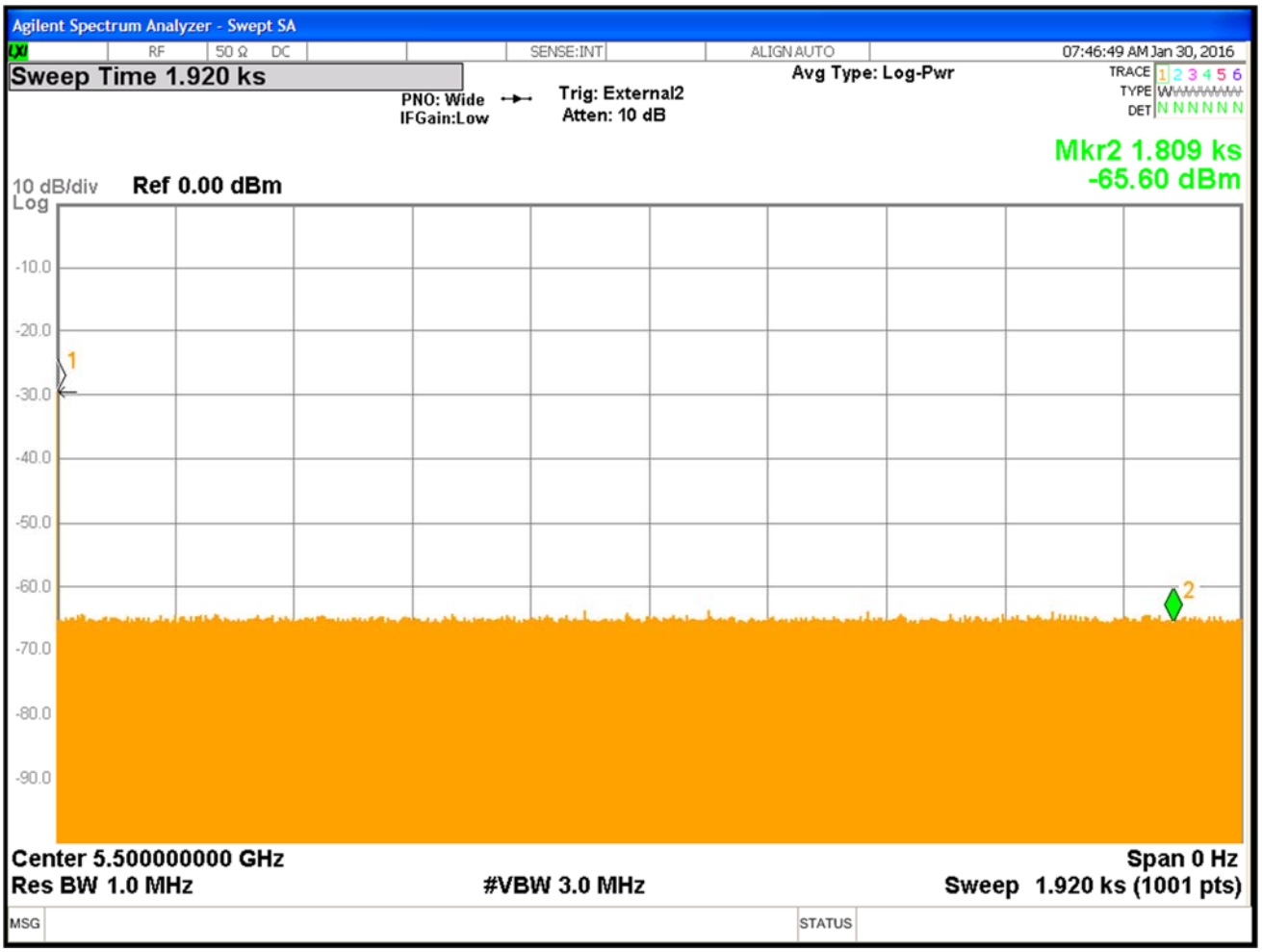


Figure 20: Channel Non–occupancy plot for 32min at 5500MHz with 80MHz BW
Master and slave moved to Ch#44

1.5.1 Bandwidth of 20 MHz

Channel Move Time and Channel Closing Transmission Time at 5300 MHz

Analysis of data from plot #: 3 for 20MHz BW

Sweep Bins	40000	bins
Start time	0.000	ms
Sweep Time	12000	ms
Threshold Level	-40	dBm
End of Radar Burst Bin	0	bins
Last of Radar Burst	0.00	ms
Total Bin Above Threshold	44	bins
Bin on After Burst	44	bins
Channel Closing Trans. Time	13.2	**ms**
Last Transmission	131.9	ms
Chanel Move Time	131.9	ms

Slave Device moved to Non DFS Channel# 48 along with master. No transmission was found at 5300MHz for 30 min

1.5.2 Bandwidth of 40 MHz

Channel Move Time and Channel Closing Transmission Time at 5300 MHz

Analysis of data from plot #: 5 for 40MHz BW

Sweep Bins	40000	bins
Start time	0	ms
Sweep Time	12000	ms
Threshold Level	-40	dBm
End of Radar Burst Bin	0	bins
Last of Radar Burst	0.00	ms
Total Bin Above Threshold	73	bins
Bin on After Burst	66	bins
Channel Closing Trans. Time	21.9	**ms**
Last Transmission	66.76	ms
Chanel Move Time	66.76	ms

Slave Device moved to Non DFS Channel# 38 (5190MHz) along with master. No transmission was found at 5300MHz for 30 min.

1.5.3 Bandwidth of 80 MHz

Channel Move Time and Channel Closing Transmission Time at 5300 MHz

Analysis of data from plot#: 7 for 80MHz BW.

Sweep Bins	40000	bins
Start time	0	ms
Sweep Time	12000	ms
Threshold Level	-40	dBm
End of Radar Burst Bin	0	bins
Last of Radar Burst	000	ms
Total Bin Above Threshold	64	bins
Bin on After Burst	64	bins
Channel Closing Trans. Time	19.2	**ms**
Last Transmission	161.70	ms
Chanel Move Time	161.70	ms

Slave Device moved to Non DFS Channel# 42 (5210MHz) along with master. No transmission was found at 5300MHz for 30 min.

1.5.4 Bandwidth of 20 MHz 5500MHz

Channel Move Time and Channel Closing Transmission Time at 5500 MHz

Analysis of data from plot #: 9 for 20MHz BW.

Sweep Bins	40000	bins
Start time	0.000	ms
SweepTime	12000	ms
Threshold Level	-40	dBm
End of Radar Burst Bin	0.00	bins
Last of Radar Burst	0.00	ms
Total Bin Above Threshold	278	bins
Bin on After Burst	278	bins
Channel Closing Trans. Time	83.4	**ms**
Last Transmission	183.6	ms
Chanel Move Time	183.6	ms

Slave Device moved to another DFS Channel# 112 (5560MHz) along with master. No transmission was found at 5500MHz for 30 min

1.5.5 Bandwidth of 40 MHz 5500MHz

Channel Move Time and Channel Closing Transmission Time at 5500 MHz

Analysis of data from plot #: 11 for 40MHz BW.

Sweep Bins	40000	bins
Start time	0	ms
Sweep Time	12000	ms
Threshold Level	-40	dBm
End of Radar Burst Bin	0	bins
Last of Radar Burst	0	ms
Total Bin Above Threshold	49	bins
Bin on After Burst	49	bins
Channel Closing Trans. Time	14.7	**ms**
Last Transmission	138.2	ms
Chanel Move Time	138.2	ms

Slave Device moved to another DFS Channel# 110 (5550MHz) along with master. No transmission was found at 5500MHz for 30 min

1.5.6 Bandwidth of 80 MHz 5500MHz

Channel Move Time and Channel Closing Transmission Time at 5500 MHz

Analysis of data from plot#: 13 for 80MHz BW

Sweep Bins	40000	bins
Start time	0	ms
Sweep Time	12000	ms
Threshold Level	-40	dBm
End of Radar Burst Bin	0	bins
Last of Radar Burst	000	ms
Total Bin Above Threshold	52	bins
Bin on After Burst	52	bins
Channel Closing Trans. Time	15.6	**ms**
Last Transmission	189.2	ms
Chanel Move Time	189.2	ms

Slave Device moved to Non DFS Channel# 46 (5210MHz) along with master. No transmission was found at 5500MHz for 30 min

2 Test Equipment Use List

Equipment	Manufacturer	Model	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Horn Antenna	EMCO	3115	9710-5301	10/08/2015	10/08/2016
Horn Antenna	Sunol Sciences	DRH-118	A040806	02/10/2015	02/10/2016
Spectrum Analyzer	Agilent	N9030A	100169	03/02/2015	03/02/2016
Spectrum Analyzer	Agilent	N9038A	MY51210195	01/12/2015	01/12/2016
Vector Signal Generator	Rohde & Schwarz	SMU200	1141.2005.02	10/01/2015	10/1/2016

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly. NCR=No Calibration Required

3.0 Photos

3.1 EUT Photos

Figure 21 – Photo of VIP5662W (Front)

Figure 22 – Photo of VIP5662W (Front)

Figure 23 – Photo of VIP5662W (Rear)

Figure 24 – Photo of VIP5662W (Right)

Figure 25 – Photo of VIP5662W (Left)

3.2 Setup Photos

Figure 26: Dynamic Frequency Selection Test Setup – Front View

Figure 27: Dynamic Frequency Selection Test Setup – Rear View

4 EMC Test Plan

4.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

4.2 Manufacturer

Table 1 – Manufacturer Information

Company Name	ARRIS Group, Inc
Address	6450 sequence Drive
City, State, Zip	San Diego, CA 92121
Country	United States of America

Table 10: Technical Contact Information

Name	Chris Rubis
E-mail	Chris.Rubis@arris.com
Phone	(858) 404 3570

4.3 Equipment Under Test (EUT)

Table 11: EUT Specifications

EUT Specification	
IPTV WIFI SET TOP BOX	24 cm x 17.7 cm x 5.3 cm
AC Adapter	120 – 277 Vac, 50 - 60Hz Netbit part #595889-001-00 Model: NBS30B120250VU Output 12V DC 2.5A
Environment	Indoor
Operating Temperature Range:	0 to 40 degrees C
Multiple Feeds:	[X] Yes and how many 4
Hardware Version	1.00
Part Number	597604-001
RF Software Version	37.4.0.25
Radio Module 802.11-radio modules	
Operating Mode	802.11a, HT20, and HT40 and 802.11AC
Transmitter Frequency Band	5.15 GHz to 5.25 GHz 5.25 GHz to 5.35 GHz 5.47 GHz to 5.725 GHz 5.725 GHz to 5.85 GHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	Internal Bi- Polar 0.5dBi
Modulation Type	AM ☐ FM ☐ DSSS ☒ OFDM ☐ other describe: QAM

Date Rate	802.11a - 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n HT20 – 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps 802.11n HT40 – 13.5, 27, 40.5, 54, 81, 108, 121.5, 135 Mbps 802.11nVHT80 - 32.5, 65, 97.5, 130, 195, 260, 292.5, 325, 390, 433.3 520, 780, 1040, 1170, 1269, 1560, 1733 Mbps
TX/RX Chain (s)	MIMO (4x4)
Directional Gain Type	☒ Uncorrelated ☐ No Beam-Forming Other describe:
Type of Equipment	☐ ☒ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☐ Other
Note: This report documents only the DFS requirements for 5150 – 5250 MHz, 5250-5350, 5470-5725MHz bands	

Table 12: EUT Channel Power Specifications

	802.11ac @	802.11n @	802.11a @
	Ch 80MHz	40MHz	20MHz
Power Setting @ Operating Channel	36 13	13	10
	40 13	13	10
	44 13	13	10
	48 13	13	10
	52 14	17	17
	56 14	17	17
	60 14	15	17
	64 14	15	17
	100 13	14	16
	104 13	14	16
	108 13	17	15
	112 13	17	15
	116 -1	-1	16
	120 -1	-1	-1
	124 -1	-1	-1
	128 -1	-1	-1
	132 18	17	15
	136 18	17	15
	140 18	16	15
	144 18	16	16
	149 12	13	15
	153 12	13	16
	157 12	17	17
	161 12	17	17
	165 -1	-1	17

Table 13: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
HDMI	HDMI	YES	2m	M

Table 14: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Dell	Precision M20	4SFSC91	EUT setup operating channel and mode
Access Point	Arris Group	VAP3402	M91531SA002L	Master device. It pings and controls set top box
HD TV	Vizio	VIZIO VX20L HDTV	LSAAAAH2503020	HD TV for display of Streaming video
Note:				

4.4 Configuration(s)

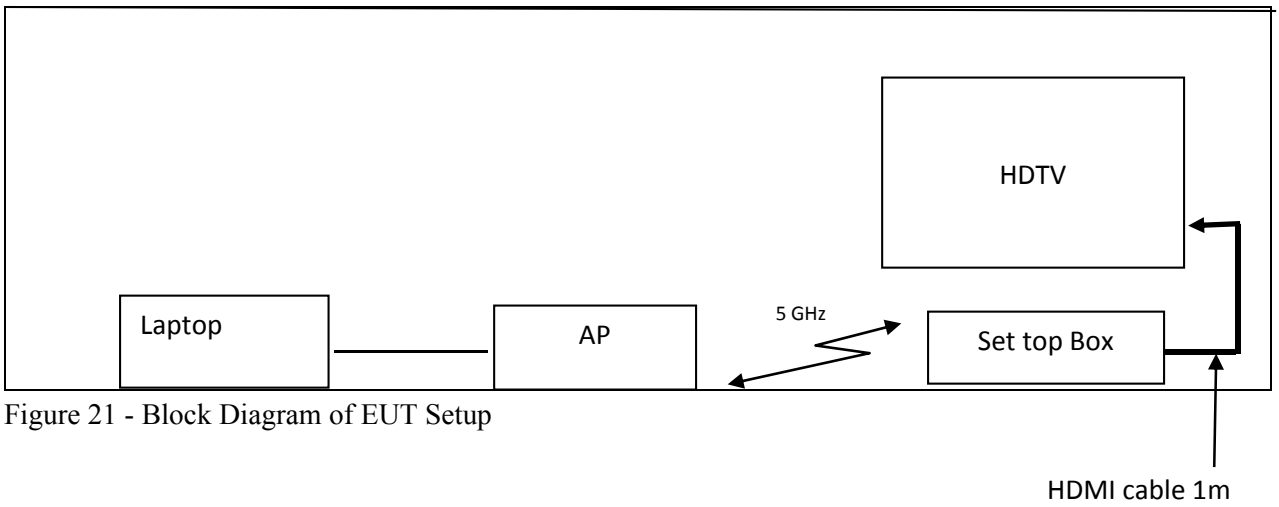


Figure 21 - Block Diagram of EUT Setup

Table 15: Description of Sample used for Testing

Device	Serial Number	Config.	Test	Mode
VIP5662W	H91537 8IA937	Transmit & Receive to AP. Streaming Video on HDMI port	Channel Shutdown	20MHz Bandwidth: 5300 MHz, 5500 MHz 40MHz Bandwidth: 5300 MHz, 5500 MHz 80 MHz bandwidth :5300MHz, 5500MHz
Note:				

Table 16: Description of Test Configuration used for DFS Evaluation.

Device	Antenna	Mode	Setup Description
VIP5662W	Attached	Transmit & Receive	EUT was positioned horizontally on the table; a typical orientation.
Note: The EUT designed to lay flat on the table			

3.4 Test Specifications

Testing requirements

Table 18: Test Specifications

Emissions and Immunity	
Standard	Requirement
RSS 247 Issue 1, 2015	All