



FCC 15.407
DYNAMIC FREQUENCY SELECTION
TEST REPORT

For

IEI Integration Corp.

No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)

FCC ID: RFHMODAT-550A

Report Type: Original Report	Product Type: PDA
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TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	4
TEST METHODOLOGY	4
TEST FACILITY	4
SYSTEM TEST CONFIGURATION.....	5
DESCRIPTION OF TEST CONFIGURATION	5
EUT EXERCISE SOFTWARE	5
EQUIPMENT MODIFICATIONS	5
SUPPORT EQUIPMENT LIST AND DETAILS	5
SUMMARY OF TEST RESULTS	6
APPLICABLE STANDARDS.....	7
DFS REQUIREMENT	7
DFS MEASUREMENT SYSTEM.....	11
SYSTEM BLOCK DIAGRAM	11
RADIATED METHOD.....	13
TEST PROCEDURE	13
TEST RESULTS.....	14
DESCRIPTION OF EUT	14
CHANNEL LOADING	14
TEST EQUIPMENT LIST AND DETAILS.....	15
CONDUCTED TEST SETUP CONFIGURATION	15
CALIBRATION OF DFS DETECTION THRESHOLD LEVEL	16
TEST ENVIRONMENTAL CONDITIONS	16
CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME	18
TEST PROCEDURE	18
TEST RESULTS	18
NON-OCCUPANCY PERIOD.....	23
TEST PROCEDURE	23
TEST RESULT	23
TEST SETUP PHOTOGRAPHS.....	25

GENERAL INFORMATION**Product Description for Equipment under Test (EUT)**

Applicant	IEI Integration Corp. No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)
Manufacturer	IEI Integration Corp. No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)
Brand(Trade) Name	
Product	PDA
Main Model Name	MODAT-550A-OA53
Series Model Name	MODAT-550A-OA53-ET
Model Discrepancy	MODAT-550A-OA53 with Barcode Reader MODAT-550A-OA53-ET without Barcode Reader
Antenna Specification	FPC Antenna / Gain: 0 dBi
Transmit Power	IEEE 802.11a Mode: 14.49dBm (0.028W) IEEE 802.11ac VHT20 Mode: 13.80dBm (0.024W) IEEE 802.11ac VHT40 Mode: 13.62dBm (0.023W)
Frequency Range	5150 MHz ~ 5250 MHz, 5250 MHz ~ 5350 MHz, 5470 MHz ~ 5725 MHz, 5725 MHz ~ 5850 MHz
Modulation Technique	IEEE 802.11a Mode: OFDM IEEE 802.11ac VHT20 Mode: OFDM IEEE 802.11ac VHT40 Mode: OFDM
Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter: Brand Name: Asian Power Devices Inc Model: WA15IO5R I/P: 100-240V 50~60Hz 0.5A O/P: 5Vdc, 3A ☐ By AC Power Cord ☐ PoE ☐ DC Type ☒ Battery: Rechargeable Li-polymer Battery Brand Name: QIAO XIN TECHNOLOGY CO., LTD Model: IE-01S02A0 3.7V = 4000mAh, 14.8W ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter ☐ Host System

Received Date	Dec 07, 2018
Date of Test	Dec 07, 2018 ~ Feb 19, 2019

Objective

This report is prepared on behalf of IEI Integration Corp. in accordance with Part 2-Subpart J, Part 15-Subparts A, B and E of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15.407(h)(2) Radar Detection Function of Dynamic Frequency Selection (DFS);

Test Methodology

FCC CFR 47 Part2, Part15.407 (h)

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on

☒ 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

☐ 68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (Taiwan) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3180) and the FCC designation No.TW3180 under the Mutual Recognition Agreement (MRA) in FCC Test. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 974454. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The EUT was configured for testing in an normal mode which was provided by the manufacturer.

EUT Exercise Software

The software Rev: 7.1.2

Equipment Modifications

N/A

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
APD	Adapter	WA-15105R	N/A
DELL	NB	E6410	10912240367
DELL	Control PC	OPTIPLEX 7020	13853681714
NETGEAR	AP Router	R7800	4H72675800870

Master device FCC ID: PY315100319

SUMMARY OF TEST RESULTS

A compliant test report to FCC 15.407 shall be sufficient to show compliance of a transmitter or receiver with the requirement of this standard.

The following result table represents the list of measurements required under the CFR §47 Part 15.407(h), and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v02

Items	Description of Test	Result
Detection Bandwidth	UNII Detection Bandwidth	Not applicable
Performance Requirements Check	Initial Channel Availability Check Time (CAC)	Not applicable
	Radar Burst at the Beginning of the CAC	Not applicable
	Radar Burst at the End of the CAC	Not applicable
In-Service Monitoring	Channel Move Time	Compliant
	Channel Closing Transmission Time	Compliant
	Non-Occupancy Period	Compliant
Radar Detection	Statistical Performance Check	Not applicable

Note:

Not applicable: the EUT is a client unit without radar detection

APPLICABLE STANDARDS

DFS Requirement

CFR §47 Part 15.407(h),

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

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

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
<i>Non-Occupancy Period</i>	Yes	Not required	Yes
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Availability Check Time</i>	Yes	Not required	Not required
<i>U-NII Detection Bandwidth</i>	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
<i>DFS Detection Threshold</i>	Yes	Not required
<i>Channel Closing Transmission Time</i>	Yes	Yes
<i>Channel Move Time</i>	Yes	Yes
<i>U-NII Detection Bandwidth</i>	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
<i>U-NII Detection Bandwidth and Statistical Performance Check</i>	All BW modes must be tested	Not required
<i>Channel Move Time and Channel Closing Transmission Time</i>	Test using widest BW mode available	Test using the widest BW mode available for the link
<i>All other tests</i>	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: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP $\geq$ 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
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds See Note 1.
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 100% of the U- NII 99% transmission power bandwidth. See Note 3.
Note 1: <i>Channel Move Time</i> and the <i>Channel Closing Transmission Time</i> should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The <i>Channel Closing Transmission Time</i> is comprised of 200 milliseconds starting at the beginning of the <i>Channel Move Time</i> plus any additional intermittent control signals required to facilitate a <i>Channel</i> 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 <i>U-NII Detection Bandwidth</i> 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	Roundup $\left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\}$	60%	30
		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			
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.					

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.

For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 usec is selected, the number of pulses

would be $\text{Roundup} \left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{3066} \right) \right\} = \text{Roundup} \{17.2\} = 18$.

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

The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 1-4. For example, the following table indicates how to compute the aggregate of percentage of successful detections.

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	35	29	82.9%
2	30	18	60%
3	30	27	90%
4	50	44	88%
Aggregate $(82.9\% + 60\% + 90\% + 88\%)/4 = 80.2\%$			

Table 6 – Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μ sec)	Chirp Width (MHz)	PRI (μ sec)	Number of Pulses per <i>Burst</i>	Number of <i>Bursts</i>	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

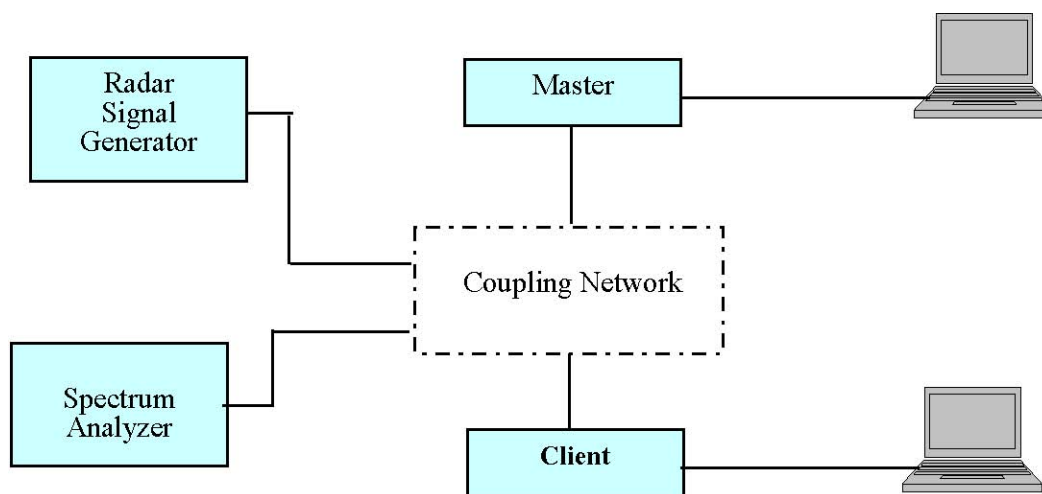
Table 7 – Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μ sec)	PRI (μ sec)	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

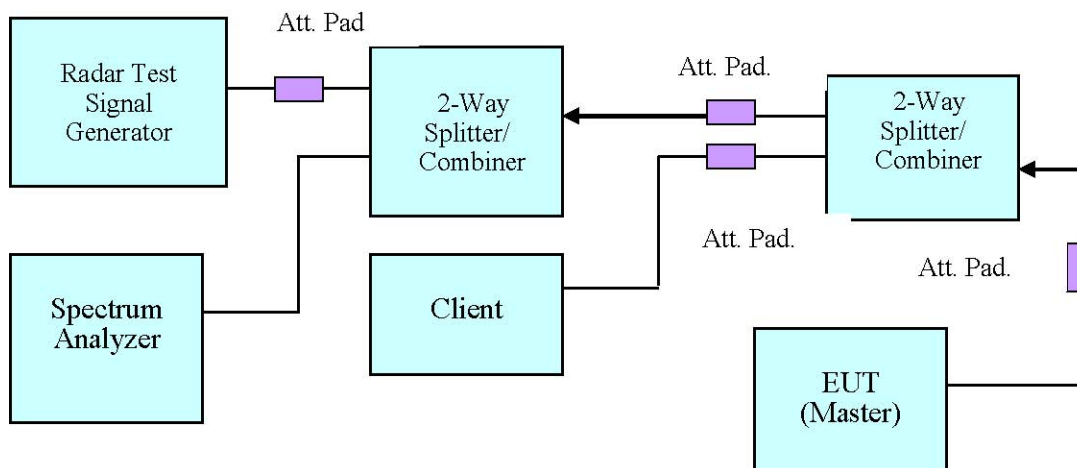
DFS Measurement System

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

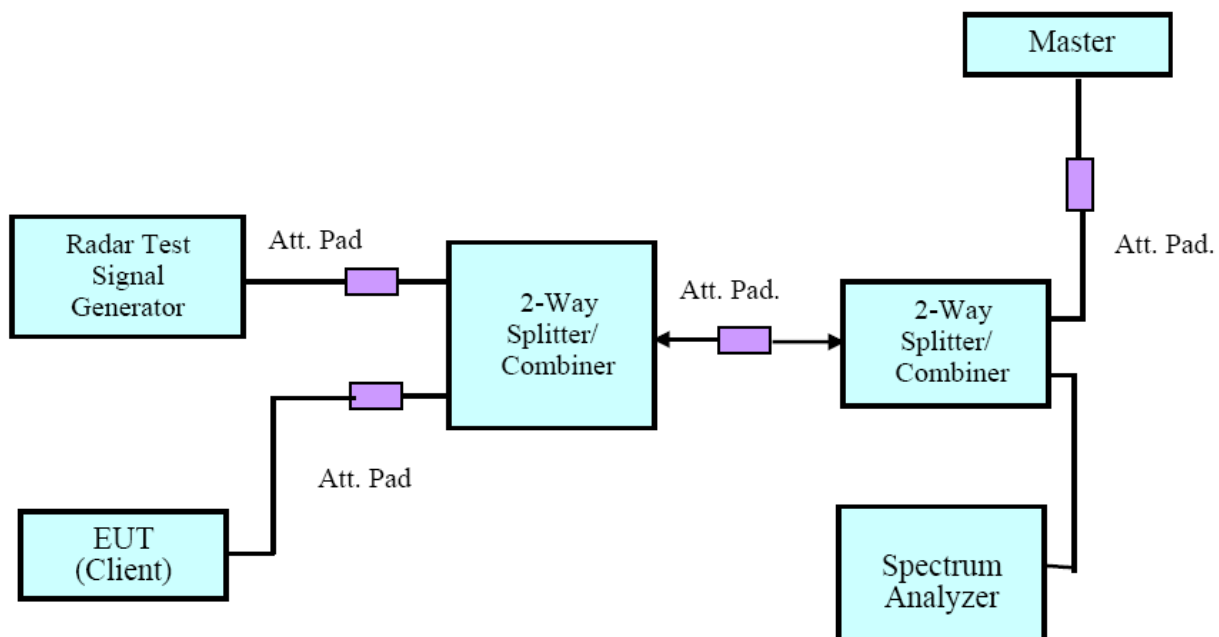
System Block Diagram

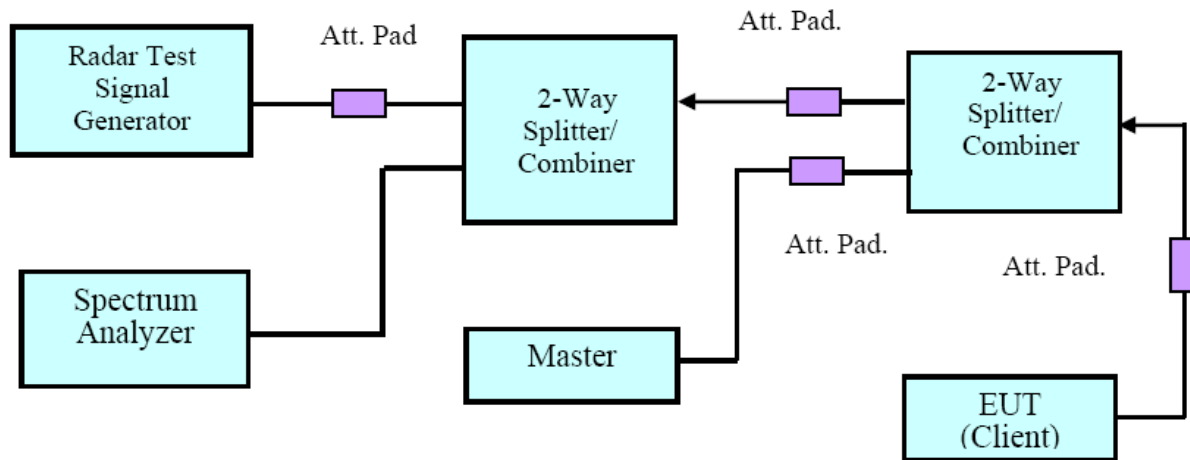
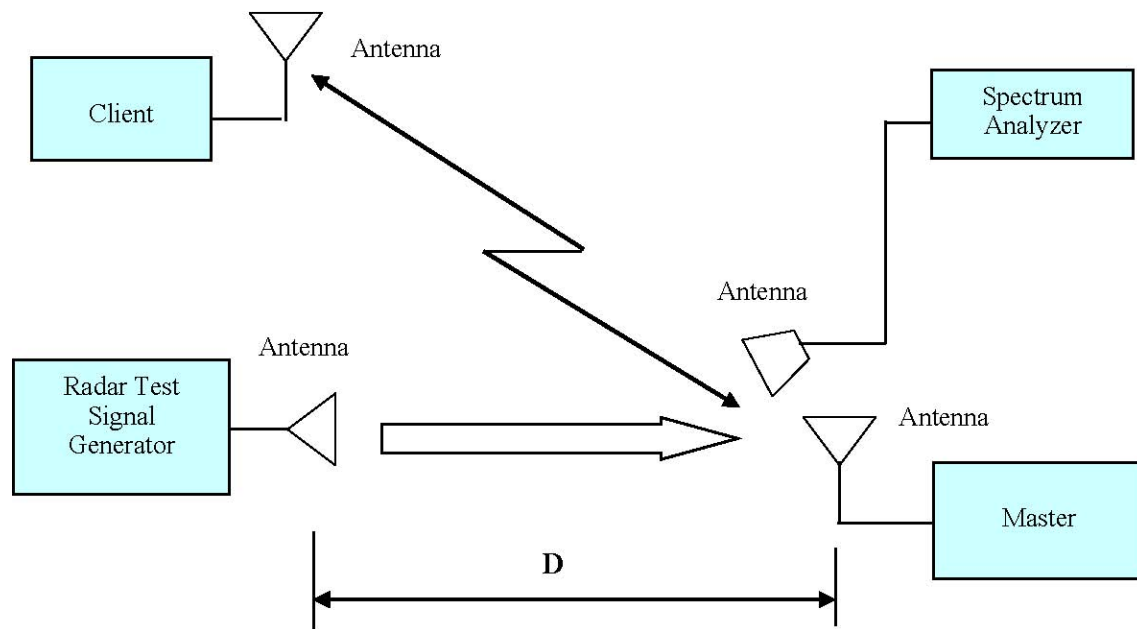


Conducted Method



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.

TEST RESULTS

Description of EUT

The EUT operates in 5250-5350 MHz and 5470-5725 MHz range.

The rated output power of master device is >23 dBm (EIRP), therefore the required interference threshold level is -64 dBm, the required radiated threshold at antenna port is -64dBm.

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.

The calibrated radiated DFS detection threshold level is set to $-64+1+(\text{Master antenna gain})=$

Band 2 : $-64+1.11+1= -61.89$ dBm.

Band 3 : $-64+1.61+1= -61.39$ dBm

Channel Loading

System testing will be performed with channel-loading using means appropriate to the data types that are used by the unlicensed device. The following requirements apply:

- a) The data file must be of a type that is typical for the device (i.e., MPEG-2, MPEG-4, WAV, MP3, MP4, AVI, etc.) and must generally be transmitting in a streaming mode.
- b) Software to ping the client is permitted to simulate data transfer but must have random ping intervals.
- c) Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyzer for zero span and approximate the Time On/ (Time On + Off Time). This can be done with any appropriate channel BW and modulation type.
- d) Unicast or Multicast protocols are preferable but other protocols may be used. The appropriate protocol used must be described in the test procedures.

The sample is use method (C)

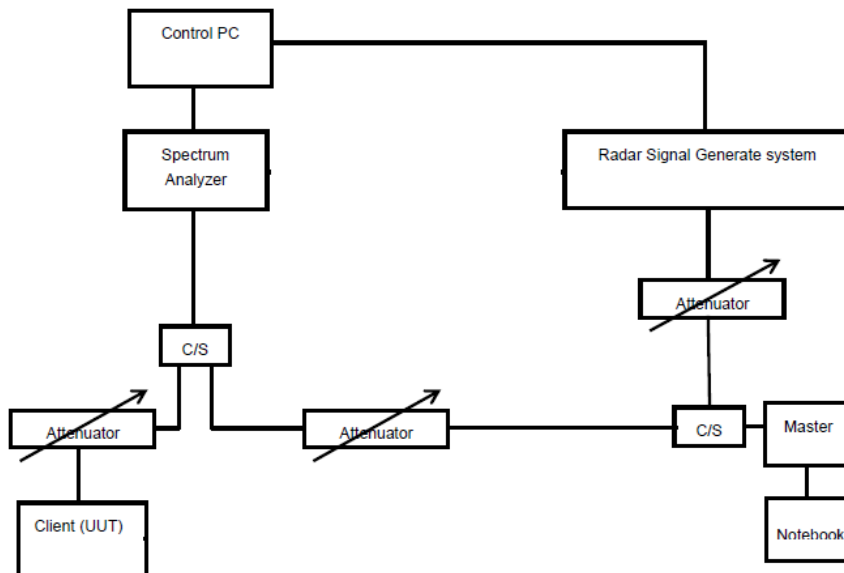
WLAN traffic is generated by streaming the video file TestFile.mpg, this file is used by IP and Frame based systems for loading the test channel during the In-service compliance testing of the U-NII device. The file is streamed from the Access Point to the Client in full motion video mode using the media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

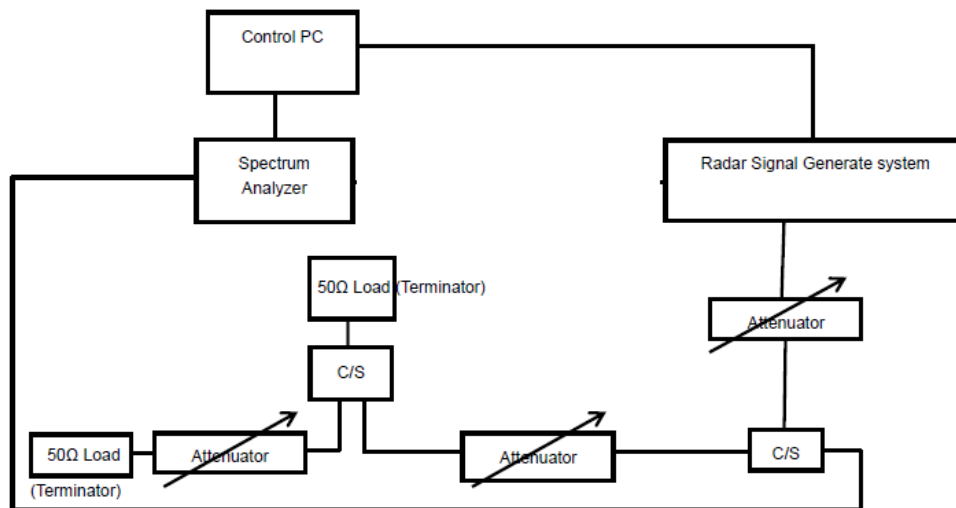
Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2018/11/22	2019/11/21
Vector Signal Generator	Rohde & Schwarz	SMBV100A	261748	2018/11/22	2019/11/21
Power Splitter	Mini-Circuits	ZFRSC-183-S+	SF448201614S	N.C.R	N.C.R
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11
Cable	Rohde & Schwarz	Rohde & Schwarz	J12J102248-00-B-1	2019/01/04	2020/01/03
Cable	Rohde & Schwarz	Rohde & Schwarz	J12J102248-00-B-3	2019/01/04	2020/01/03
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2019/03/07	2020/03/06
Attenuator	MINI-CIRCUITS	BW-S20W5+	1430	2019/01/04	2020/01/03

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements

Conducted Test Setup Configuration

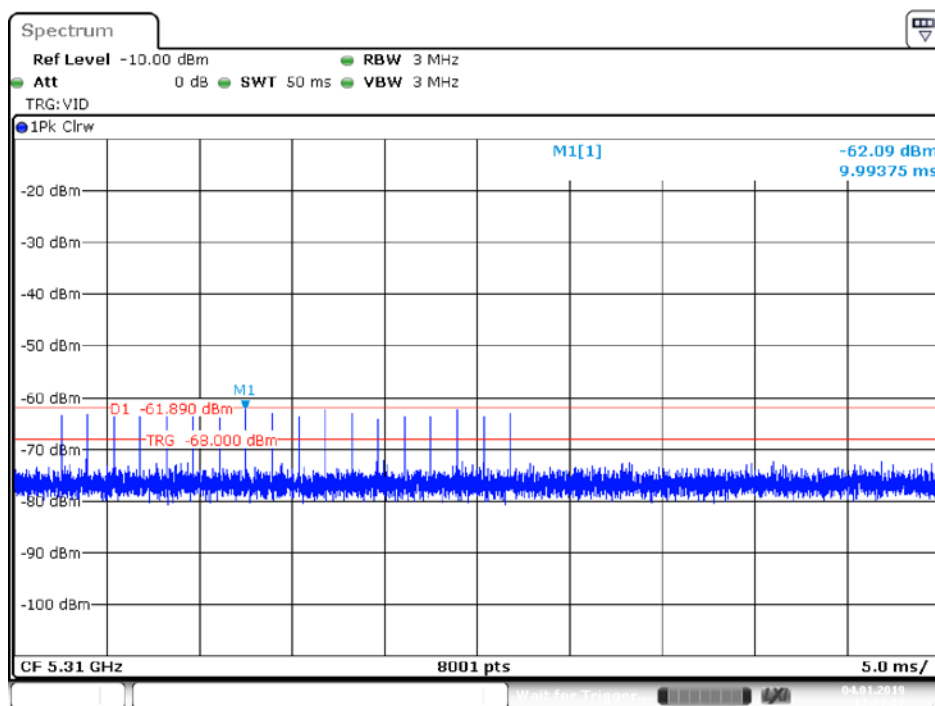


Calibration of DFS Detection Threshold Level**Test Environmental Conditions**

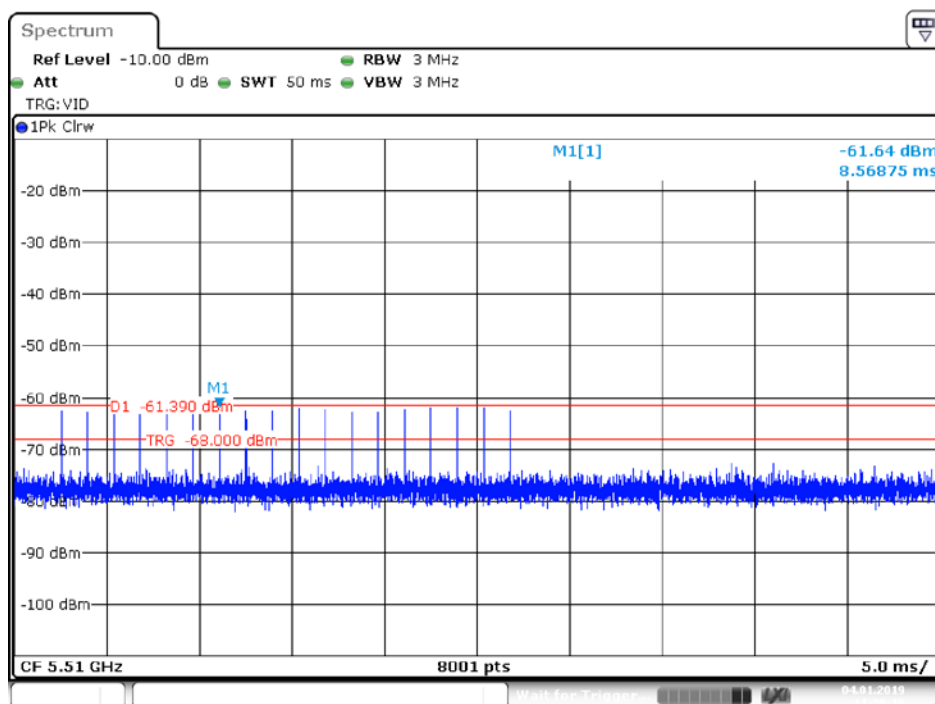
Temperature:	25.5 ° C
Relative Humidity:	49 %
ATM Pressure:	1006 hPa

The testing was performed by Tom Hsu on 2019-01-04.

Plots of Radar Waveforms

5310 MHz :**Radar Type 0**

Date: 4. JAN. 2019 13:21:07

5510 MHz :**Radar Type 0**

Date: 4. JAN. 2019 11:30:17

CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME

Test Procedure

Perform type 0 short pulse radar waveform. The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = $N \times \text{Dwell Time}$

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. 10000)

Test Results

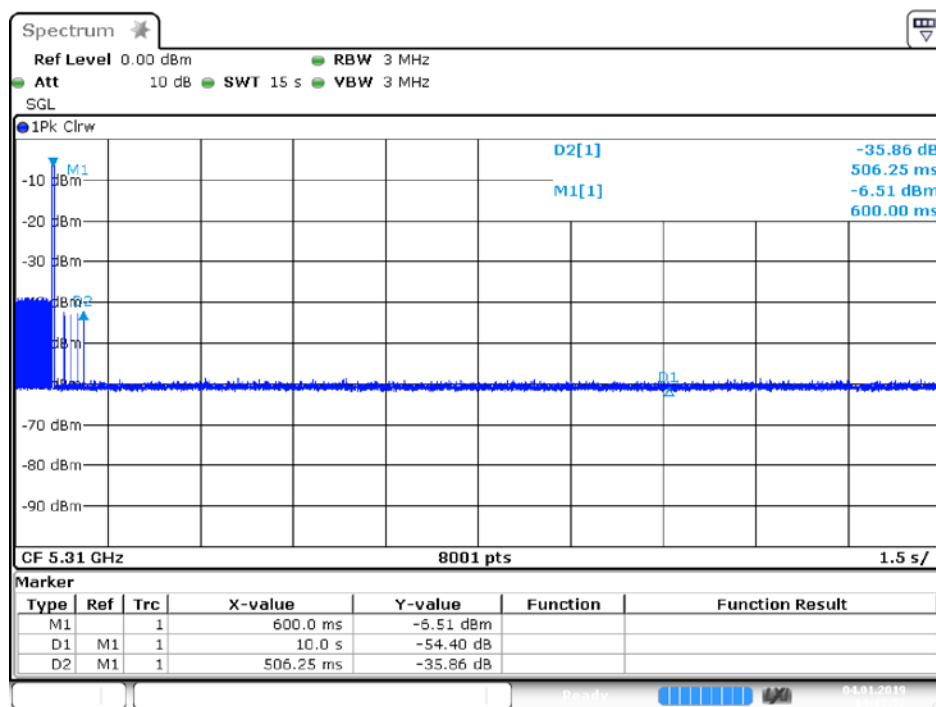
Frequency (MHz)	Bandwidth (MHz)	Radar Type	Results
5310	40	Type 0	Compliant
5510	40	Type 0	Compliant

Please refer to the following tables and plots.

5310 MHz

Type 0 radar channel move time result:

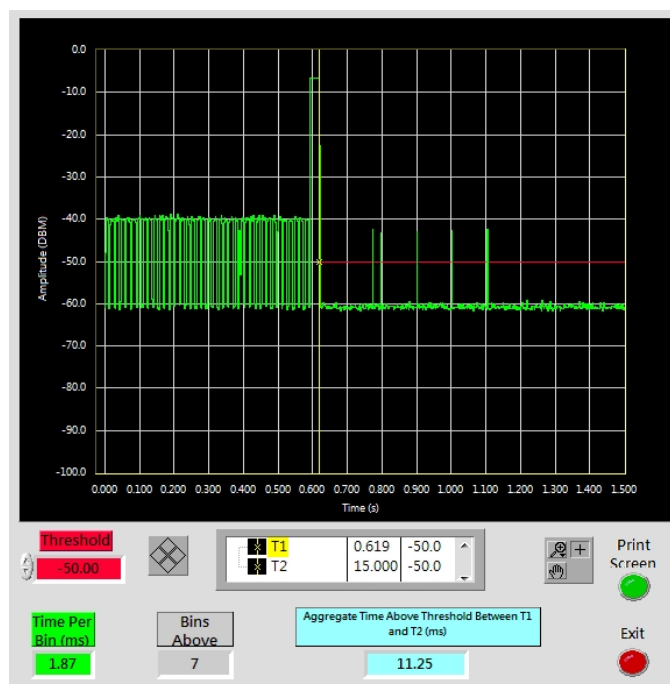
Item	Time (s)	Limit (s)
Channel move time	0.506	10



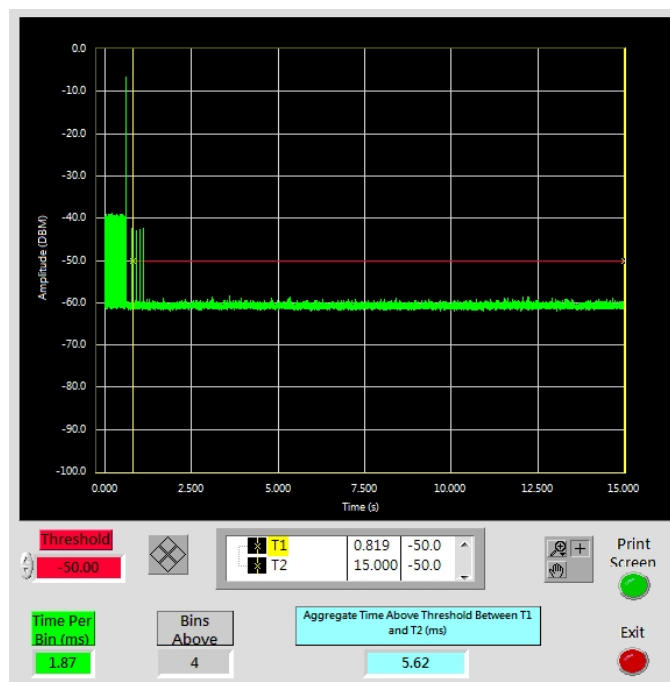
Date: 4.JAN.2019 14:13:52

Type0 radar channel closing transmission time result:

Item	Transmission After 200ms	Aggregate Transmission Time After 200ms Delay (ms)	Limit (ms)	Result
Closing Transmission Time	YES	5.62	60	PASS



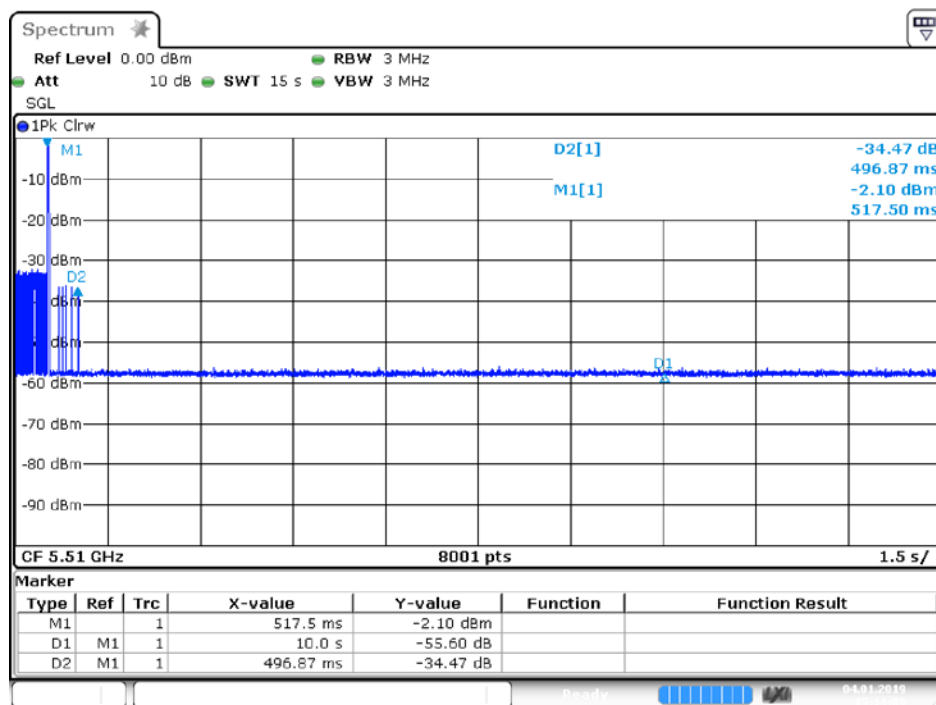
T1 : Radar wave end time.



T1 : The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus.

Type 0 radar channel move time result:

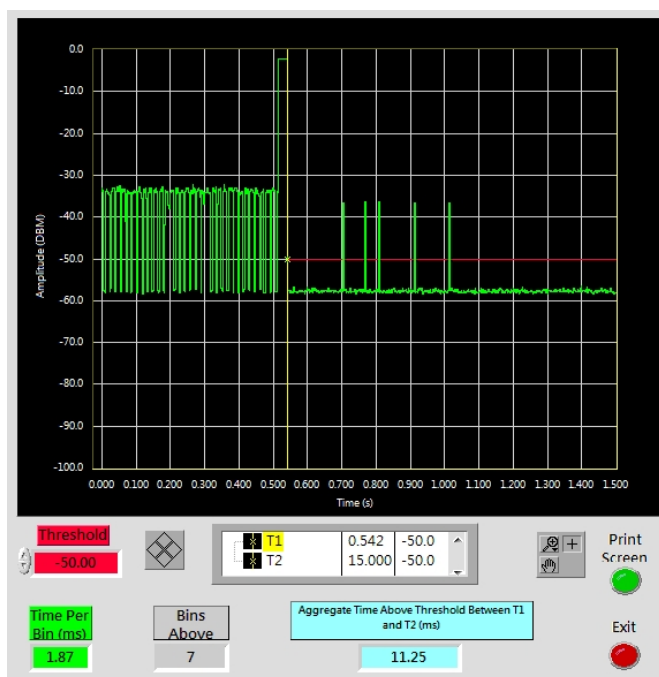
Item	Time (s)	Limit (s)
Channel move time	0.496	10



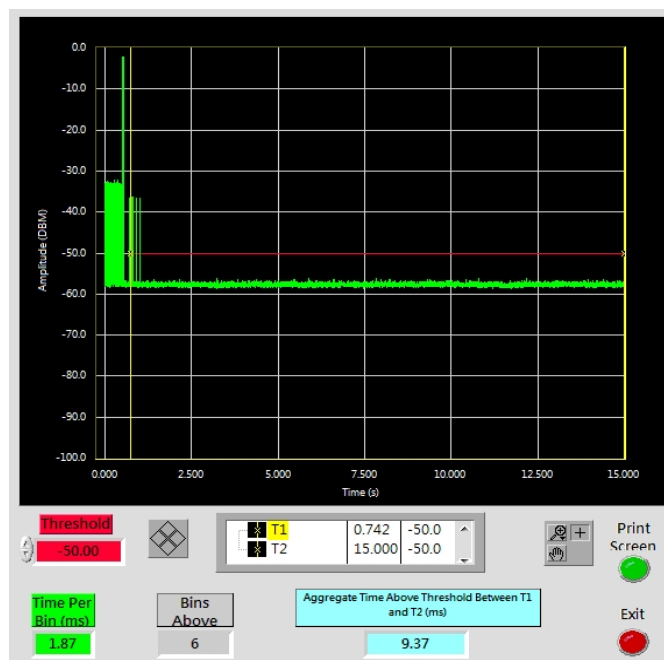
Date: 4.JAN.2019 15:11:09

Type0 radar channel closing transmission time result:

Item	Transmission After 200ms	Aggregate Transmission Time After 200ms Delay (ms)	Limit (ms)	Result
Closing Transmission Time	YES	9.37	60	PASS



T1 : Radar wave end time.



T1 : The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus.

NON-OCCUPANCY PERIOD

Test Procedure

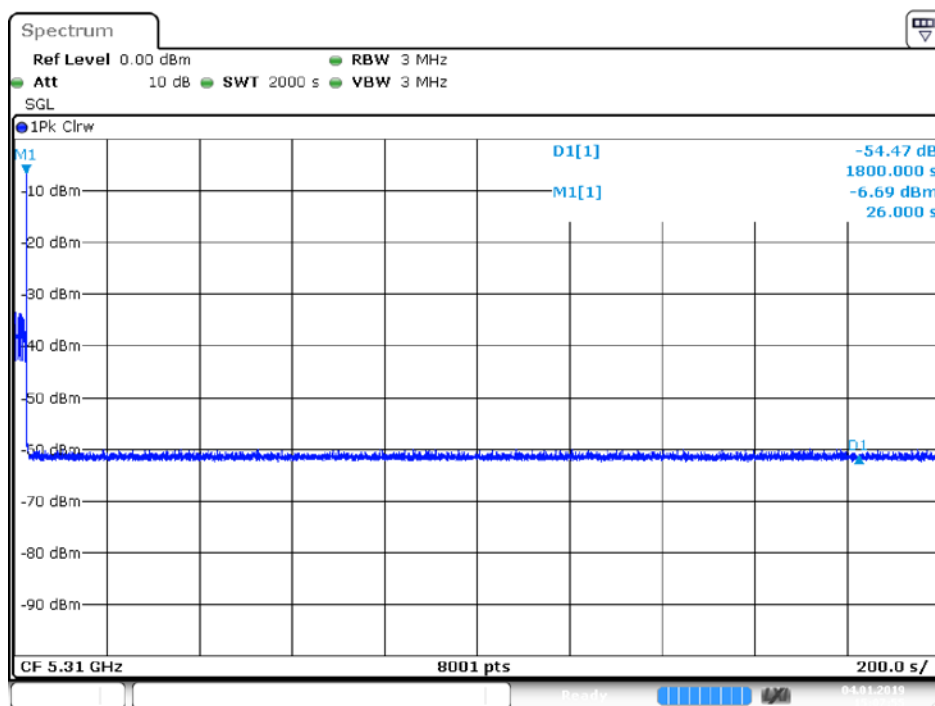
Measure the EUT for more than 30 minutes following the channel close/move time to verify that the EUT does not resume any transmissions on this channel. Provide one plot to demonstrate no transmission on the channel for the non-occupancy period (30 minutes observation time)

Test Result

Frequency(MHz)	Bandwidth (MHz)	Spectrum Analyzer Display
5310	40	No transmission within 30 minutes
5510	40	No transmission within 30 minutes

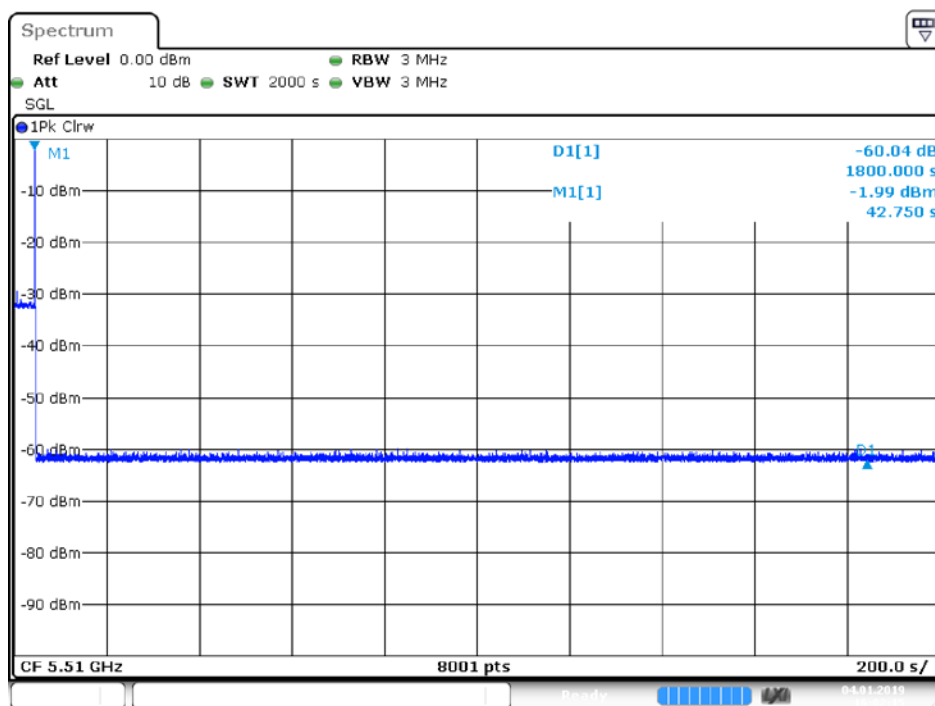
Please refer to the following plots.

5310 MHz



Date: 4.JAN.2019 15:07:56

5510 MHz



Date: 4.JAN.2019 16:02:16

TEST SETUP PHOTOGRAPHS



***** END OF REPORT *****