NVLAP LAB CODE 200167-0

Bay Area Compliance Lab Corp.

FCC PART 15.407 DYNAMIC FREQUENCY SELECTION

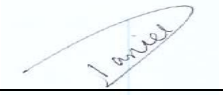
MEASUREMENT AND TEST REPORT

For

Colubris Networks, Inc.

200 West Street
Waltham, MA 02451, USA

FCC ID: RTPWCB-200
Model: WCB-200

Report Type: ☒ Original Report	**Equipment Type:** Wireless Client Bridge
Test Engineer:	Daniel Deng 
Report Number:	S0712068-DFS
Testing Date(s):	2007-06-11 to 2007-06-15
Report Date:	2007-12-21
Reviewed By:	Dan Coronia, Test Engineer 
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Document History

Revision	Date	Comment
0	2007-12-21	NA

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ATTESTATION OF TESTING

Manufacturer:	Colubris Networks, Inc 200 West Street Waltham, MA 02451, USA
EUT:	802.11a/b/g Wireless Client Bridge
FCC ID:	RTPWCB-200
Model:	WCB-200
S/N:	B043-01224
Test date:	June 11-15,2007

Standard(s)	Results
FCC PART15.407 (DFS Requirement) FCC 06-96	Compliant

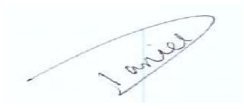
Bay Area Compliance Laboratories Corp. (BACL) tested the equipment mentioned in accordance with the CFR47 §15.407 (h) Dynamic Frequency Selection (DFS) requirements. Test result indicated that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: 1) Test results apply to the tested sample.

2) Details of test methods used have been recorded and kept on file by BACL.

3) The document may only be updated by BACL personnel, any changes will be noted in the document history section in this report.

Tested By:



Daniel Deng
RF Engineering Lead

Approved By:

Dan Coronia
Testing Engineer

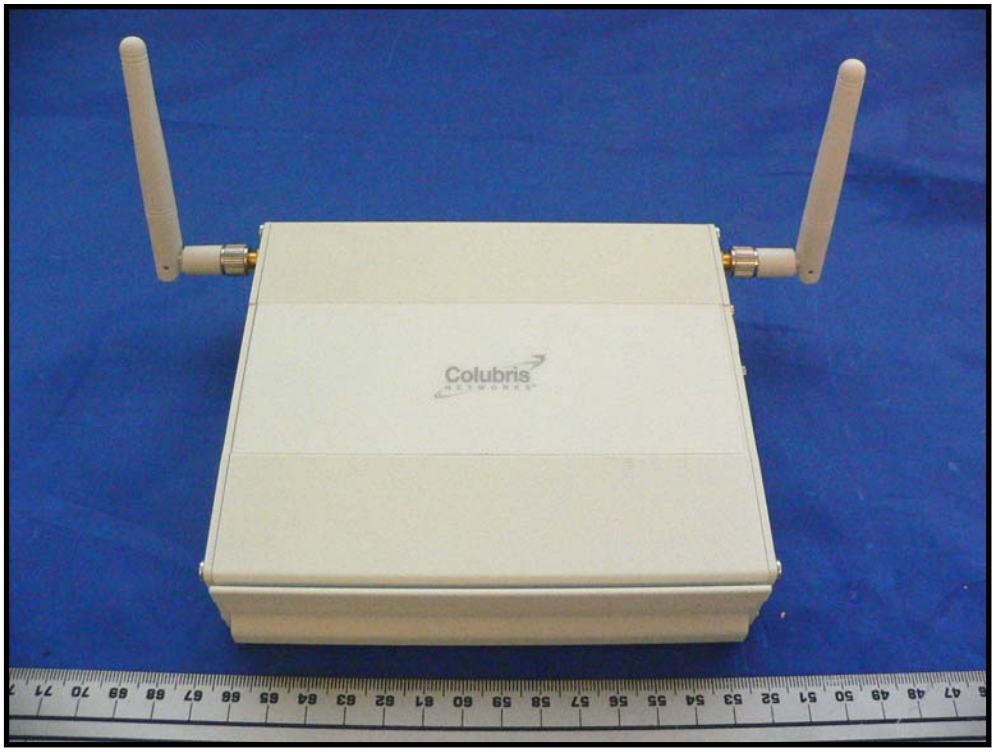
GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

This Bay Area Compliance Laboratories Corp. measurement and test report has been prepared on behalf of *Colubris Networks Inc.* and their device model:*WCB-200 Wireless Client Bridge FCC ID: RTPWCB-200, IC: 4891A-0100166*, which will be referred to as the EUT in the rest of this report. The EUT is a Wireless 802.11 a/b/g Client Bridge. The EUT operates in the frequency bands of 2.412 - 2.462 GHz, 5.180 - 5.240 GHz, 5.745 - 5.805 GHz, 5.260 - 5.320 GHz and 5.500 - 5.700 GHz and is powered by AC/DC adapter. The EUT employs DFS for the 5.250-2.350 GHz and 5.5-5.7 GHz bands the testing of which is covered in the DFS report submitted along with this application. The EUT's firmware is programmed at the point of manufacture for client only functionality. Testing was done with the following two identical antennae:

Item Number	Antenna Information	
WTS WLAN Tri-Band antenna	Model number:	WTS2450-RPSMA
	Manufacturer:	Centurion
	Frequency Range:	2.4-2.5 GHz, and 4.9-5.875 GHz
	Connector Type/ Maximum Gain	RP-SMA / 2.5 dBi @ 2.45 GHz, 3.4 dBi @ 5.875 GHz
	Pattern:	Vertical / omni directional
	Measurement:	Length: 95.9 mm (L) x 9.3 mm (D)

EUT Photo



WCB-200

Additional EUT photos in Exhibit C

Mechanical Description

The EUT is of metallic construction with approximate dimensions of 140 mm (L) x 125 mm (W) x 33 mm (H) and weighs approximately 455 g.

** The test data gathered is from production sample, with serial numbers: B043-01224 & B051-00350, provided by the manufacturer.*

Objective

This supplemental testing report is prepared on behalf of *Colubris Networks, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts E of the Federal Communication Commissions rules.

This is class II permissive change is in order to add new UNII bands (5260-5320 MHz, 5500-5700 MHz) with DFS function. This is a software only change without any modification being made to the hardware.

Test Methodology

FCC CFR 47 Part2, Part15.407 (h)

FCC 06-96 Appendix "COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSEDNATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION."

The methods used for DFS radar generation were the NTIA matlab scripts adapted for use on BACL systems.

Test Facility

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 sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has 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 facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

APPLICABLE STANDARDS

DFS Requirement

FCC CFR47 §15.407 (h) and FCC 06-96 Appendix.

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** (Without DFS)	**Client** (With DFS)
DFS Detection Threshold	Yes	Not Required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes

Table 3: Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (See Notes 1 and 2)
≥ 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 UNII 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 1 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 (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
1	1	1428	18	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

Table 6: Long Pulse Radar Test Signal

Radar Type	Bursts	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

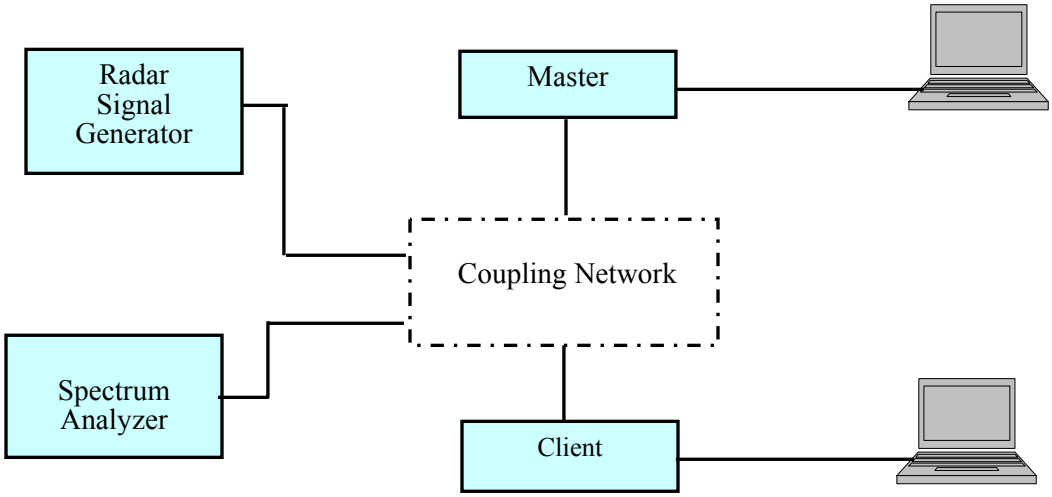
Table 7: Frequency Hopping Radar Test Signal

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

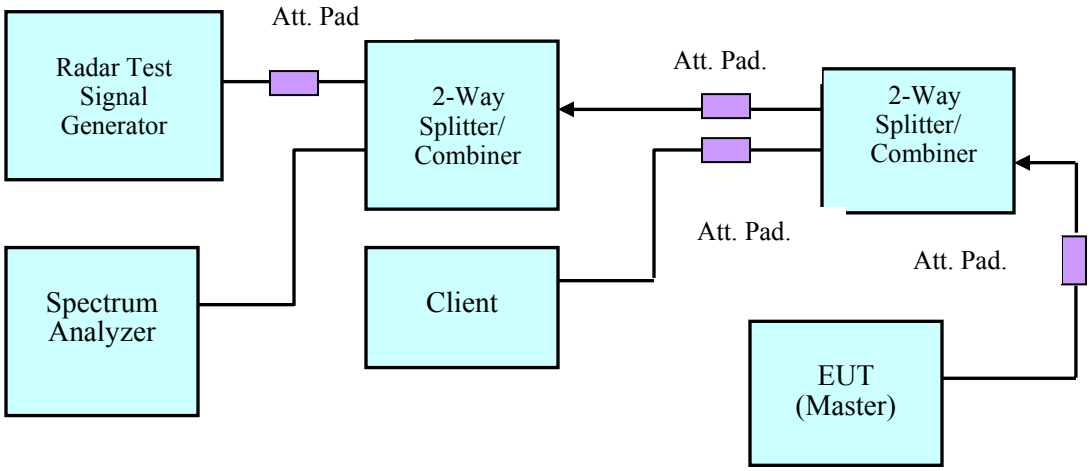
DFS Measurement System

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

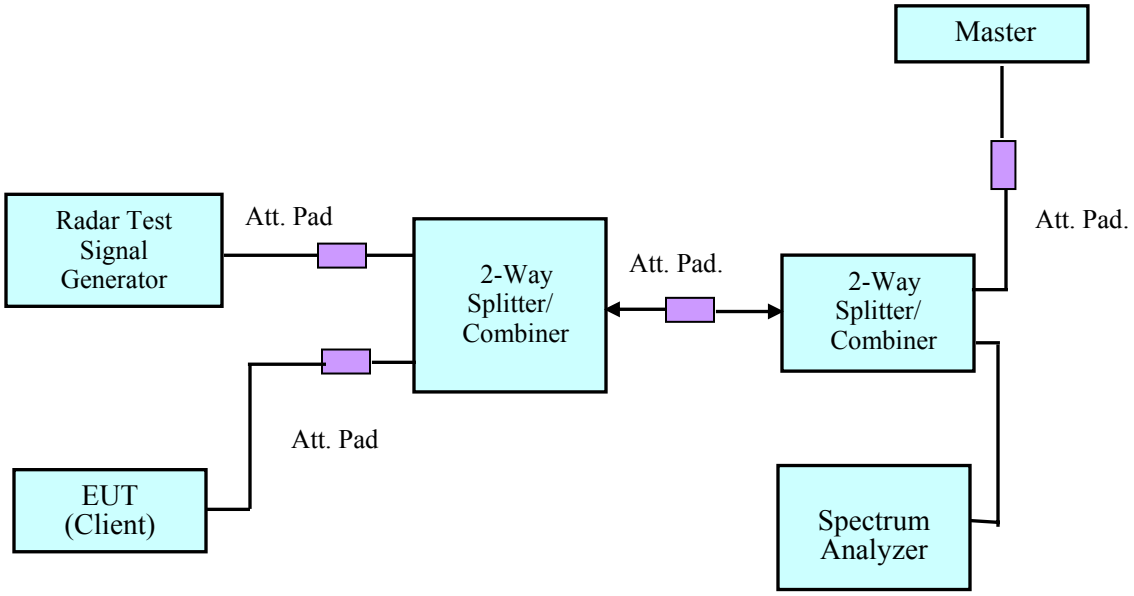
System Block Diagram



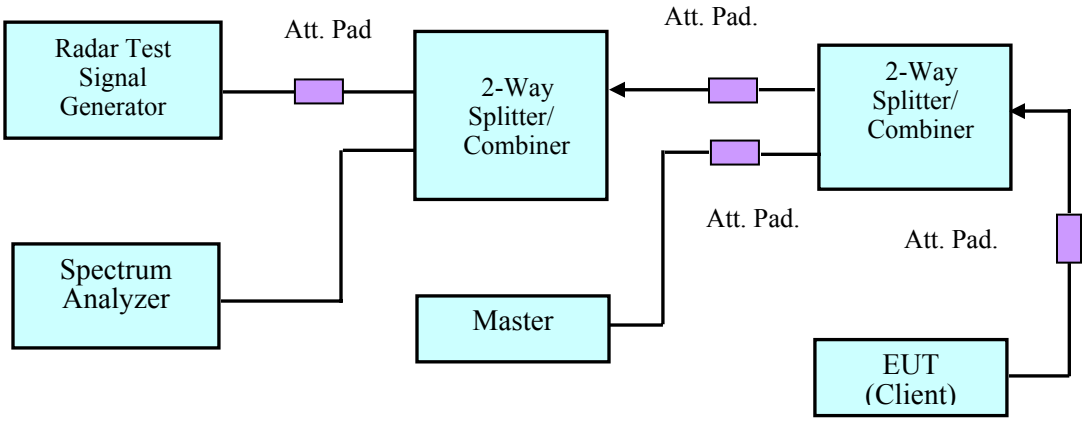
Conducted Method



Setup for Master with injection at the Master

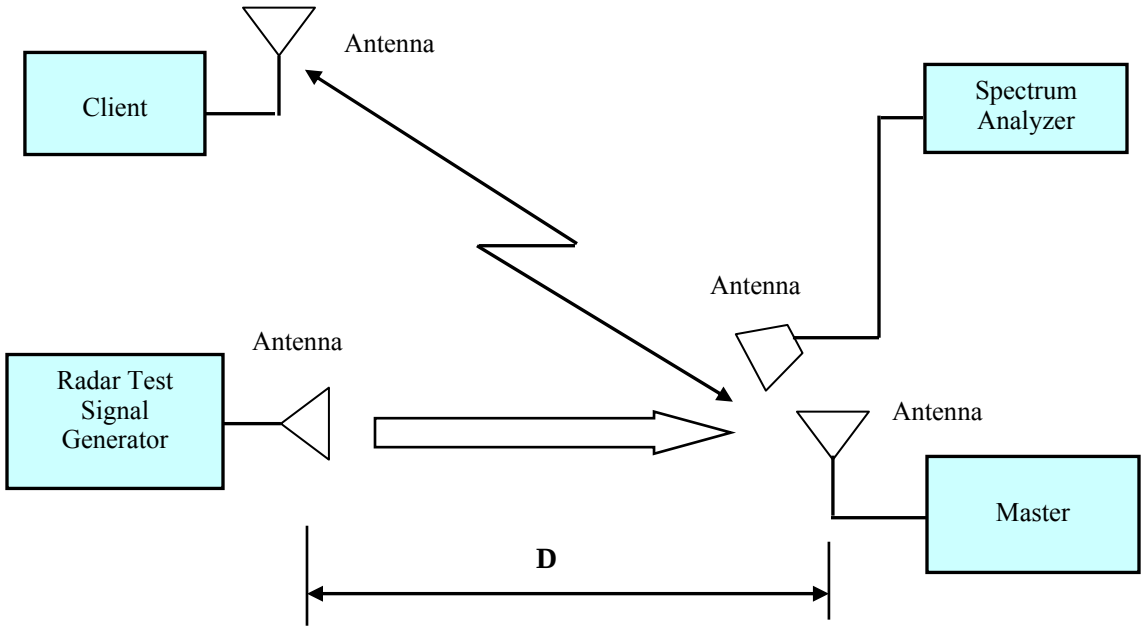


Setup for Client with injection at the Master



Setup for Client with injection at the Client

Radiated Method



Test Procedure

A spectrum analyzer is used as a monitor verifies that the EUT status including Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the diction and Channel move. It is also used to monitor EUT transmissions during the Channel Availability Check Time.

SUMMARY OF TEST RESULTS

The following result table represents the list of measurements required under the CFR47 §47 Part15.407 (h) and FCC 06-96.

Items	Description of Test	Result
Detection Bandwidth	UNII Detection Bandwidth	NR
Performance Requirements Check	Initial Channel Availability Check Time (CAC)	NR
	Radar Burst at the Beginning of the CAC	NR
	Radar Burst at the End of the CAC	NR
In-Service Monitoring	Channel Move Time	Complies
	Channel Closing Transmission Time	Complies
	Non-Occupancy Period	NR
Radar Detection	Statistical Performance Check	NR

Note: *NR – Not Required.*

TEST RESULTS

Description of EUT

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

The EUT is a Slave device without radar detection function.

The antenna of the EUT is tri-band Omni antenna, the gain is 2.6 dBi (5.3 GHz) and 3.2 dBi (5.6 GHz).

The rated output power of EUT is <23 dBm (EIRP).

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 Master device supported for testing is Cisco Aironet 1130AG Series IEEE 802.11 a/b/g Acess Point
FCC ID: LDK102054E
Model No.: AIR-AP1131AG-A-K9
S/N: FTX1109T0X8
Manufacturer: Cisco Systems, Inc.

Test Equipment

Equipment Description	Manufacturer	Model Number	S/N
NI PXI-1042 8-Slot chassis	National Instruments	PXI-1042	V08X01EE1
Arbitrary Waveform Generator	National Instruments	PXI-5421	N/A
RF Upconverter	National Instruments	PXI-5610	N/A
Upconverter	Ascor	AS-7206	N/A
Spectrum Analyzer	Agilent	E4440A	MY44303352
Pre-Amplifier	Avantek	2-8 GHz Lab AMP	218
Pre-Amplifier	Ducommun Technologies	ALN-09173030-01	990297-02
Splitter/Combiner	Mini-Circuits	2FSC-2-10G	0349
Splitter/Combiner	Narada	4326B-2	03514
Attenuator	MIDWest	290-30	N/A
Attenuator	Mini-Circuits	BW-S30W2	N/A

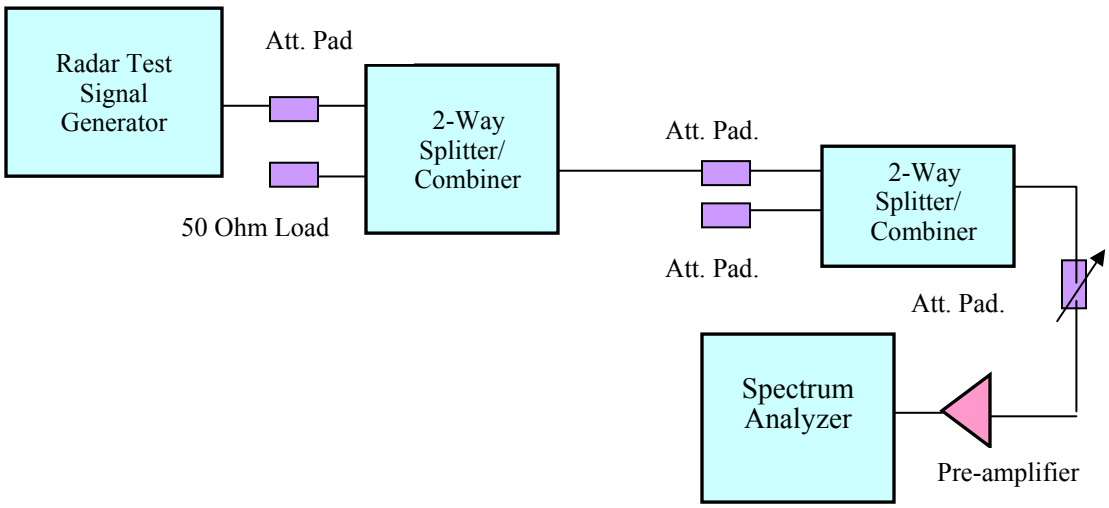
*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	20-23 °C
Relative Humidity:	48 % - 55 %
ATM Pressure:	1015 kPa

Testing performed by Daniel Deng on 2007-06-11 ~ 2007-06-15

Radar Waveform Calibration

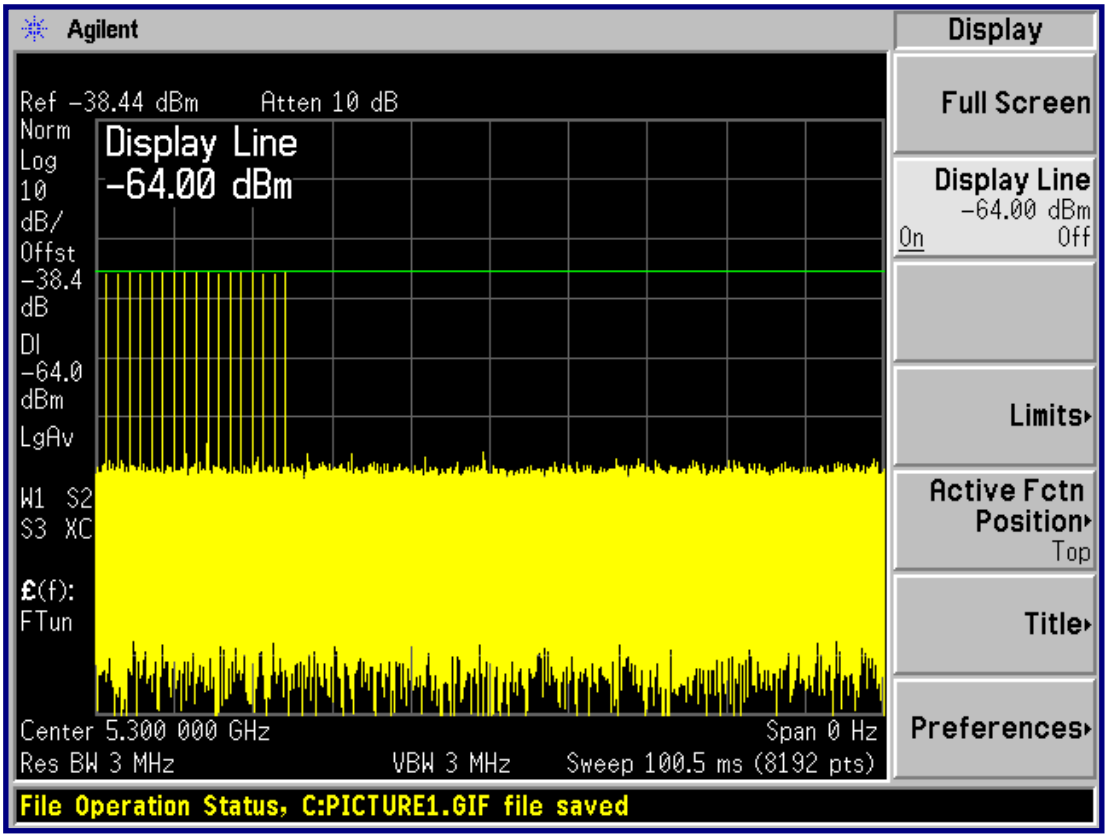


Conducted Calibration Setup Block Diagram

Plots of Radar Waveforms

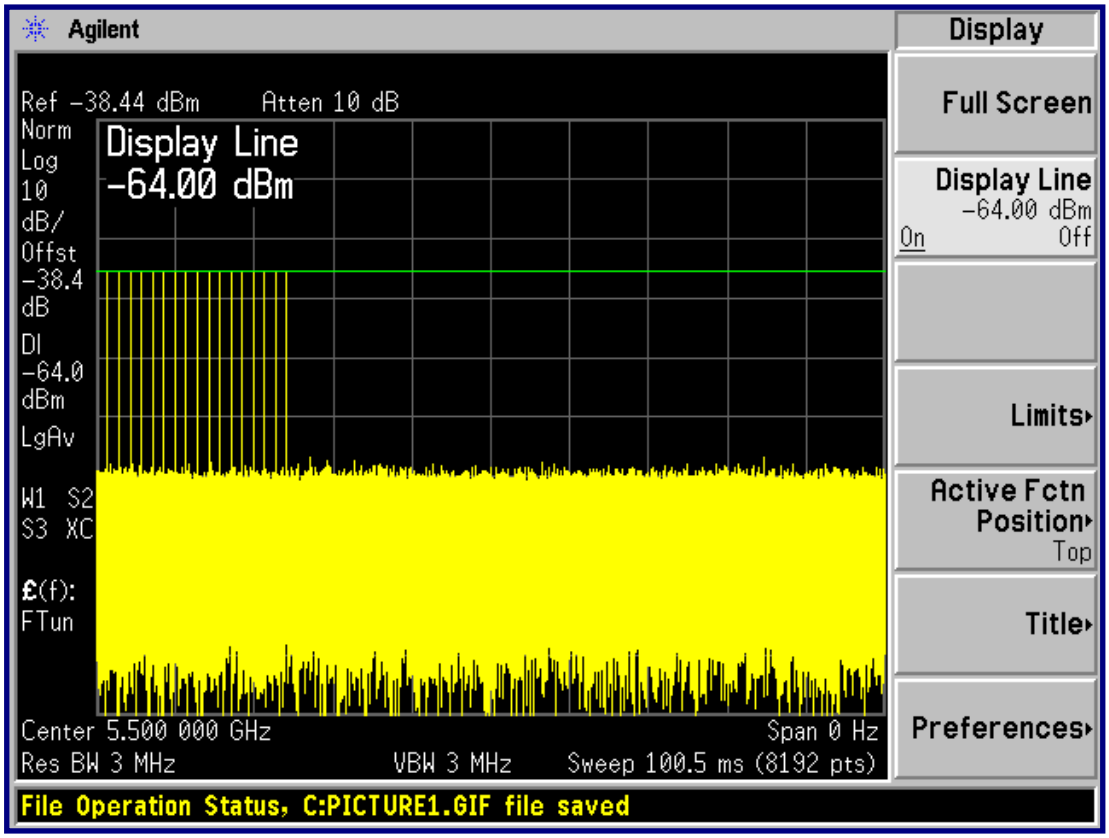
5300 MHz

Radar Type 1



5500 MHz

Radar Type 1



Channel Availability Check Time (CAC)

Test Procedure

1) Measure the initial power-up time of EUT.
2) With link established on channel, apply a radar signal within 0~6 seconds after the initial power-up period, monitor the transmissions on channel from the spectrum analyzer.
3) Reboot EUT, with a link established on channel, apply a radar signal within 54~60 seconds after the initial power-up period, monitor the transmission on channel from the spectrum analyzer.

EUT Initial power-up Cycle Time

EUT initial Power-up cycle (Second)
/

Results: Not Required.

Timing of Radar Burst	Spectrum Analyzer Display
No Radar Triggered	/
Within 6 seconds of the CAC starting	/
Within the last 6 seconds of the CAC	/

Channel Move time and channel closing transmission time

Test Procedure:

Perform one of the type1 to type 4 short pulse radar waveform, BACL use type 1 radar signal, repeat using a long pulse radar type5 waveform.

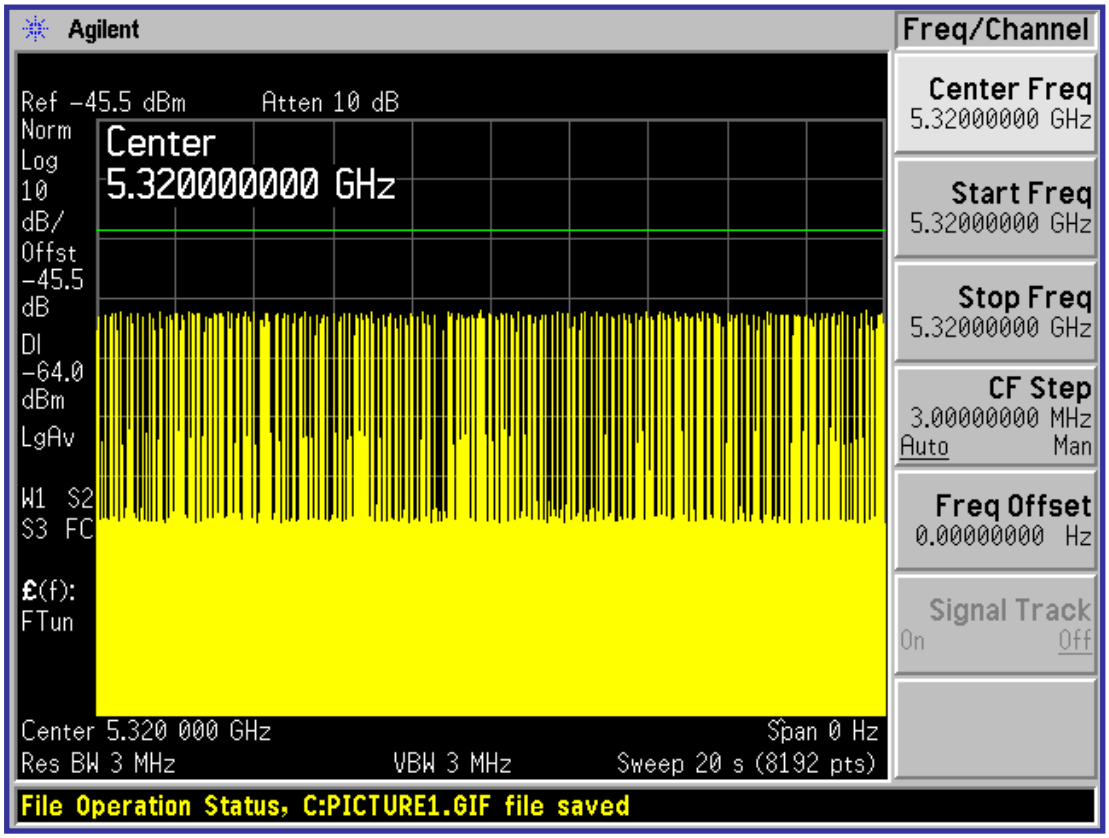
The aggregate channel closing transmission time is calculated as follows:

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)

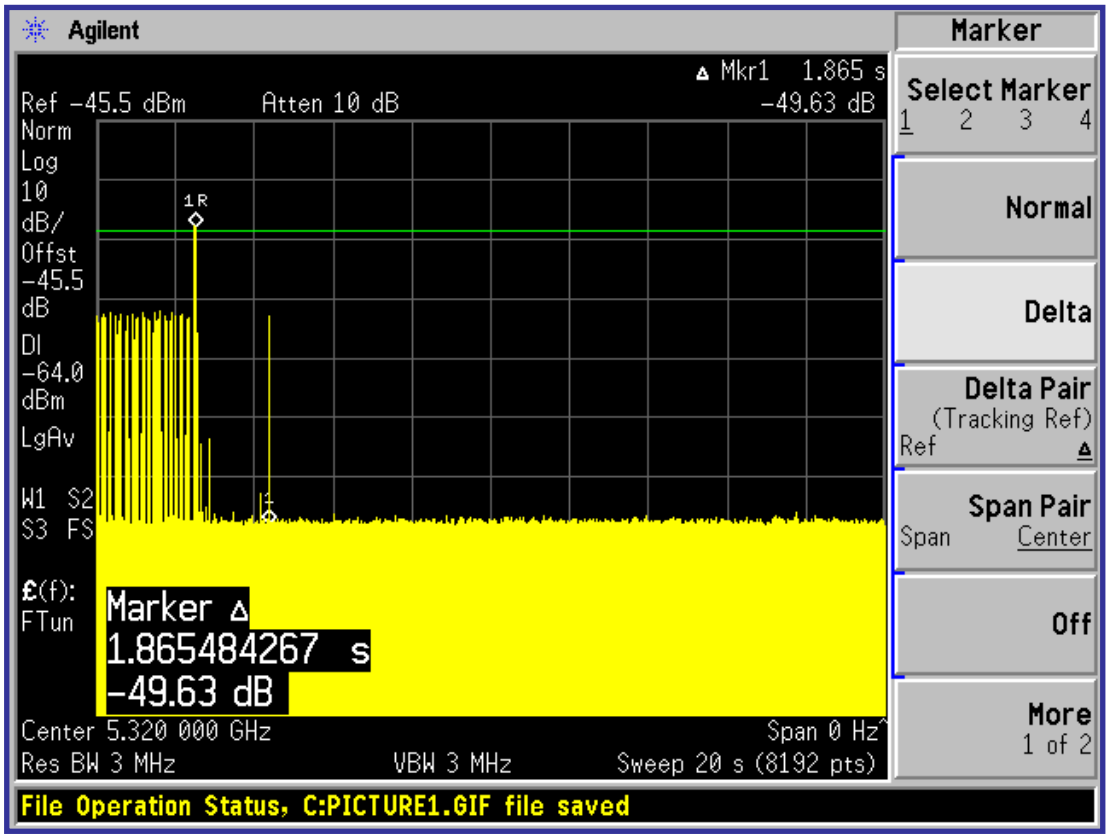
5320 MHz

WLAN Traffic:



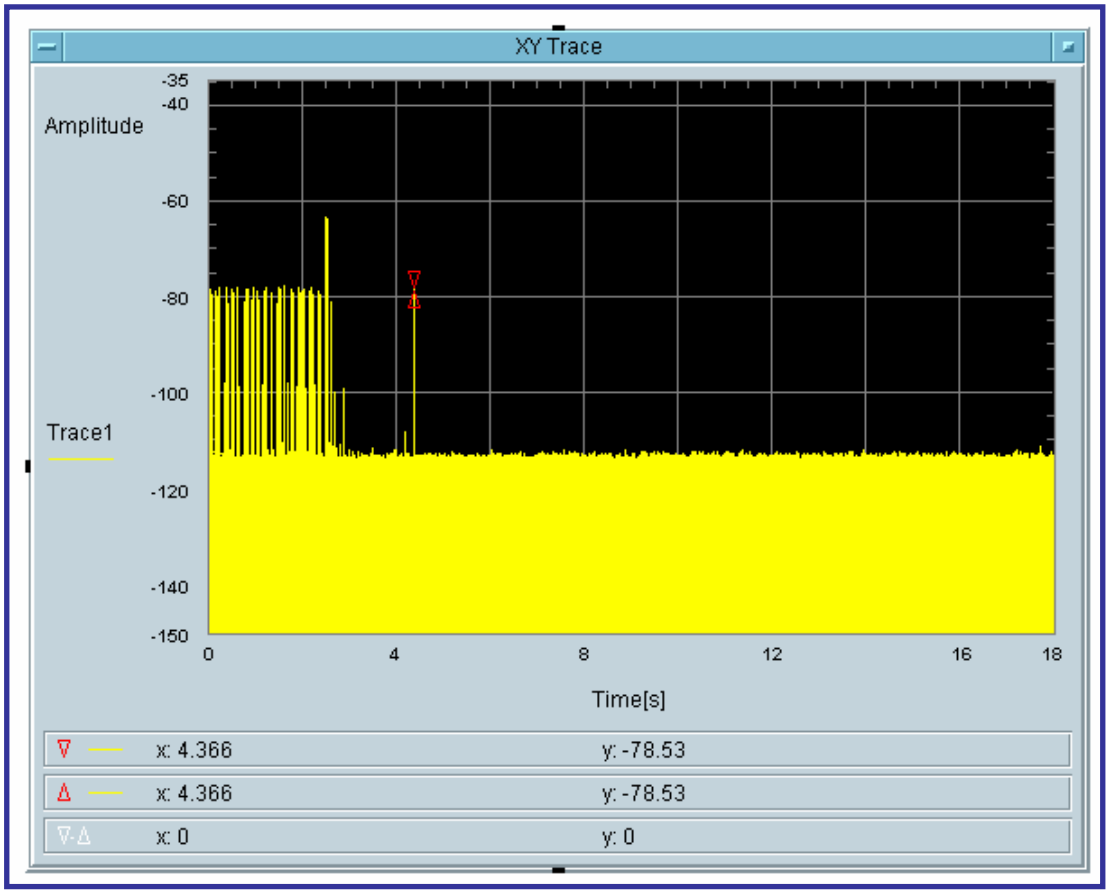
Type 1 radar channel move time result:

Channel Move Time (sec.)	Limit (sec.)
1.8655	10



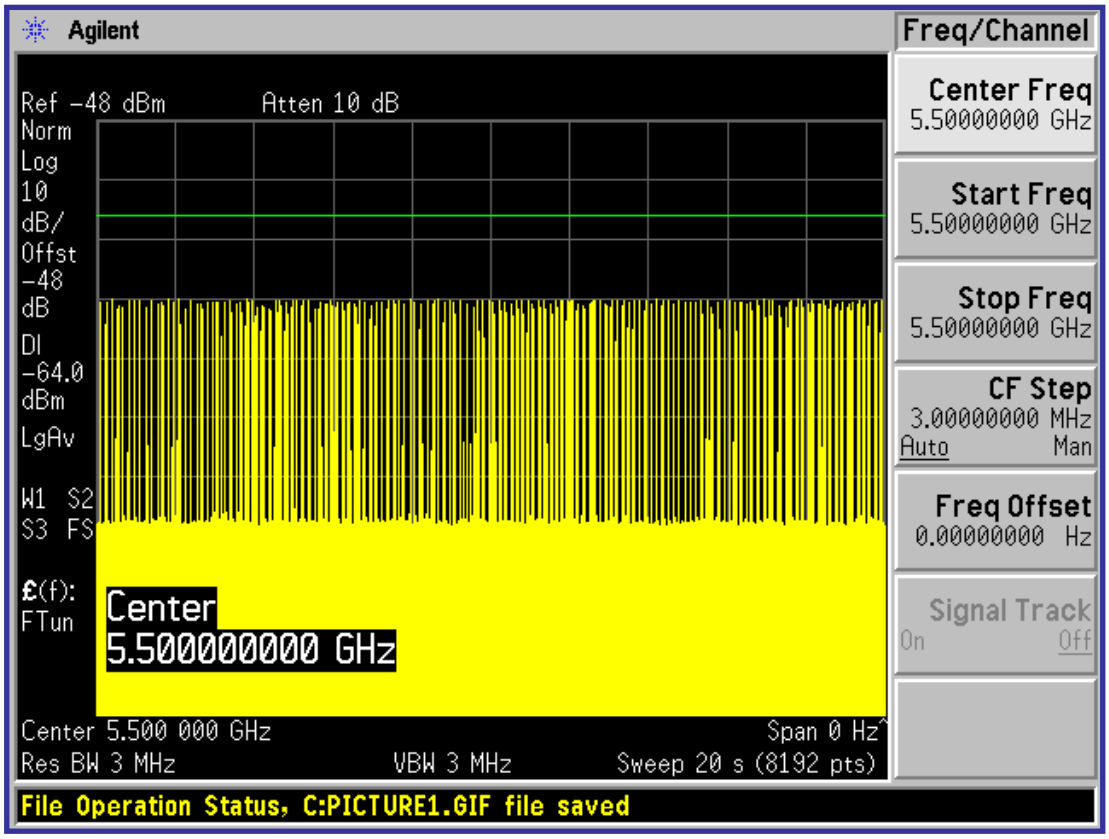
Type1 radar channel closing transmission time result:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
1.221	60	58.779



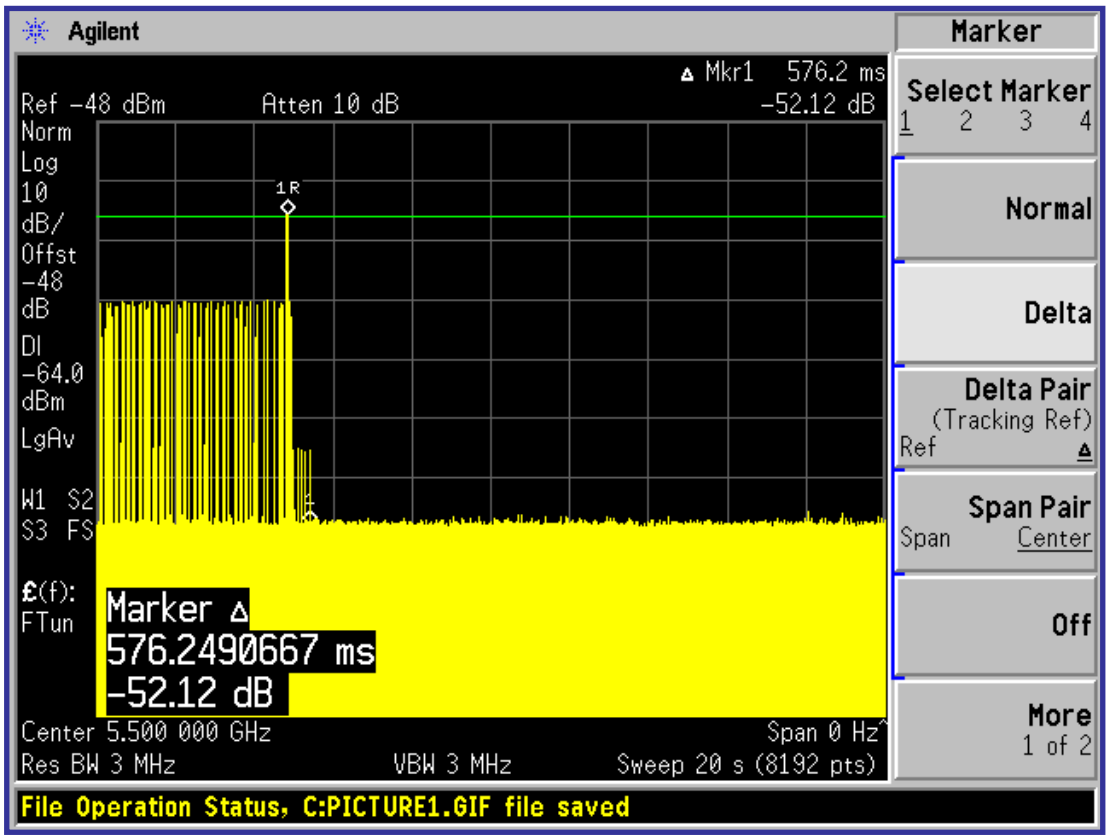
5500 MHz

WLAN Traffic:



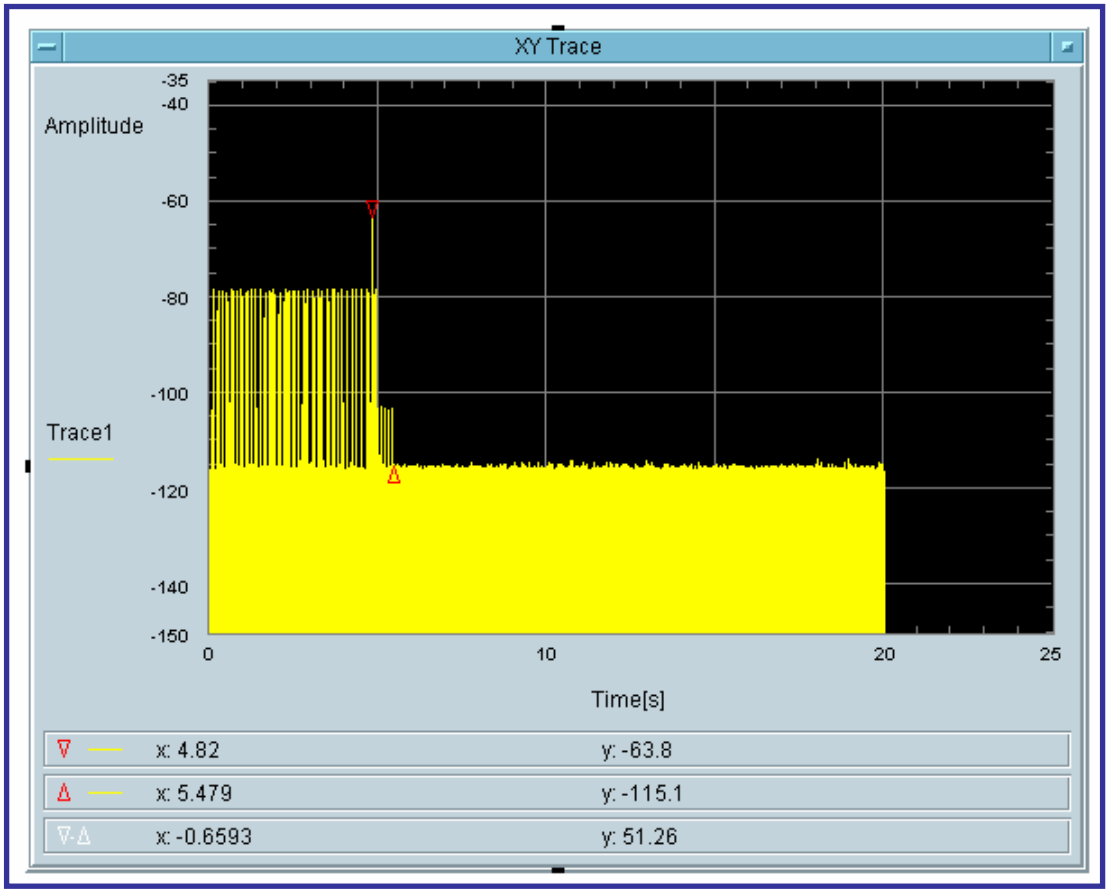
Type 1 radar channel move time result:

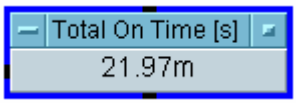
Channel Move Time (sec.)	Limit (sec.)
0.576	10



Type1 radar channel closing transmission time result:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
0	60	60





Non-Occupancy Period

Test Procedure

Client device is not permitted to transmit beacons on DFS frequencies.

1) Non-associated test: The master has been off, monitor the analyzer on the test mode frequency that have been selected for testing, power up the client for 30 minutes to make sure no beacons have been transmitted.
2) Associated test: Associate the master and client and stream the movie as specified for non-occupancy test. Transmit Radar type 1, monitor the test frequency to make sure no beacons have been transmitted for 30 minutes.

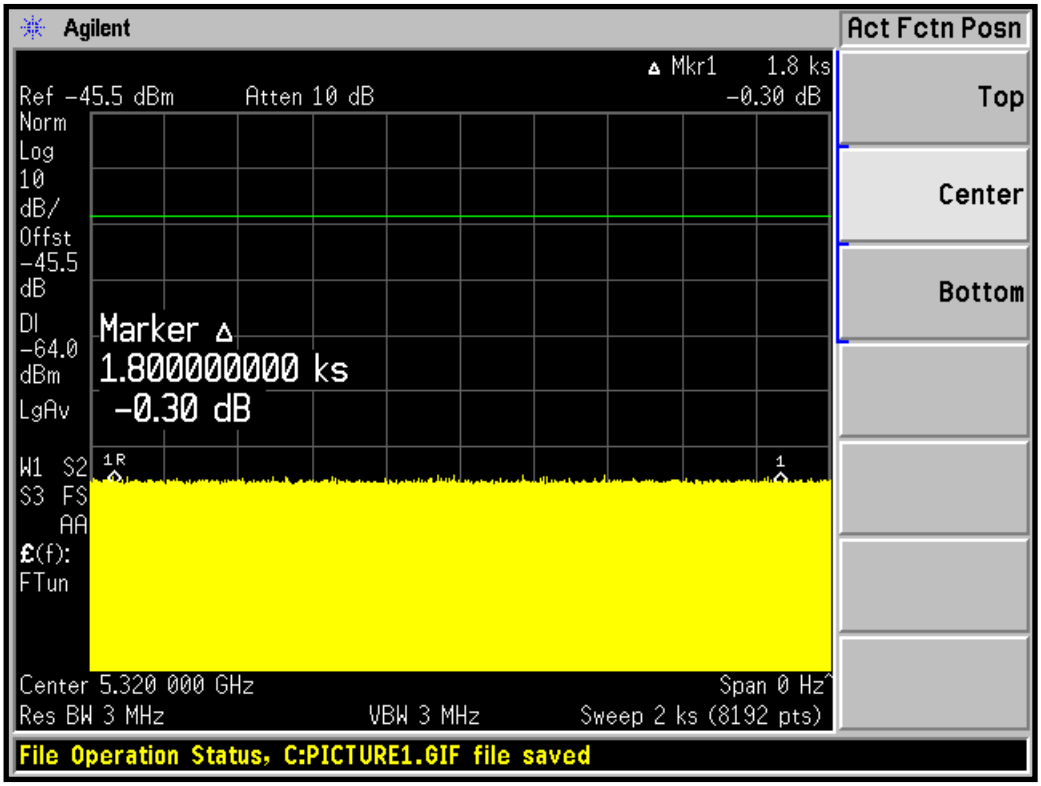
Result: Pass.

Mode	Results
Non-Associated	No Beacons transmit
Associated	No transmissions

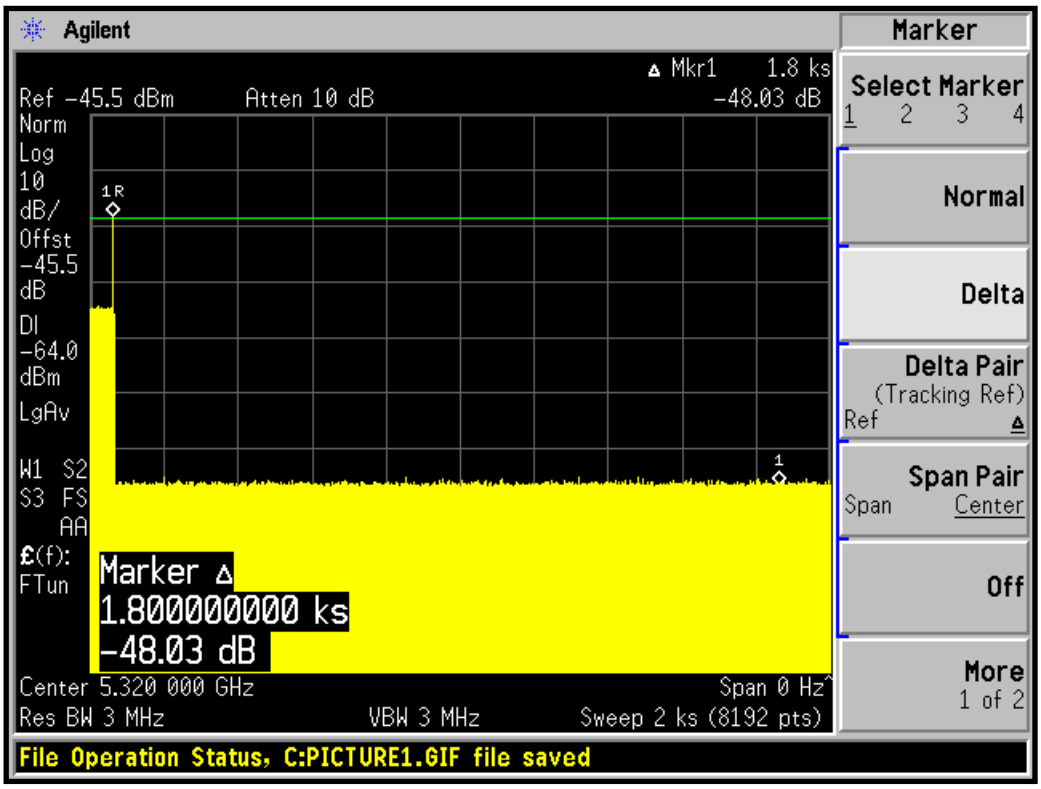
Please refer to the following plots.

5320 MHz:

1) Non-associated:

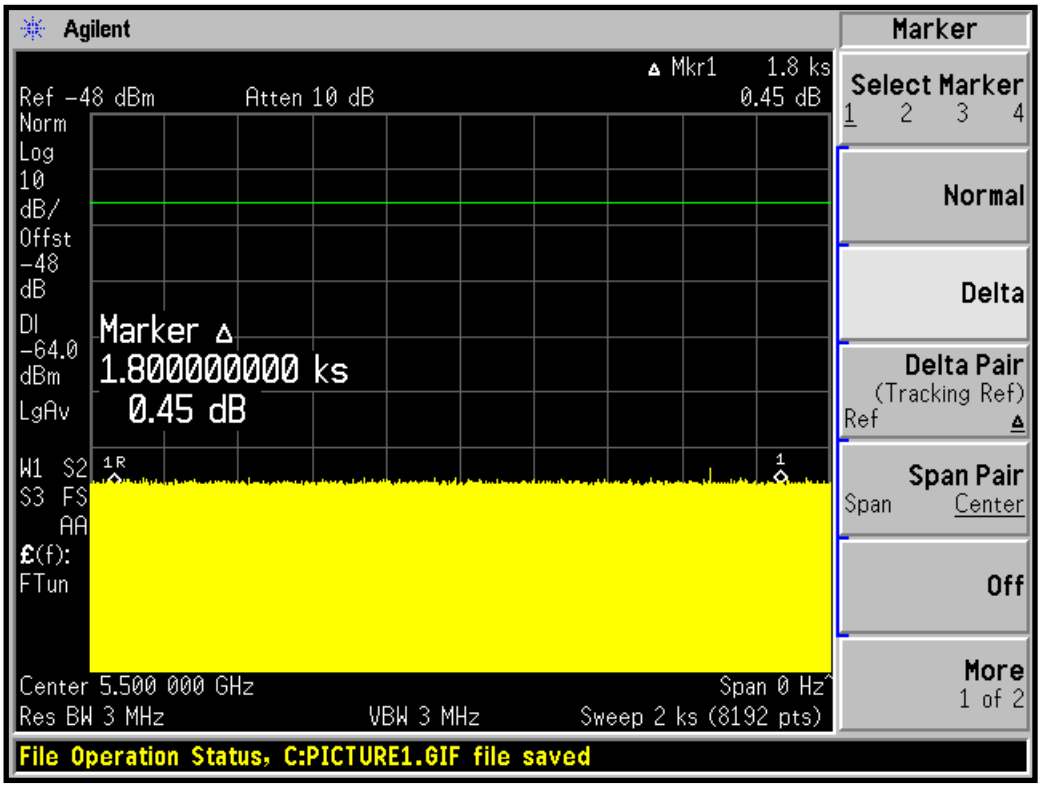


2) Associated:

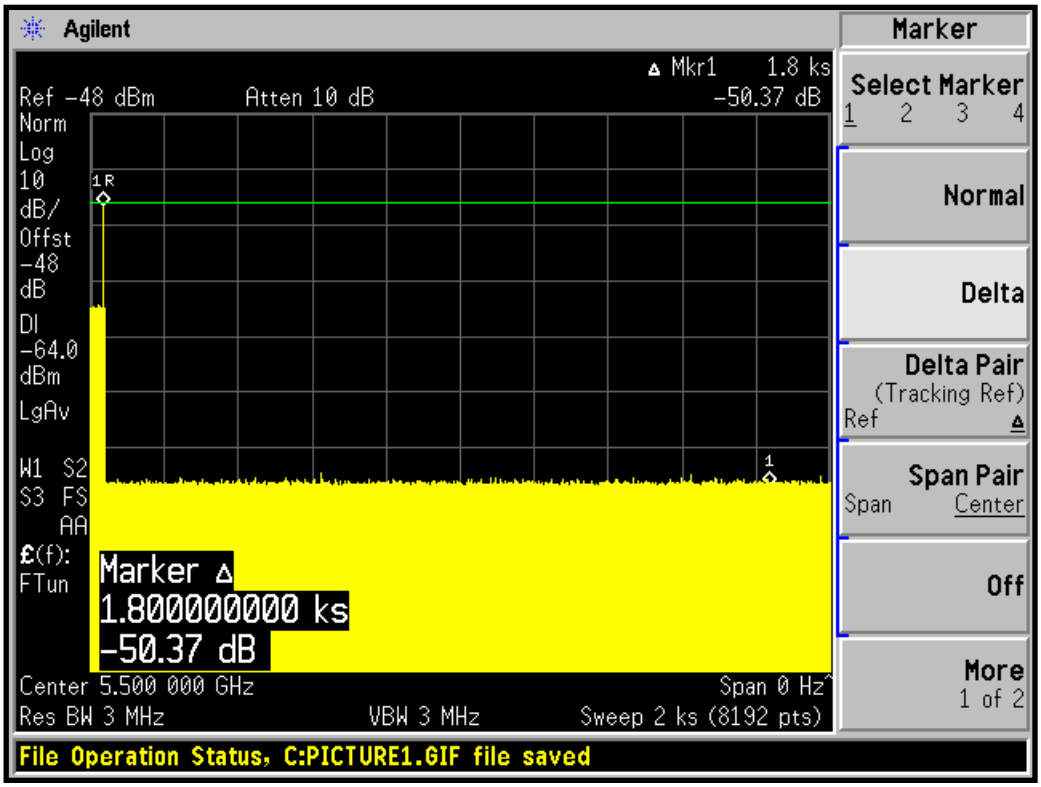


5500 MHz:

1) Non-associated:



2) Associated:



Detection Bandwidth

Procedure:

Performed with any one of the short pulse radar waveforms (type 1, 2, 3 or 4)

Start with radar generator frequency set to the center of the channel (Fc)
Perform at least 10 trials and confirm at least 90% detected
Increment radar generator frequency by 1 MHz and repeat
Perform at least 10 trials and confirm at least 90% detected
Continue incrementing the radar frequency until detection rate falls below 90%

Starting at Fc - 1 MHz, repeat the process, this time decrementing the radar frequency by 1 MHz

F_L is the lowest frequency at which detection was 80% or better
F_H is the highest frequency at which detection was 80% or better

UNII Detection Bandwidth = F_H - F_L

Result: Not Required.

In-Service Monitoring

Procedure:

Stream MPEG file from master to slave
Generate radar waveform
Record whether or not the waveform was detected
At least 30 trials are applied for each radar type
For radar types with randomized parameters, each trial uses a unique waveform
Perform with each of the radar types 1-6

Confirm that the detection rate for each radar type meets the minimum requirement
Type 1, 2, 3, 4: 60% each
Type 5: 80%
Type 6: 70%
Confirm that the mean of the rates for radar types 1 through 4 meets the requirement of 80%

$$\text{Detection Ratio} = \frac{\text{Total Waveform Detections}}{\text{Total Waveform Trails}} \times 100$$

Result: Not Required.