




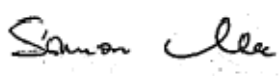
FCC PART 15.407
 IC RSS-247, ISSUE 1, MAY 2015
 DYNAMIC FREQUENCY SELECTION
 TEST AND MEASUREMENT REPORT

For

NVIDIA CORPORATION

2701 San Tomas Expressway,
 Santa Clara, CA 95050, USA

FCC ID: VOB-P2290W
IC: 7361A-P2290W

Report Type: Original Report	Product Type: Tablet
Prepared By: Todd Moy Test Engineer	
Report Number: R1511101-DFS	
Report Date: 2016-04-01	
Reviewed By: Simon Ma RF Lead	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164	

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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" (b)(7)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1511101-DFS	Original	2016-04-01

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *NVIDIA CORPORATION*, and their product model: *P2290W*, FCC ID: VOB-P2290W; IC: 7361A-P2290W or the “EUT” as referred to in this report. It is a tablet that operates in the 2.4 GHz and 5 GHz bands.

1.2 Mechanical Description of EUT

The EUT measures approximately 218 mm (L) x 123 mm (W) x 8 mm (H) and weight 350 g.

The test data gathered are from typical production sample, serial number: 0424515000397 assigned by NVIDIA CORPORATION.

1.3 Objective

This report is prepared on behalf of *NVIDIA CORPORATION* in accordance with FCC CFR47 §15.407 (h) & RSS 247 §6.3 and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v01r02.

The objective is to determine compliance with FCC rules for DFS Detection Threshold, Channel Availability Check Time, Uniform Spreading U-NII Detection Bandwidth, Channel Closing Transmission Time, and Channel Move time in Master Mode.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

FCC CFR 47 Part2, Part15.407 (h)

RSS 247 §6.3

KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v01r02.

COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION

1.6 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 Luminaires 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 C63.4-2014, ANSI C63.10-2013, 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 FCC CFR47 §15.407 (h) & RSS 247 §6.3, and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v01r02.

2.2 EUT Exercise Software

ES File Explorer was used to extract a video through a network while VLC player was used to play the video.

2.3 Equipment Modifications

N/A

2.4 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude D630
Fortinet	Access Controller	FG-60D-POE
Fortinet	Access Point	FAP-221C-E

2.5 EUT Internal Configuration Details

Manufacturer	Description	Model
NVIDIA	Main Board	P2290
BYD	battery	11416519-00

2.6 Interface Ports and Cables

No interface ports or cables were used with the EUT.

2.7 Power Supply List and Details

Manufacturer	Description	Model
NVIDIA	USB Power Adapter	SPA011AU5W2

3 Summary of Test Results

The following result table represents the list of measurements required under the FCC CFR47 §15.407 (h) & RSS 247 §6.3, and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v01r02.

Items	Description of Test	Results
Detection Bandwidth	UNII Detection Bandwidth	N/A*
Performance Requirements Check	Initial Channel Availability Check Time (CAC)	N/A*
	Radar Burst at the Beginning of the CAC	N/A*
	Radar Burst at the End of the CAC	N/A*
In-Service Monitoring	Channel Move Time	Compliant
	Channel Closing Transmission Time	Compliant
	Non-Occupancy Period	N/A*
Radar Detection	Statistical Performance Check	N/A*

*Note: The EUT is a client device without radar detection.

4 Applicable Standards

4.1 DFS Requirement

FCC CFR47 §15.407 (h) & RSS 247 §6.3, and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v01r02.

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
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 each of the bonded 20 MHz channels and the channel center frequency.

Table 3: Interference Threshold for Master and Client 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 < 10dBm/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 <i>See Note 1.</i>
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. <i>See Notes 1 and 2.</i>
U-NII Detection Bandwidth	Minimum 100% of the UNII 99% transmission power bandwidth. <i>See Note 3.</i>

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 (Microseconds)	PRI (Microseconds)	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	$\text{Roundup} \left\{ \begin{matrix} \left(\frac{1}{360} \right) \\ \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \end{matrix} \right.$	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 6: Long Pulse Radar Test Signal

Radar Type	Bursts	Chirp Width (MHz)	PRI (usec)	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

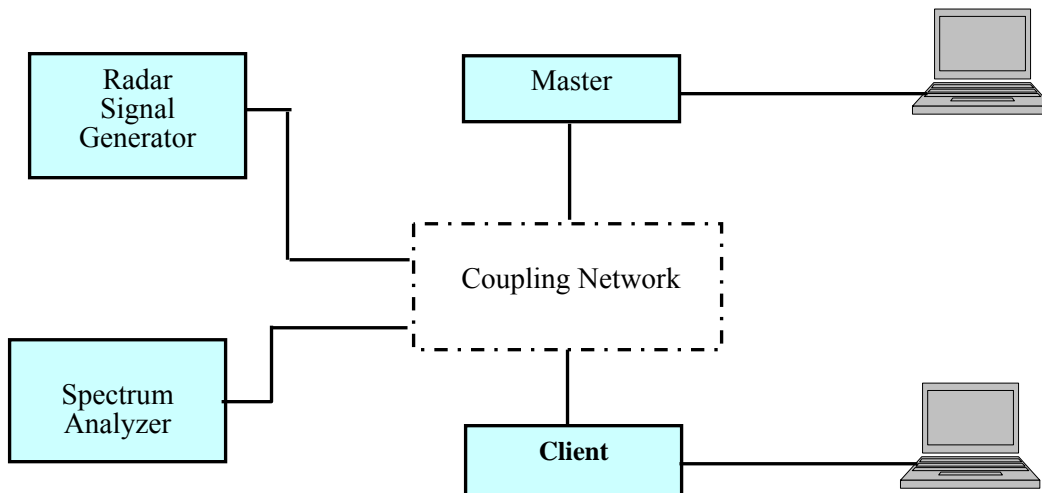
Table 7: Frequency Hopping Radar Test Signal

Radar Type	Pulse Width (usec)	PRI (usec)	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

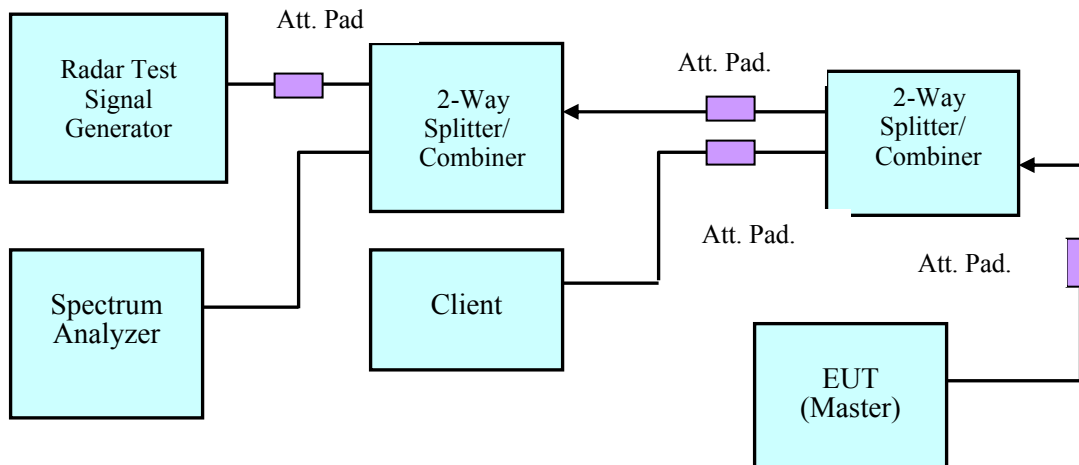
4.2 DFS Measurement System

BACL DFS measurement system consists of two subsystems: (1) The radar signal generating subsystem and (2) the traffic monitoring subsystem.

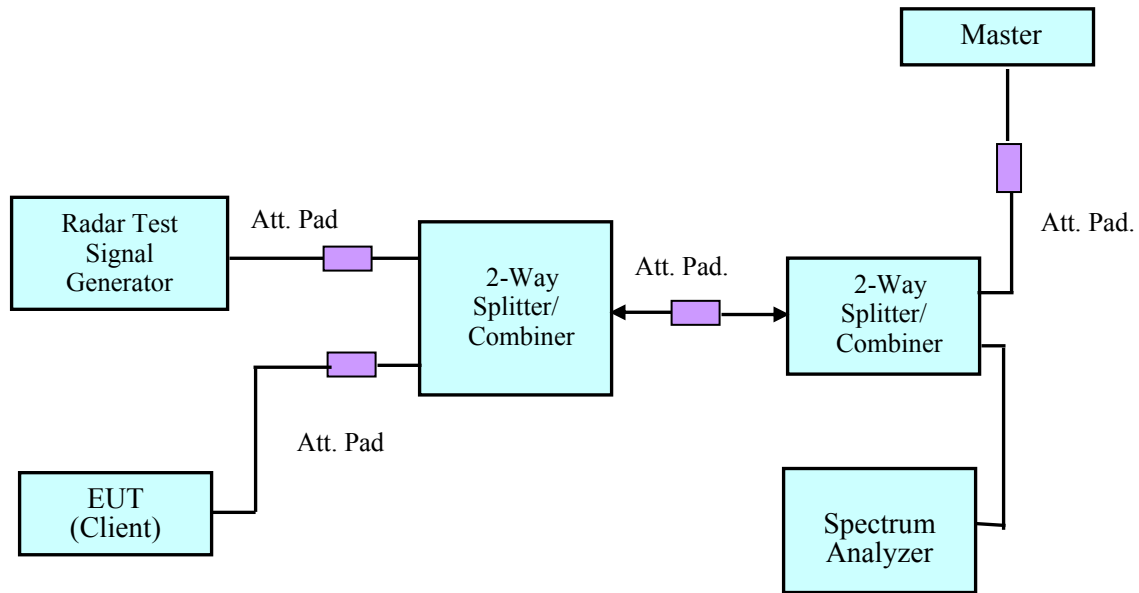
4.3 System Block Diagram



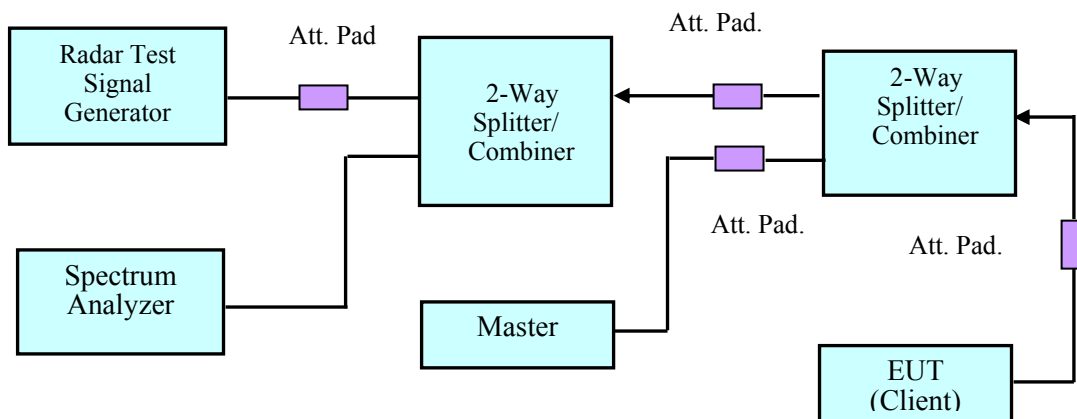
4.4 Conducted Method



Setup for Master with injection at the Master

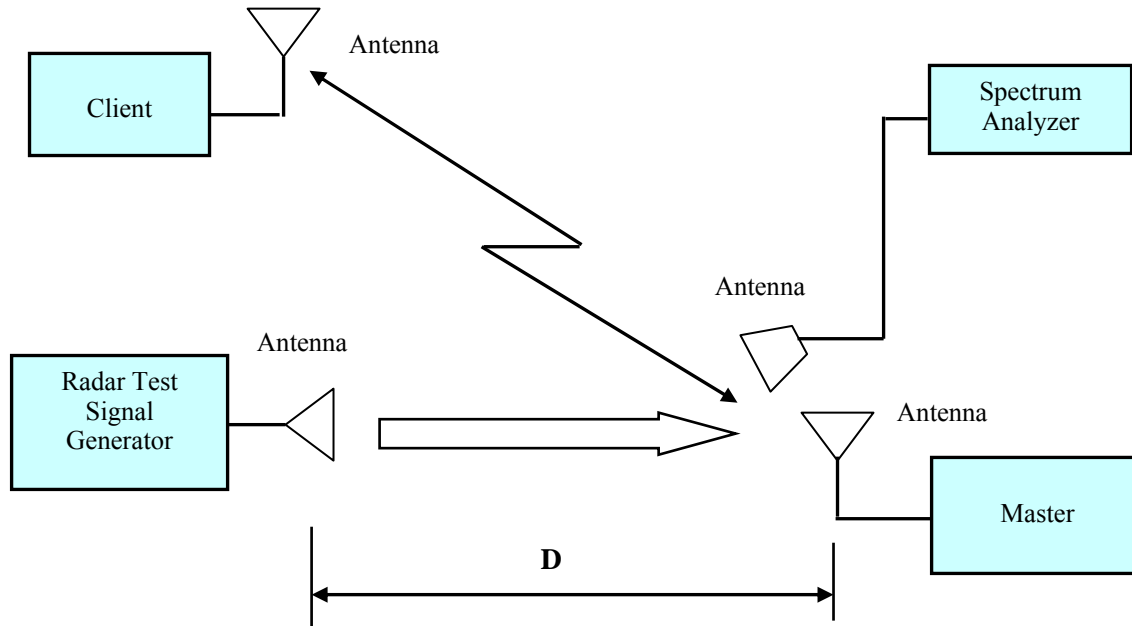


Setup for Client with injection at the Master



Setup for Client with injection at the Client

4.5 Radiated Method



4.6 Test Procedure

A spectrum analyzer is used as a monitor that verifies the EUT's status, which includes the Channel Closing Transmission Time and the Channel Move Time. The Spectrum analyzer is used to monitor the equipment under test (EUT) does not transmit on the same channel during the Non-Occupied Period after the radar detection. It is also used to monitor EUT transmissions during the Channel Availability Check Time.

5 Test Results

5.1 Description of EUT

The EUT operates in 5230-5350 MHz and 5470-5725 MHz range in Master Mode.

The rated output power of EUT is < 23 dBm (EIRP) with a power spectral density < 10 dBm/MHz, therefore the required interference threshold level is -62 dBm, the required radiated threshold at antenna port is -62 dBm.

The calibrated radiated DFS detection threshold level is set to -62 dBm.

WLAN traffic is generated by streaming the video file TestFile.mpg, this file is used by IP and Frame based systems for loading the test channel during the In-service compliance testing of the U-NII device. The file is streamed from the Access Point to the Client in full motion video mode using the media player with the V2.61 Codec package.

The EUT was tested with antenna gains of 2.7 dBi and 0.2 dBi for the 5250 to 5350 MHz band and antenna gains of 2.7 dBi and 2.3 dBi for the 5470 to 5725 MHz band.

5.2 Antenna Description

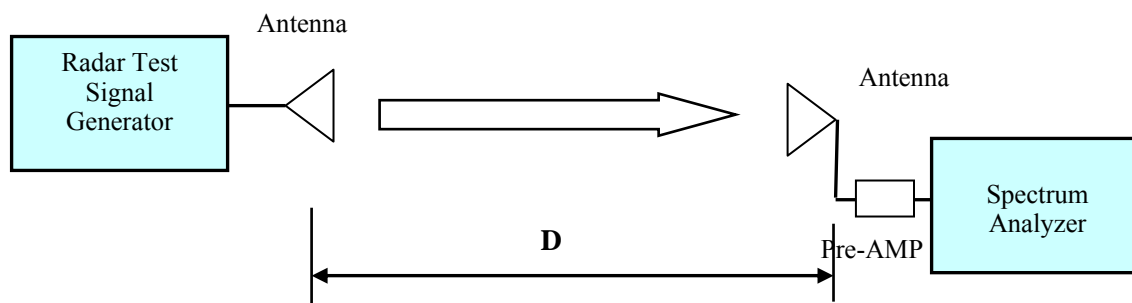
Chain	Antenna Gain (dBi)		
	5150-5350 MHz	5470-5725 MHz	5725-5850 MHz
Wi-Fi 0	2.7	2.7	3.5
Wi-Fi 1	0.2	2.3	1.9

5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial No.	Calibration Date	Calibration Interval
National Instruments	NI PXI-1042 8-Slot chassis	PXI-1042	V08X01EE1	N/A	N/A
National Instruments	Arbitrary Waveform Generator	PXI-5421	N/A	N/A	N/A
National Instruments	RF Upconverter	PXI-5610	N/A	N/A	N/A
ASCOR	Upconverter	AS-7206	N/A	N/A	N/A
Agilent	Analyzer, Spectrum	E4446A	US44300386	2015-10-22	1 year
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Mini-Circuits	Splitter/Combiner	2FSC-2-10G	0349	N/A	N/A
Narda	Splitter/Combiner	4326B-2	03514	N/A	N/A
Midwest	Attenuator	290-30	N/A	N/A	N/A
Mini-Circuits	Attenuator	BW-S30W2	N/A	N/A	N/A

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

5.4 Radar Waveform Calibration



Radiated Calibration Setup Block Diagram

5.5 Test Environmental Conditions

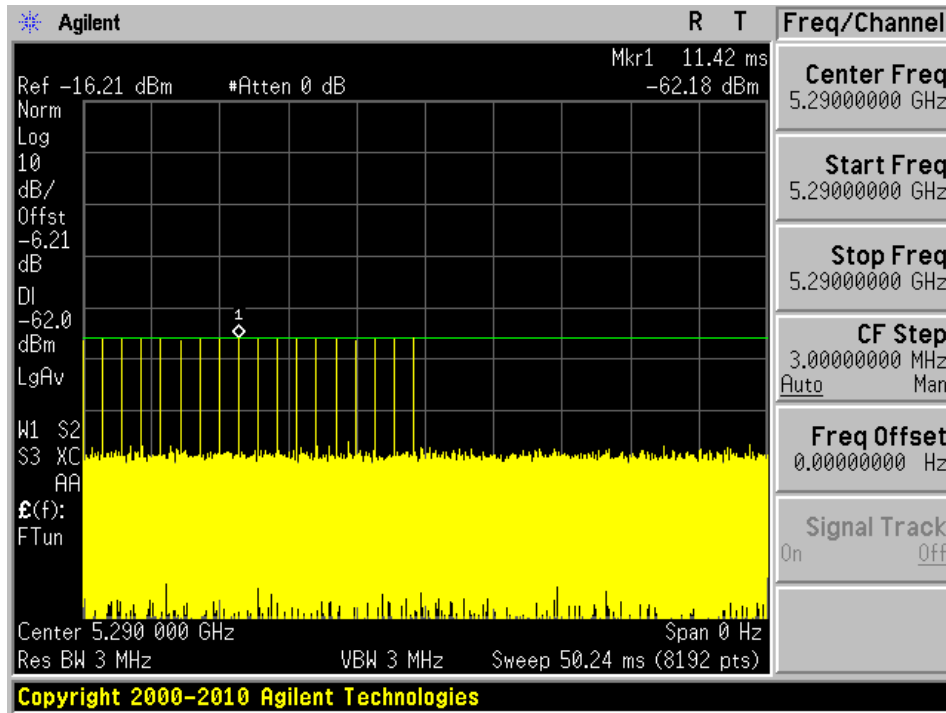
Temperature:	25° C
Relative Humidity:	36 %
ATM Pressure:	101.65 kPa

Testing performed by Todd Moy on 2016-02-24 at DFS testing site.

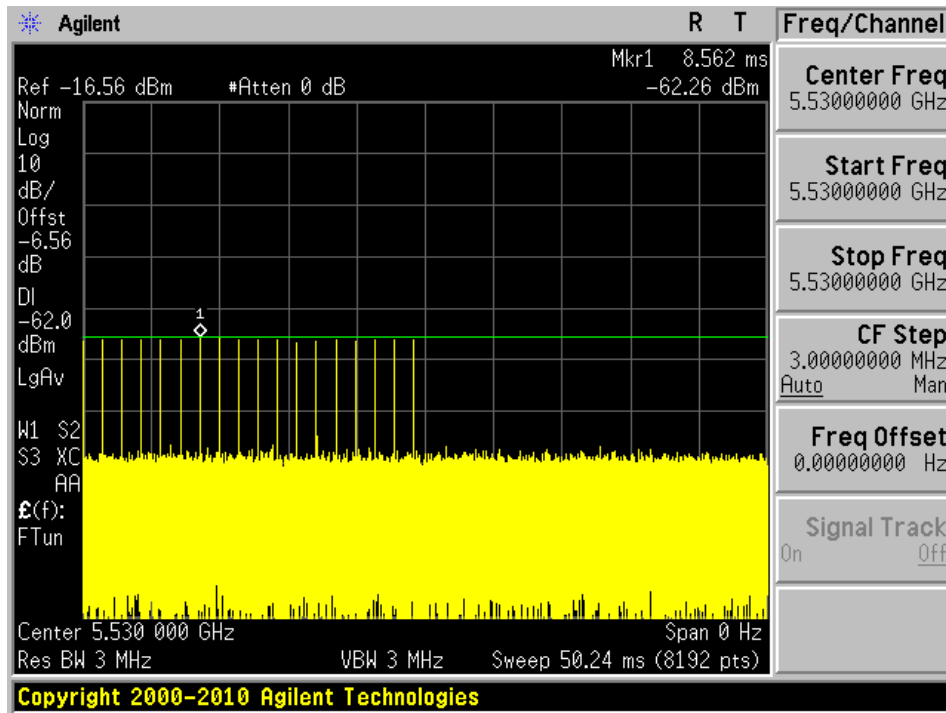
Plots of Radar Waveforms

Radar Type 0

5290 MHz



5530 MHz



6 Channel Move Time and Channel Closing Transmission Time

6.1 Test Procedure

BACL use type 0 radar signal to test the channel move time and channel closing transmission time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = N * Dwell Time

N is the number of spectrum analyzer bins showing a device transmission

Dwell Time is the dwell time per bin (i.e. Dwell Time = S/B, S is the sweep time and B is the number of bin, i.e. 8192)

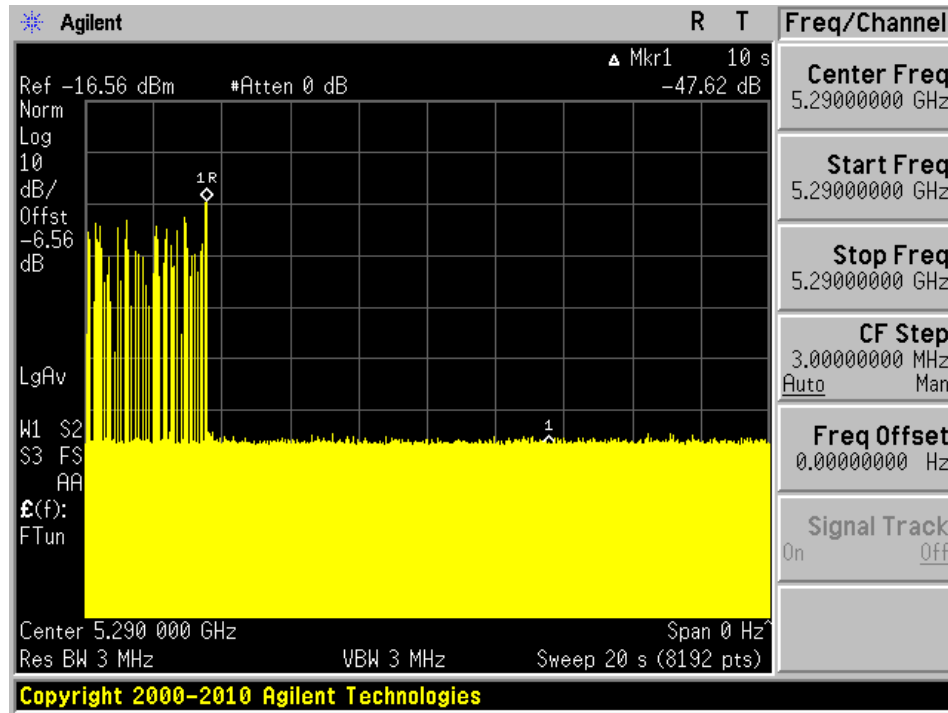
6.2 Test Results

Frequency (MHz)	Bandwidth (MHz)	Radar Type	Results
5290	80	Type 0	Compliant
5530	80	Type 0	Compliant

Please refer to the following tables and plots.

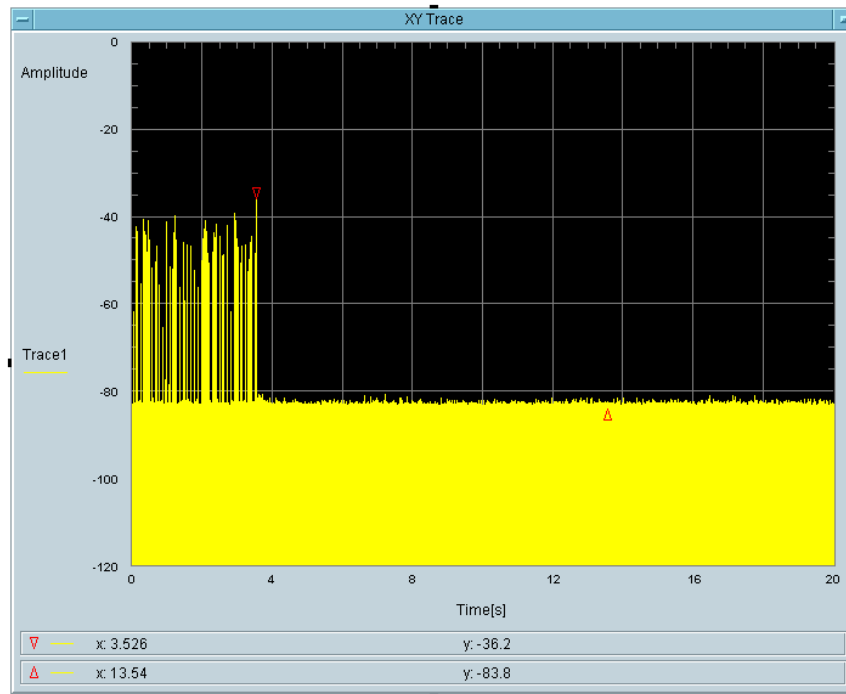
5290 MHz, Bandwidth 80 MHz

Type 0 radar channel move time result:



Type 0 radar channel closing transmission time result:

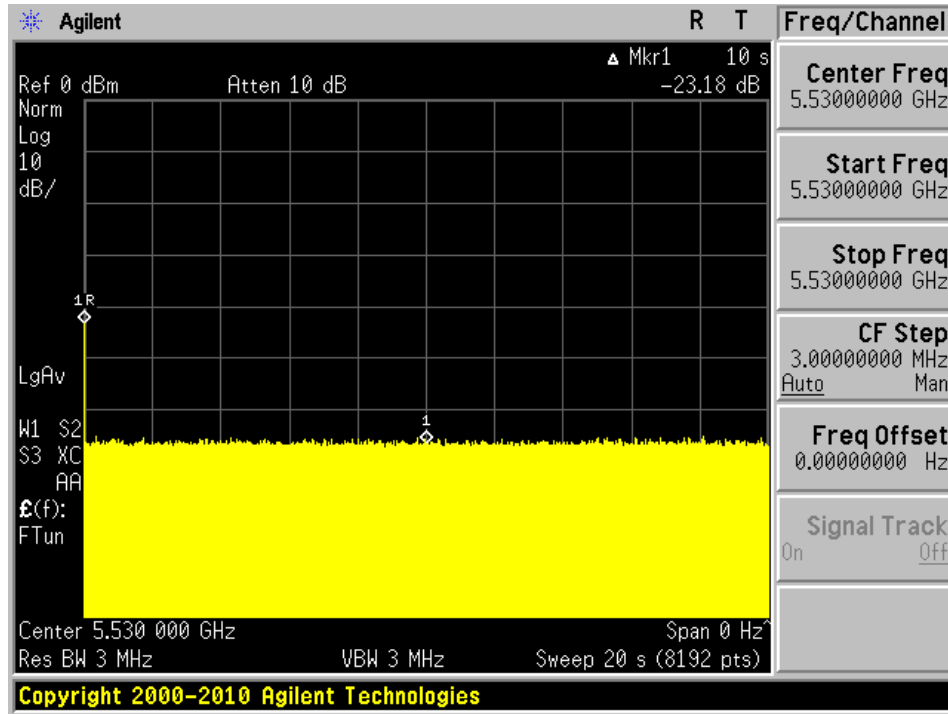
Channel closing transmitting time (ms)	Limit (ms)	Result
7.324	200	Pass



Total On Time [s]
7.324m

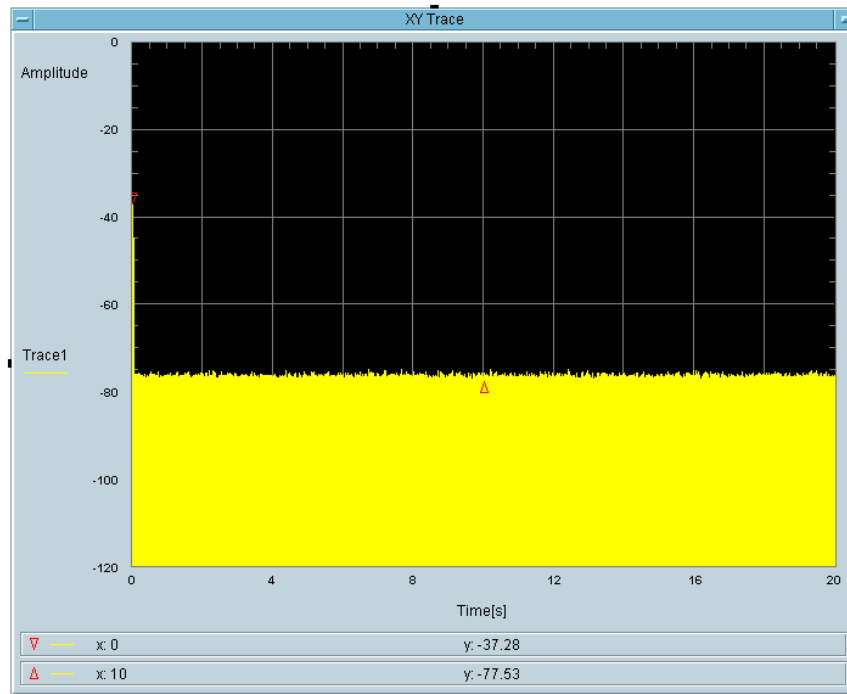
5530 MHz, Bandwidth 80 MHz

Type 0 radar channel move time result:



Type 0 radar channel closing transmission time result:

Channel closing transmitting time (ms)	Limit (ms)	Result
12.21	200	Pass



Total On Time [s]
12.21m