Dynamic Frequency Selection (DFS)

Test Report

(Class II Permissive Change)

Product Name	MOXA IEEE 802.11a/n/ac 4*4 module
Model No	WAPC002
FCC ID	SLE-WAPC002

Applicant	MOXA Inc.
Address	FL.4, NO. 135. LANE 235, BAOQIAO RD. XINDIAN DIST.,NEW TAIPEI CITY, TAIWAN

Date of Receipt	July 12, 2018
Issued Date	June 10, 2019
Report No.	1870151R-RFUSP16V00
Report Version	V1.0

Testing Laboratory
3023

DFS Test Report

Issued Date: June 10, 2019
Report No.: 1870151R-RFUSP16V00

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Applicant	MOXA Inc.
Address	FL.4, NO. 135. LANE 235, BAOQIAO RD. XINDIAN DIST.,NEW TAIPEI CITY, TAIWAN
Manufacturer	MOXA Inc.
Model No.	WAPC002
FCC ID.	SLE-WAPC002
EUT Rated Voltage	DC 24~110V
EUT Test Voltage	DC 24V
Trade Name	MOXA
Applicable Standard	FCC CFR Title 47 Part 15 Subpart E 15.407 (h): 2016 KDB 905462 D02 UNII DFS Compliance Procedures v02 KDB 905462 D04 Operational Modes for DFS Testing v01 KDB 905462 D06 802 11 Channel Plans New Rules v02 FCC 16-24
Test Result	Complied

Documented By : Genie Chang

(Senior Adm. Specialist / Genie Chang)

Tested By : Benjamin Pan

(Engineer / Benjamin Pan)

Approved By :

(Director / Vincent Lin)

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Standard Requirement

FCC Part 15.407:

U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30dBm. A TPC mechanism is not required for systems with an E.I.R.P. of less than 500mW.

U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

1.2. EUT Description

Product Name	MOXA IEEE 802.11a/n/ac 4*4 module
Trade Name	MOXA
FCC ID.	SLE-WAPC002
Model No.	WAPC002
DFS Frequency Range	802.11a/n-20MHz:5260-5320MHz,5500-5700MHz 802.11n-40MHz:5270-5310MHz,5510-5670MHz 802.11ac-20MHz:5720MHz, 802.11ac-40MHz:5710MHz 802.11ac-80MHz:5290MHz,5530-5690MHz
Number of DFS Channels	802.11a/n-20MHz: 15, n-40MHz: 7 802.11ac-20MHz: 1, 802.11ac-40MHz: 1, 802.11ac-80MHz: 4
Data Rate	802.11a: 6-54Mbps, 802.11n: up to 600Mbps 802.11ac-80MHz: up to 1733.3MHz
Channel Control	Auto
Type of Modulation	802.11a/n: OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM
Channel Bandwidth	20/40/80MHz
DFS Function	■ Master □ Slave
TPC Function	■ <500mW not required □ ≧ 500mW employ a TPC*
Communication Mode	■ IP Based Systems □ Frame Based System □ Other System
Antenna Gain	Refer to the table “Antenna List”

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	MOXA	MAT-WDB-PA-NF-2-0708	Panel	7.63dBi For 2.4GHz 8.77dBi For 5.15~5.25GHz 8.77dBi For 5.25~5.35GHz 8.5dBi For 5.47~5.725GHz 8.18dBi For 5.725~5.825GHz
2	MOXA	WI25-A1-0810012-RG316	Panel	8.5dBi For 2.4GHz 10.5dBi For 5GHz
3	MOXA	ANT-WSB-PNF-12	Panel	12dBi For 2.4GHz
4	MOXA	ANT-WDB-PNF-1518	Panel	15dBi For 2.4GHz 18 dBi For 5GHz
5	MOXA	MI05-A1-XX23037-X0	Panel	23dBi For 5GHz
6	MOXA	MI05-A1-XX16020-X0	Panel	12dBi For 5GHz
7	MOXA	ANT-WSB5-PNF-18	Panel	18dBi For 2.4GHz 18 dBi For 5GHz
8	MOXA	ANT-WSB-AHRM-05-1.5m BK	Omni-directional	1.51dBi For 2.4GHz
9	MOXA	ANT-WSB-ANF-09	Omni-directional	9dBi For 2.4GHz
10	MOXA	MAT-WDB-CA-RM-2-0205	Omni-directional	2.5dBi For 2.4GHz 5.0dBi For 5.15~5.25GHz 5.7dBi For 5.25~5.35GHz 4.9dBi For 5.47~5.725GHz 5.2dBi For 5.725~5.825GHz
11	MOXA	MAT-WDB-DA-RM-2-0203-1m	Omni-directional	2.43dBi For 2.4GHz 3.8dBi For 5.15~5.25GHz 2.72dBi For 5.25~5.35GHz 2.26dBi For 5.47~5.725GHz 2.34dBi For 5.725~5.825GHz
12	MOXA	ANT-WDB-ANM-0306	Omni-directional	3.8dBi For 2.4GHz 5.7dBi For 5.15~5.25GHz 5.7dBi For 5.25~5.35GHz 6.3dBi For 5.47~5.725GHz 6.3dBi For 5.725~5.825GHz
13	MOXA	ANT-WDB-ARM-0202	Omni-directional	1.8dBi For 2.4GHz 1.8 dBi For 5GHz
14	MOXA	ANT-WDB-ARM-02	Omni-directional	2.04dBi For 2.4GHz 0.81 dBi For 5GHz
15	MOXA	ANT-WDB-ANM-0502	Omni-directional	4.62dBi For 2.4GHz 2 dBi For 5GHz
16	MOXA	ANT-WDB-ANM-0407	Omni-directional	4dBi For 2.4GHz 7 dBi For 5GHz
17	MOXA	ANT-WDB-ANF-0609	Omni-directional	6dBi For 2.4GHz 9 dBi For 5GHz
18	MOXA	ANT-WDB-ANM-0609	Omni-directional	6dBi For 2.4GHz 9 dBi For 5GHz
19	MOXA	ANT-WSB5-ANF-12	Omni-directional	12 dBi For 5GHz
20	MOXA	MHH-A11-XX110170-X0	Railway	9dBi For 2.4GHz 8dBi For 5GHz
21	MOXA	WI25-A1-1215053-X0	Sector	12dBi For 2.4GHz 15dBi For 5GHz
22	MOXA	TOP 200 AMR MF-05-4	Patch	8.2dBi For 2.4GHz 8.5dBi For 5GHz

Note: Select No.14 a low gain antenna for DFS test.

802.11a/n-20MHz Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 52:	5260 MHz	Channel 56:	5280 MHz	Channel 60:	5300 MHz	Channel 64:	5320 MHz
Channel 100:	5500 MHz	Channel 104:	5520 MHz	Channel 108:	5540 MHz	Channel 112:	5560 MHz
Channel 116:	5580 MHz	Channel 120:	5600 MHz	Channel 124:	5620 MHz	Channel 128:	5640 MHz
Channel 132:	5660 MHz	Channel 136:	5680 MHz	Channel 140:	5700 MHz		

802.11n-40MHz Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 54:	5270 MHz	Channel 62:	5310 MHz	Channel 102:	5510 MHz	Channel 110:	5550 MHz
Channel 118:	5590 MHz	Channel 126:	5630 MHz	Channel 134:	5670 MHz		

802.11ac-20MHz Center Working Frequency of Each Channel:

Channel	Frequency
Channel 144	5720MHz

802.11ac-40MHz Center Working Frequency of Each Channel:

Channel	Frequency
Channel 142:	5710MHz

802.11ac-80MHz Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 58:	5290 MHz	Channel 106:	5530 MHz	Channel 122:	5610 MHz	Channel 138:	5690 MHz

Note:

1. This system is equipped with dual modules, 2.4GHz module FCC ID:SLE-WAPN010, 5GHz module FCC ID:SLE-WAPC002.
2. This is to request a Class II permissive change for FCC ID:SLE-WAPC002, originally granted on 11/06/2018.
   The major change filed under this application is:
   Change #1: Additional Chassis is added, Product name: TAP-125 Series Industrial IEEE 802.11a/b/g/n/ac wireless AP/bridge/client, Brand: MOXA, Model number: TAP-125-w-x-z (yyyyyyyy).
   w = UN, or US (standards for different contry codes, UN stands for Universal Models without US.)
   x = CT or blank (standard for coating models)
   z = T or blank (standard for wide operation temp. models)
   y = 0-9, A-Z, and "-" or blank (standards for marketing issue)

Test Mode	Mode 1: Transmit (802.11n-20BW) Mode 2: Transmit (802.11n-40BW) Mode 3: Transmit (802.11ac-80BW)

1.3. UNII Device Description

(1) The EUT operates in the following DFS band:

1. 5250-5350 MHz
2. 5470-5725 MHz

(2) The U-NII device maximum power is 49.67dBm(E.I.R.P).

Below are the available 50 ohm antenna assemblies and their corresponding gains. 0dBi gain was used to set the -63 dBm threshold level (-64dBm +1 dB) during calibration of the test setup.

(3) WLAN traffic is generated by the test software “Iperf.exe” from the Master device to the Slave device in the transfer data rate >17%.

(4) For the 5250-5350 MHz and 5470-5725 MHz bands, the Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm.

(5) The client device is an Dell Inspiron 5459 Notebook pc contains Intel WLAN radio Module card (Model Model : 3165NGW). The Intel WLAN Module card FCC ID: PD93165NG

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	MOXA	MAT-WDB-PA-NF-2-0708	Panel	7.63dBi For 2.4GHz 8.77dBi For 5.15~5.25GHz 8.77dBi For 5.25~5.35GHz 8.5dBi For 5.47~5.725GHz 8.18dBi For 5.725~5.825GHz
2	MOXA	WI25-A1-0810012-RG316	Panel	8.5dBi For 2.4GHz 10.5dBi For 5GHz
3	MOXA	ANT-WSB-PNF-12	Panel	12dBi For 2.4GHz
4	MOXA	ANT-WDB-PNF-1518	Panel	15dBi For 2.4GHz 18 dBi For 5GHz
5	MOXA	MI05-A1-XX23037-X0	Panel	23dBi For 5GHz
6	MOXA	MI05-A1-XX16020-X0	Panel	12dBi For 5GHz
7	MOXA	ANT-WSB5-PNF-18	Panel	18dBi For 2.4GHz 18 dBi For 5GHz
8	MOXA	ANT-WSB-AHRM-05-1.5m BK	Omni-directional	1.51dBi For 2.4GHz
9	MOXA	ANT-WSB-ANF-09	Omni-directional	9dBi For 2.4GHz
10	MOXA	MAT-WDB-CA-RM-2-0205	Omni-directional	2.5dBi For 2.4GHz 5.0dBi For 5.15~5.25GHz 5.7dBi For 5.25~5.35GHz 4.9dBi For 5.47~5.725GHz 5.2dBi For 5.725~5.825GHz
11	MOXA	MAT-WDB-DA-RM-2-0203-1m	Omni-directional	2.43dBi For 2.4GHz 3.8dBi For 5.15~5.25GHz 2.72dBi For 5.25~5.35GHz 2.26dBi For 5.47~5.725GHz 2.34dBi For 5.725~5.825GHz
12	MOXA	ANT-WDB-ANM-0306	Omni-directional	3.8dBi For 2.4GHz 5.7dBi For 5.15~5.25GHz 5.7dBi For 5.25~5.35GHz 6.3dBi For 5.47~5.725GHz 6.3dBi For 5.725~5.825GHz
13	MOXA	ANT-WDB-ARM-0202	Omni-directional	1.8dBi For 2.4GHz 1.8 dBi For 5GHz
14	MOXA	ANT-WDB-ARM-02	Omni-directional	2.04dBi For 2.4GHz 0.81 dBi For 5GHz
15	MOXA	ANT-WDB-ANM-0502	Omni-directional	4.62dBi For 2.4GHz 2 dBi For 5GHz
16	MOXA	ANT-WDB-ANM-0407	Omni-directional	4dBi For 2.4GHz 7 dBi For 5GHz
17	MOXA	ANT-WDB-ANF-0609	Omni-directional	6dBi For 2.4GHz 9 dBi For 5GHz
18	MOXA	ANT-WDB-ANM-0609	Omni-directional	6dBi For 2.4GHz 9 dBi For 5GHz
19	MOXA	ANT-WSB5-ANF-12	Omni-directional	12 dBi For 5GHz
20	MOXA	MHH-A11-XX110170-X0	Railway	9dBi For 2.4GHz 8dBi For 5GHz
21	MOXA	WI25-A1-1215053-X0	Sector	12dBi For 2.4GHz 15dBi For 5GHz
22	MOXA	TOP 200 AMR MF-05-4	Patch	8.2dBi For 2.4GHz 8.5dBi For 5GHz

1.4. Test Equipment

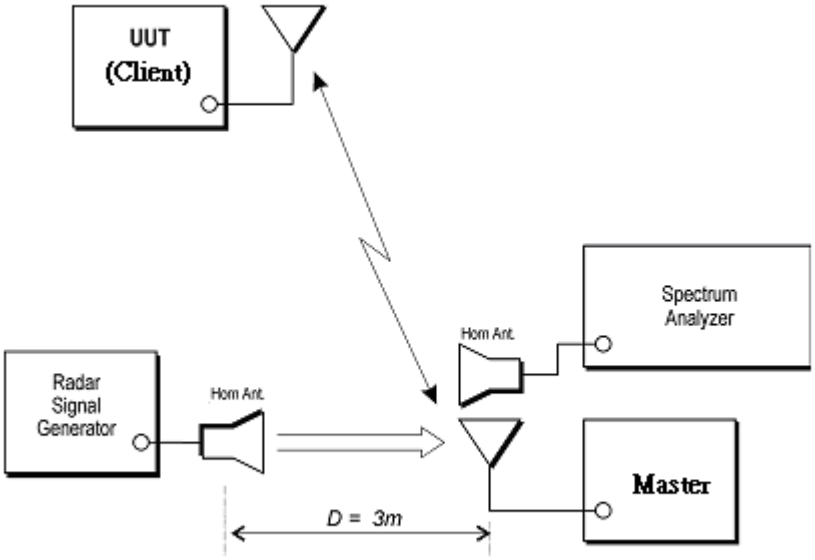
Dynamic Frequency Selection (DFS)

Instrument	Manufacturer	Type No.	Serial No	Cal. Date
Spectrum Analyzer	R&S	FSV30	103467	2019.01.16
Vector Signal Generator	R&S	SMBV100	261871	2019.03.10
Horn Antenna	ETS-Lindgren	3117	00201366	2018.09.05
Horn Antenna	ETS-Lindgren	3117	00203799	2018.10.05

Instrument	Manufacturer	Type No.	Serial No
Notebook Pc	Hp	HSTNN-155C	CNU8476RVZ
Notebook Pc	Dell	Latitude E5420	24357736765
RF Cable	WOKEN	L1406-031C	S02-130729-305
RF Cable	SUHNER	SUCOFLEX 106	3474516

Software	Manufacturer	Function
Agilent Signal Studio for Pulse Building V1.3.13.0	Agilent	Radar Signal Generation Software
Agilent DFS_TEST V6.9	Agilent	Radar Signal Generation Software
Media Player Classic v6.4.8.6	Gabest.org	Multimedia Player

1.5. Test Setup



1.6. DFS Detection Thresholds

(1) Interference Threshold value, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥200 milliwatt	-64dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64dBm
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. **Note3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

(2) 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 + approx. 60 milliseconds over remaining 10 seconds period (See Notes 1 and 2)
U-NII Detection Bandwidth	Minimum 100% of the 99% 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.

1.7. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

(1) 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 $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	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.

(2) Long Pulse Radar Test Signal

Radar Waveform	Bursts	Number of Pulses Per Burst	Pulse Width (usec)	Chirp Width (MHz)	PRI (usec)	Minimum Percentage of Successful Detection	Minimum Trials
5	8-20	1-3	50-100	5-20	1000-2000	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the long pulse radar test signal. If more than 30 waveforms are used for the long pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

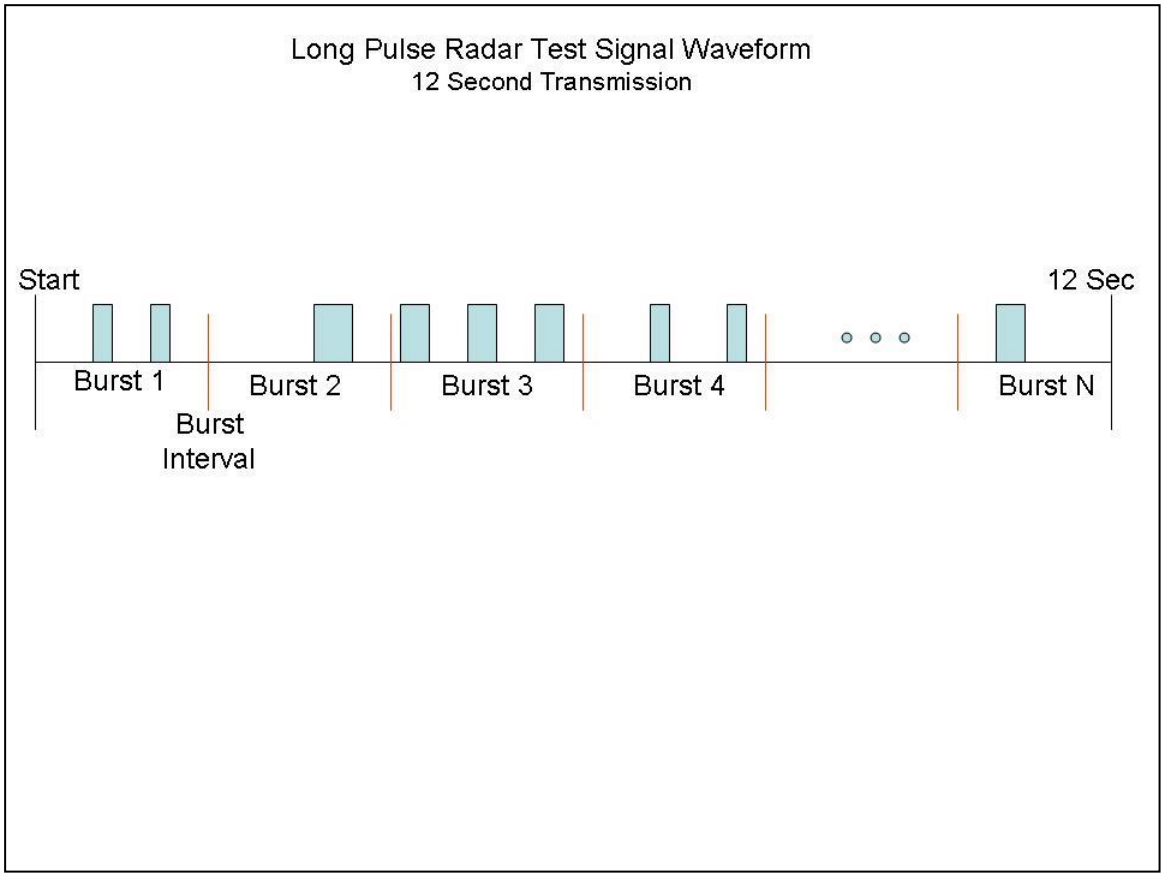
Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear frequency modulated chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a transmission period will have the same chirp width. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

A representative example of a Long Pulse radar test waveform:

1) The total test signal length is 12 seconds.
2) 8 Bursts are randomly generated for the Burst_Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) Bursts 2 through 8 are generated using steps 3 – 5.
7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

Graphical Representation of a Long Pulse radar Test Waveform



(3) Frequency Hopping Radar Test Signal

Radar Waveform	Pulse Width (μsec)	PRI (μsec)	Hopping Sequence Length (msec)	Pulses Per Hop	Hopping Rate (kHz)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	300	9	0.333	70%	30

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected[1] from the hopping sequence defined by the following algorithm:

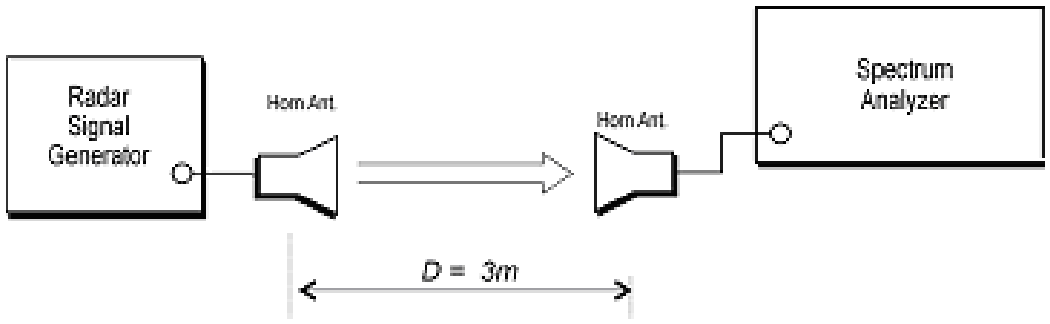
The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

1.8. Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted radar waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were replace 50ohm terminal from master and client device and no transmissions by either the master or client device. The spectrum analyzer was switched to the zero span (time domain) at the frequency of the radar waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3MHz and 3 MHz.

The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -63dBm due to the interference threshold level is not required.

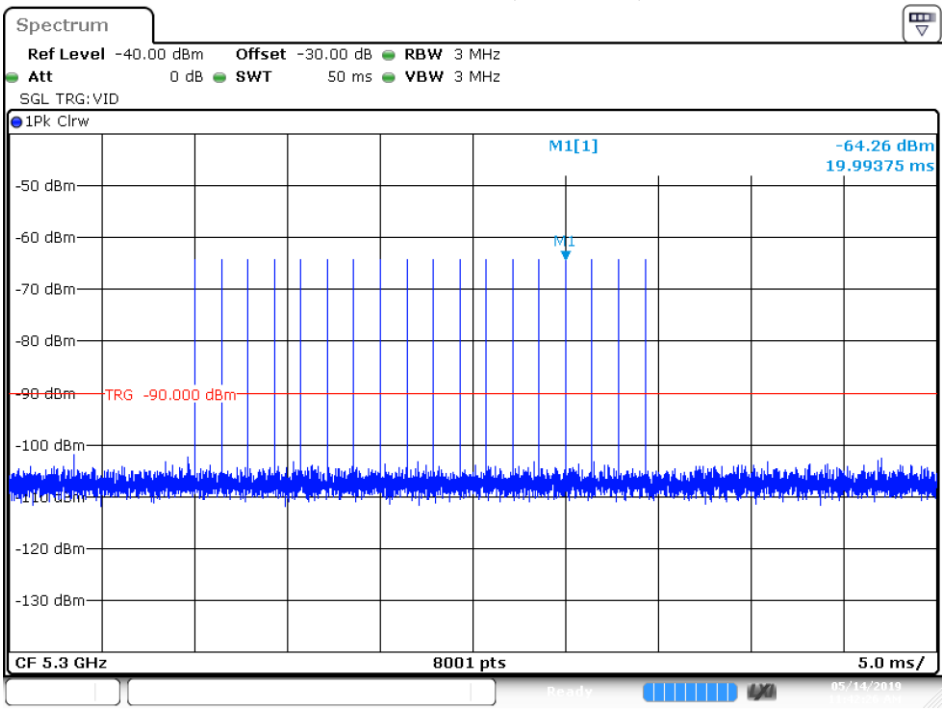
Radiated Calibration Setup



1.9. Radar Waveform Calibration Result

Radar Type 0

Calibration Plot (5300MHz)



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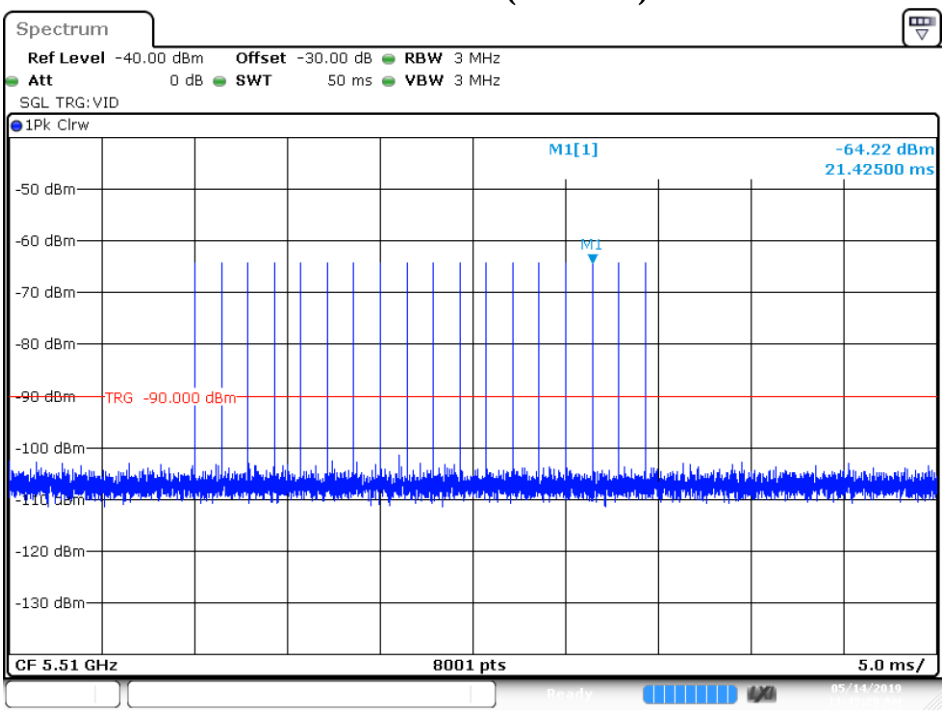
Calibration Plot (5510MHz)



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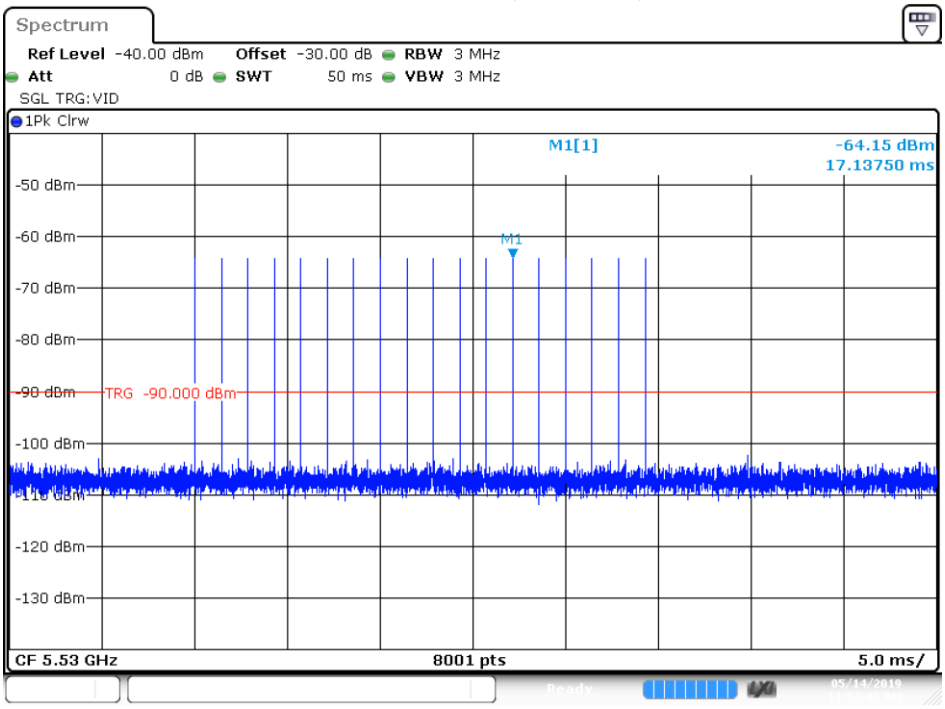
Calibration Plot (5530MHz)



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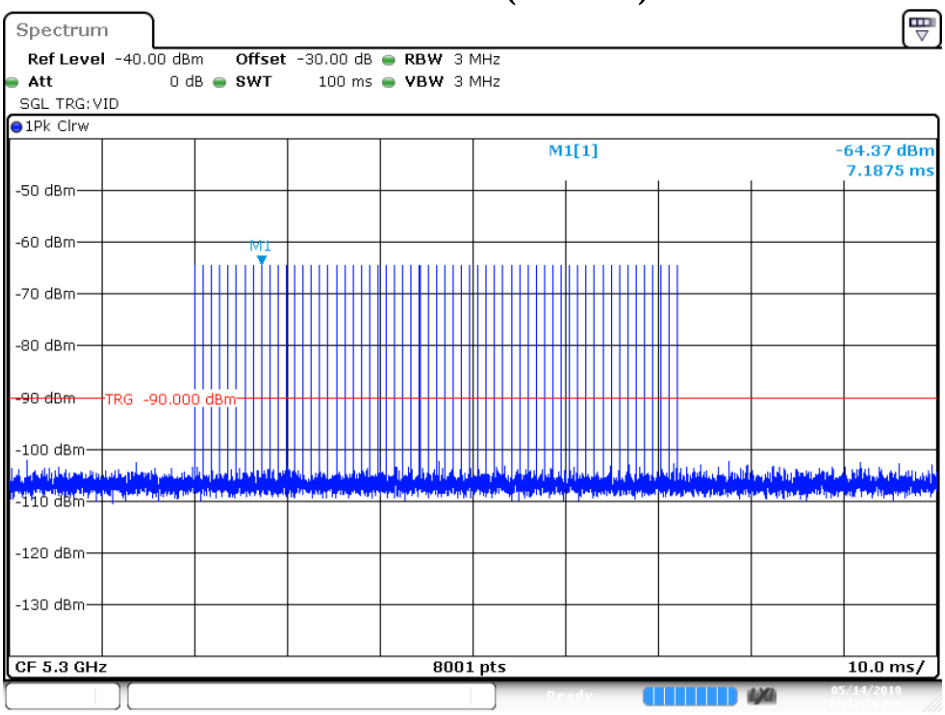
Radar Type 1-A

Calibration Plot (5300MHz)



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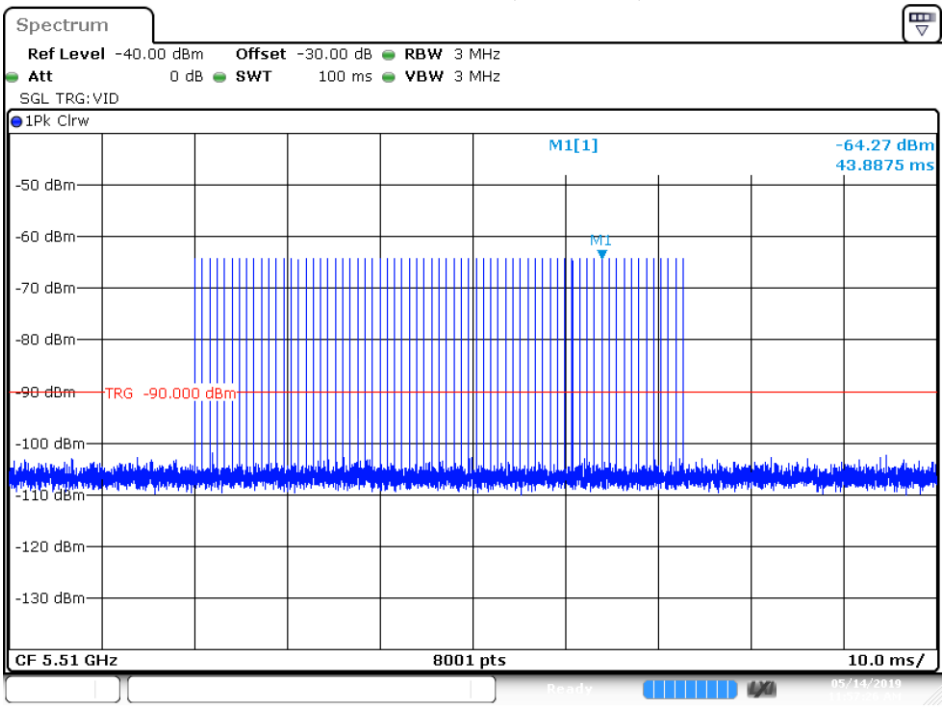
Calibration Plot (5510MHz)



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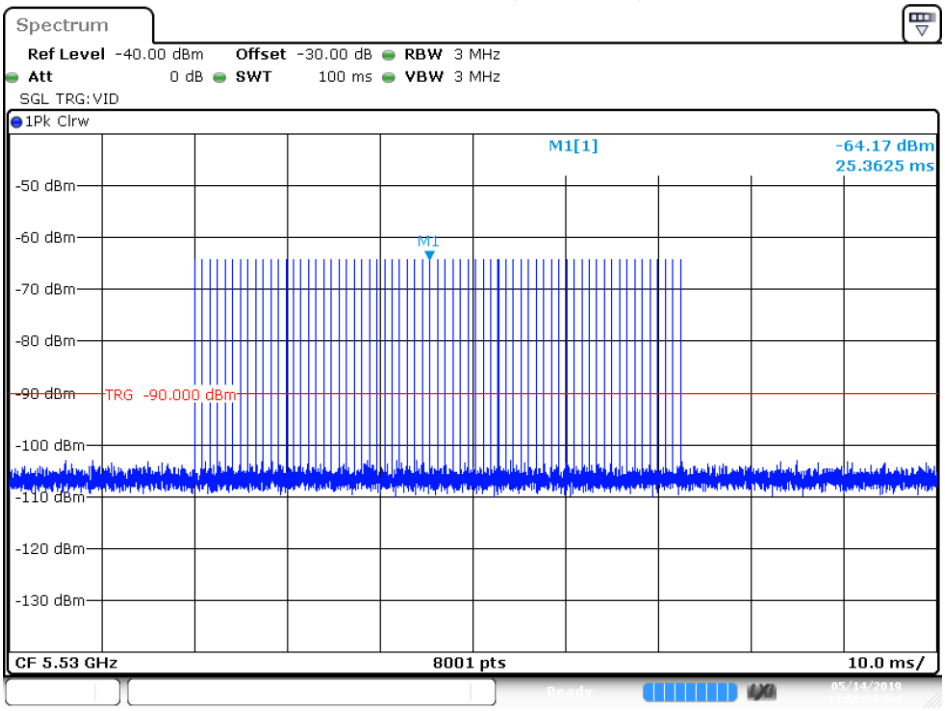
Calibration Plot (5530MHz)



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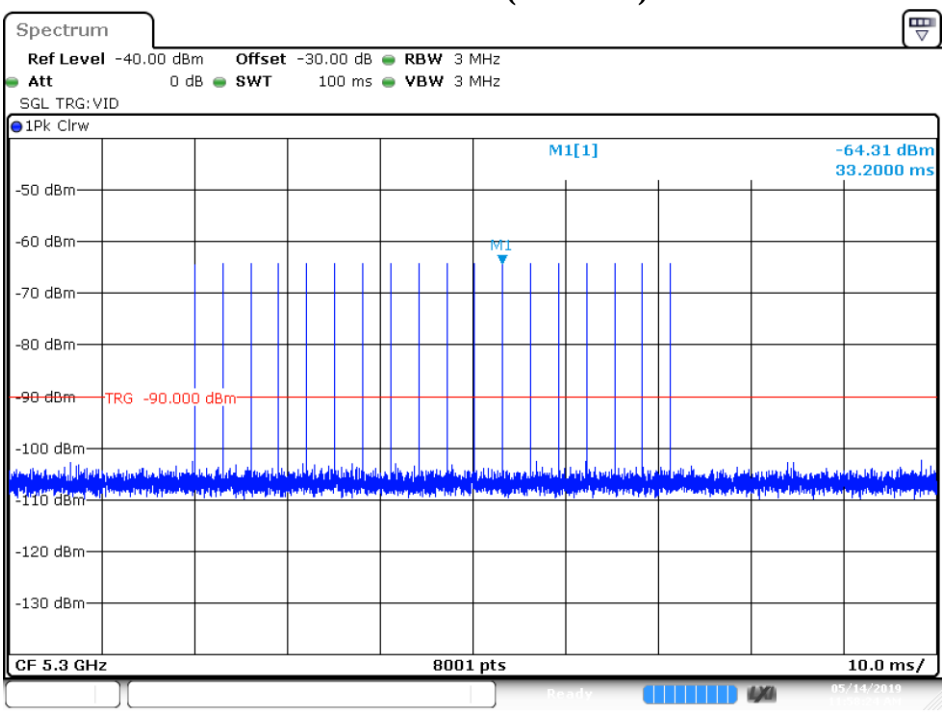
Radar Type 1-B

Calibration Plot (5300MHz)



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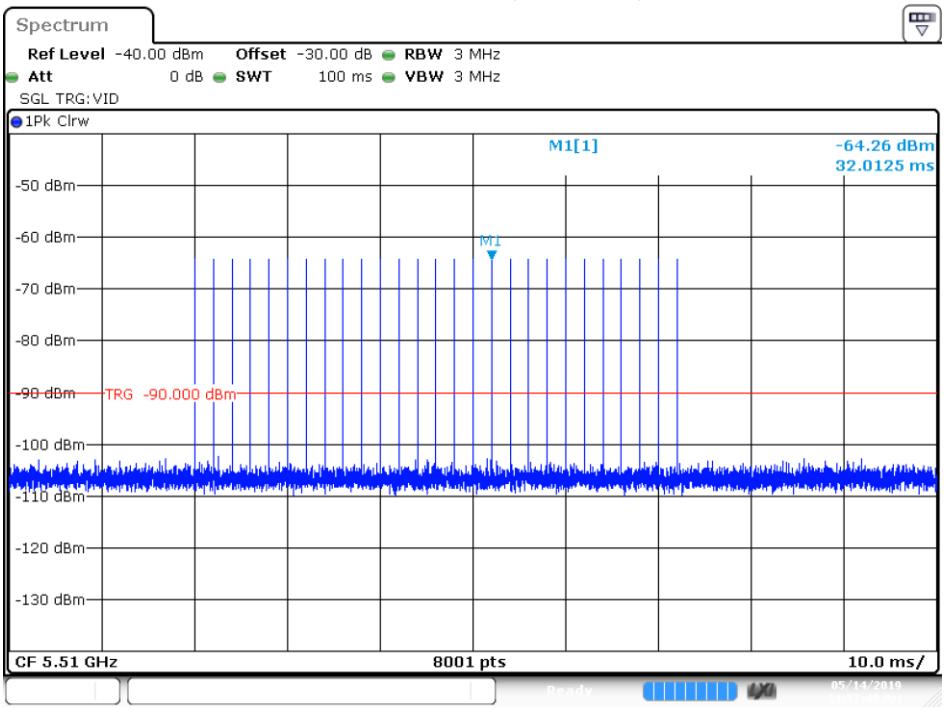
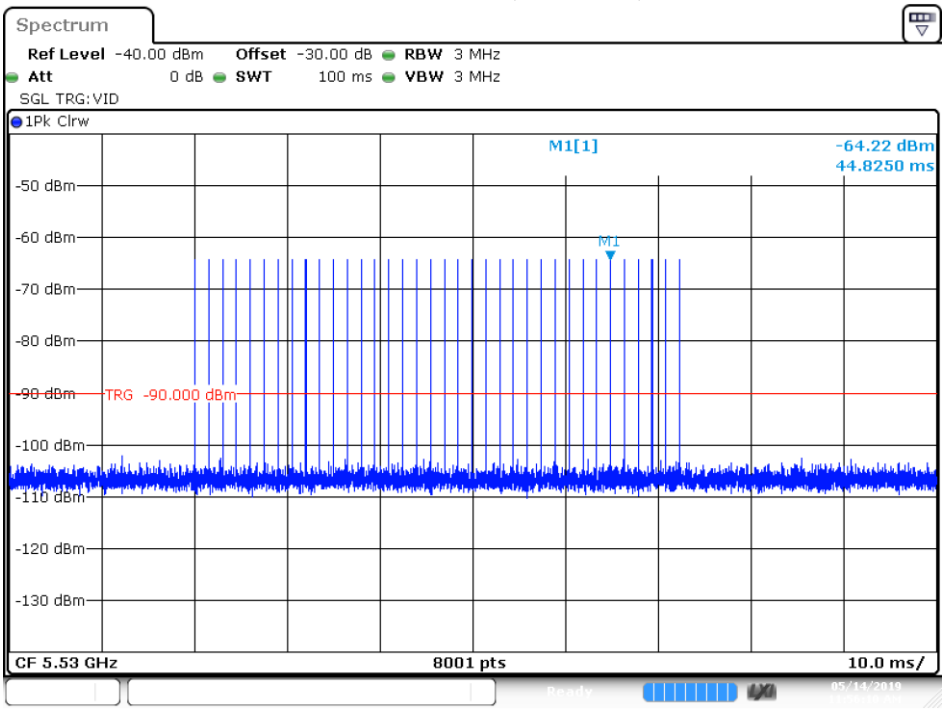
Calibration Plot (5510MHz)



Date: 14.MAY.2019 11:57:49

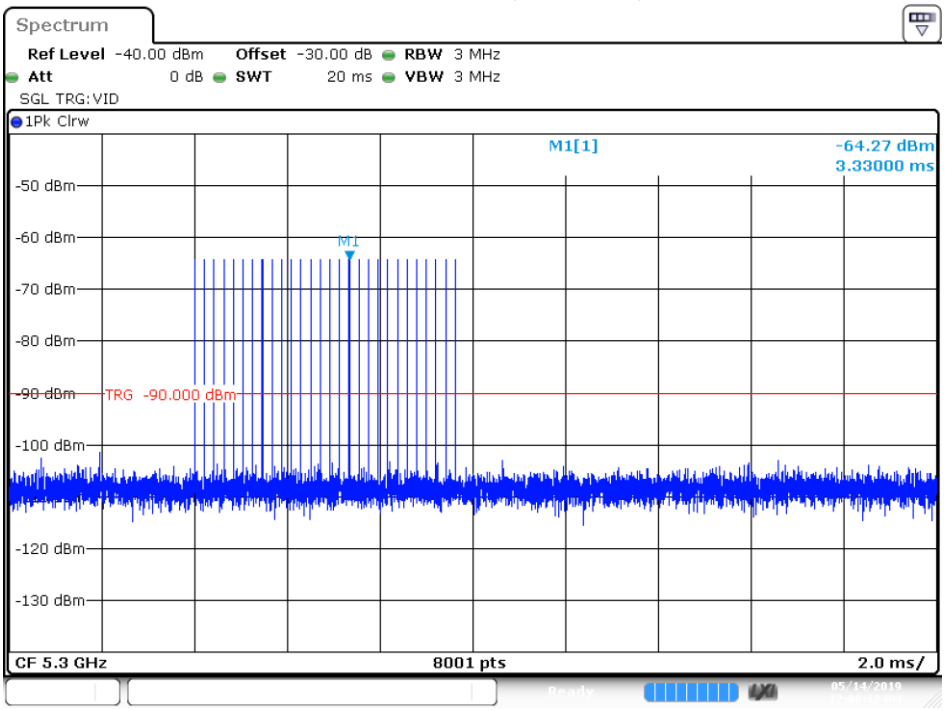
Calibration Plot (5530MHz)



Date: 14.MAY.2019 11:56:10

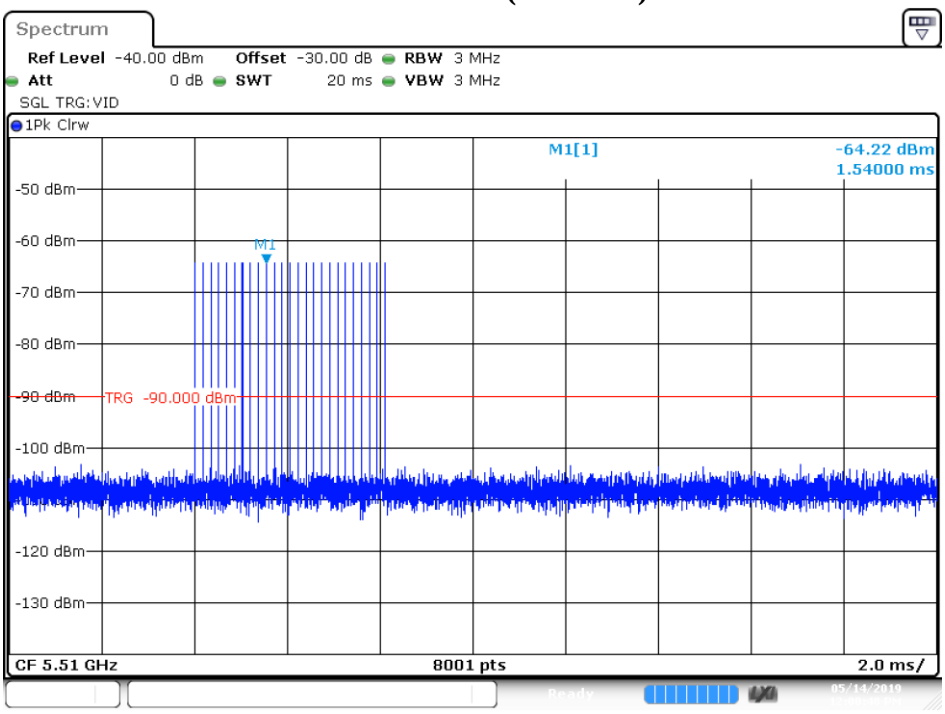
Radar Type 2

Calibration Plot (5300MHz)



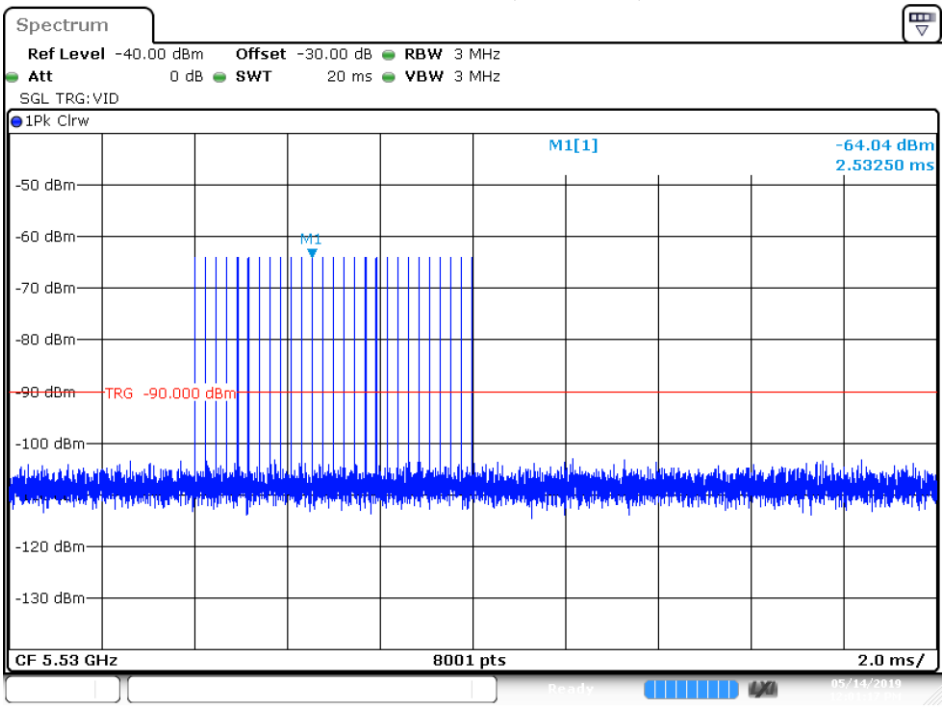
Date: 14.MAY.2019 12:00:12

Calibration Plot (5510MHz)



Date: 14.MAY.2019 12:00:48

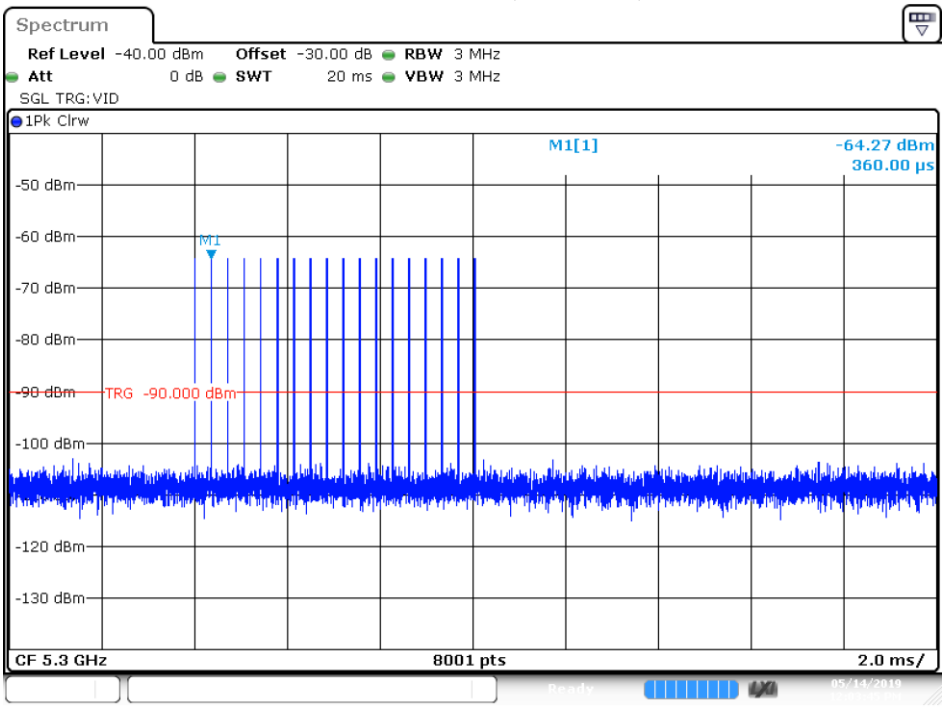
Calibration Plot (5530MHz)



Date: 14.MAY.2019 12:01:17

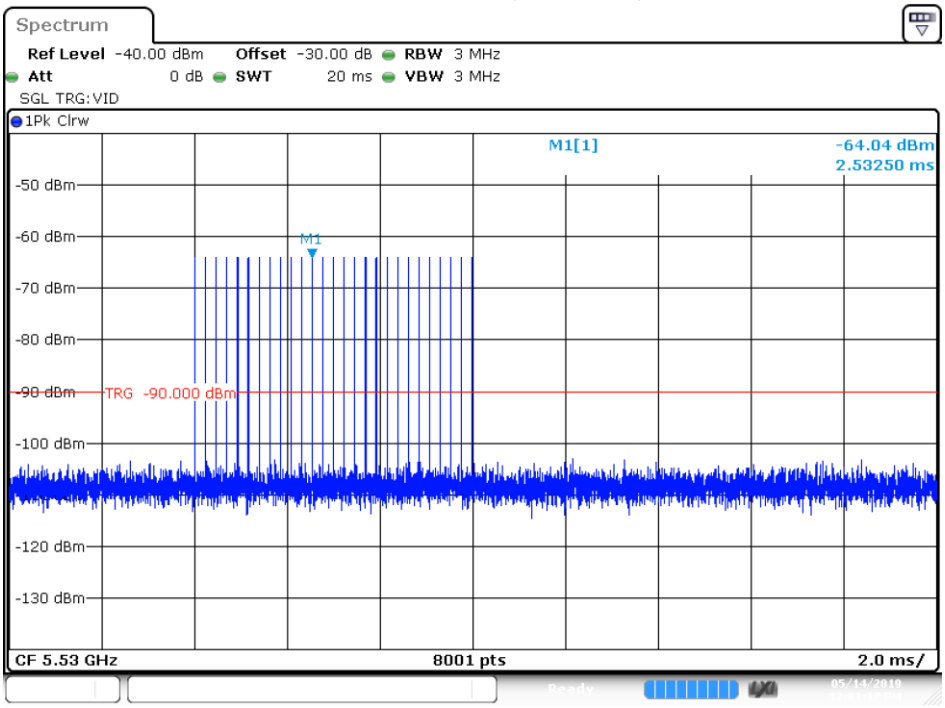
Radar Type 3

Calibration Plot (5300MHz)



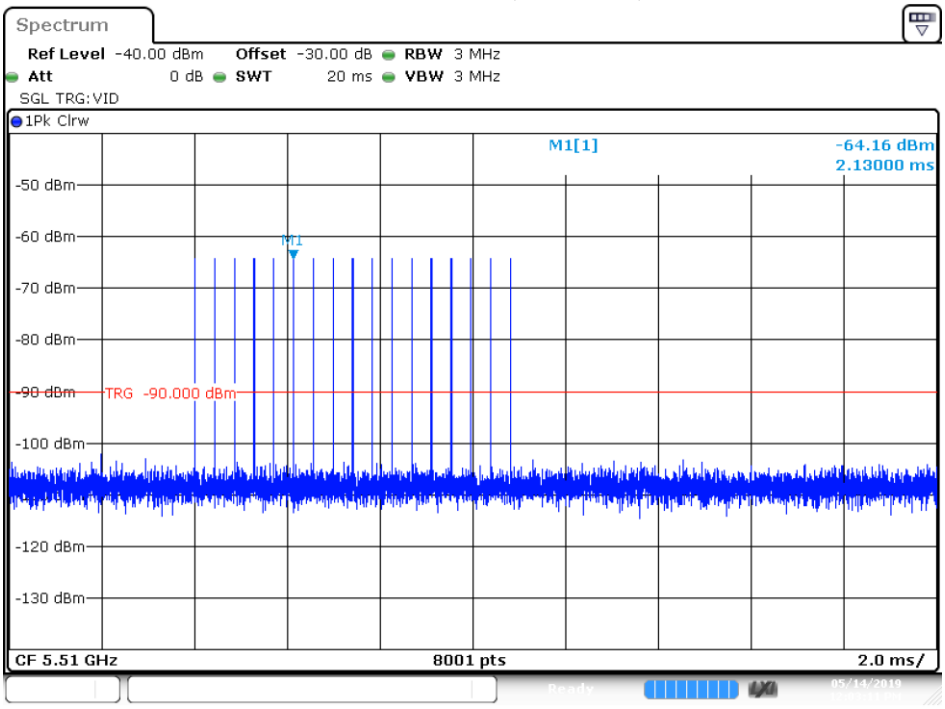
Date: 14.MAY.2019 12:03:45

Calibration Plot (5510MHz)



Date: 14.MAY.2019 12:01:17

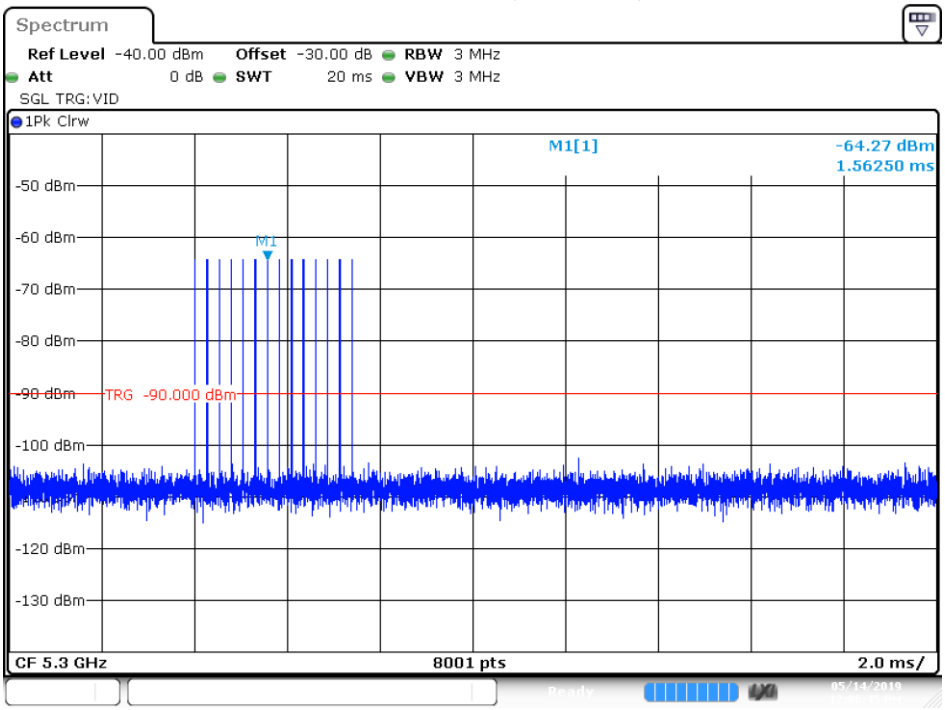
Calibration Plot (5530MHz)



Date: 14.MAY.2019 12:03:11

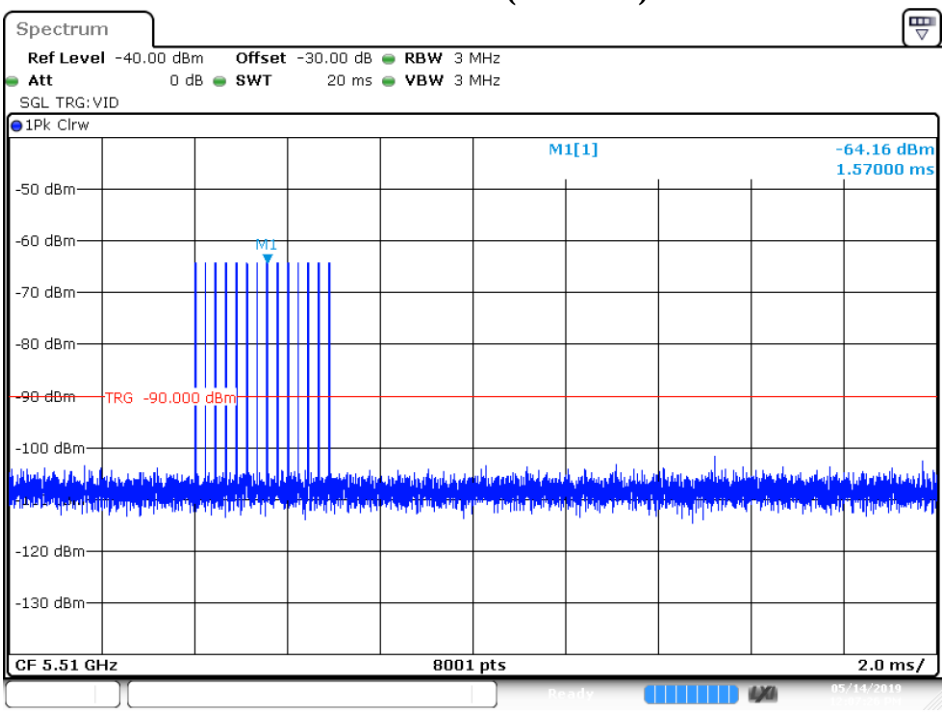
Radar Type 4

Calibration Plot (5300MHz)



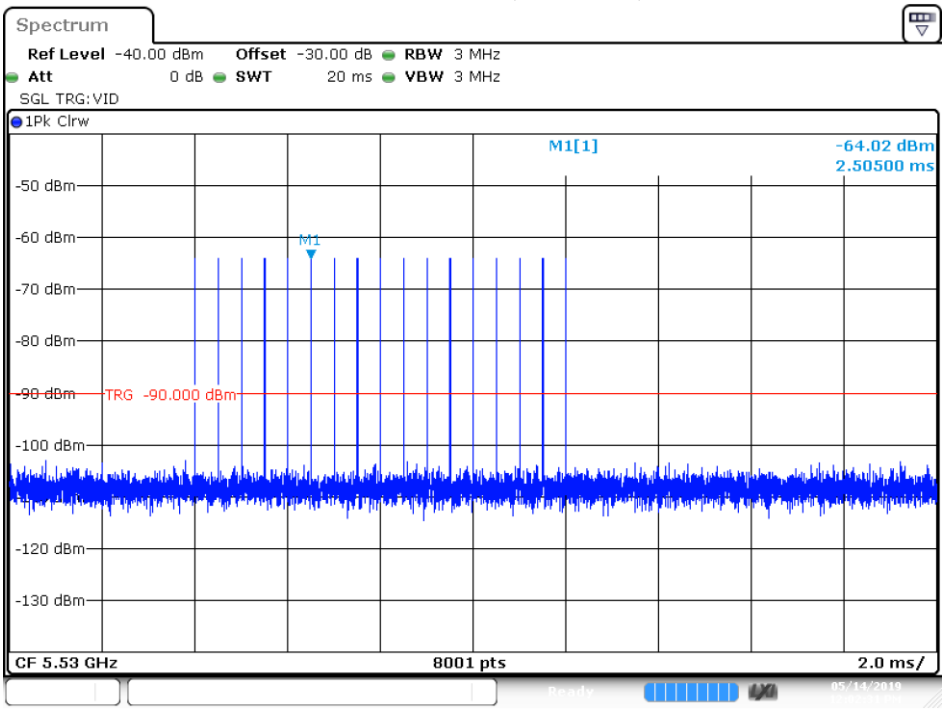
Date: 14.MAY.2019 12:06:46

Calibration Plot (5510MHz)



Date: 14.MAY.2019 12:07:26

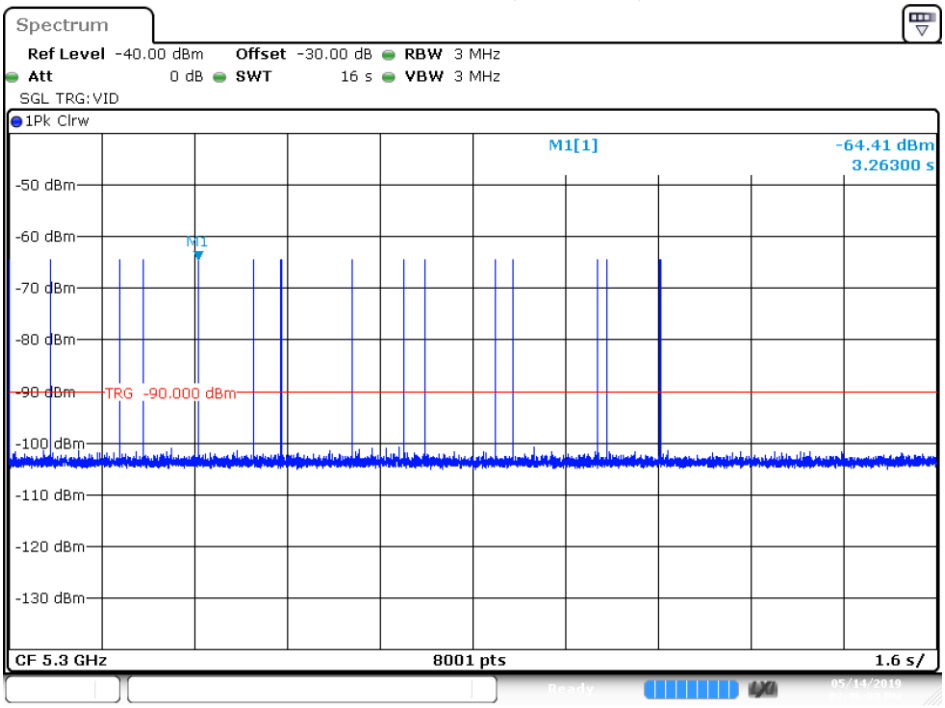
Calibration Plot (5530MHz)



Date: 14.MAY.2019 12:02:31

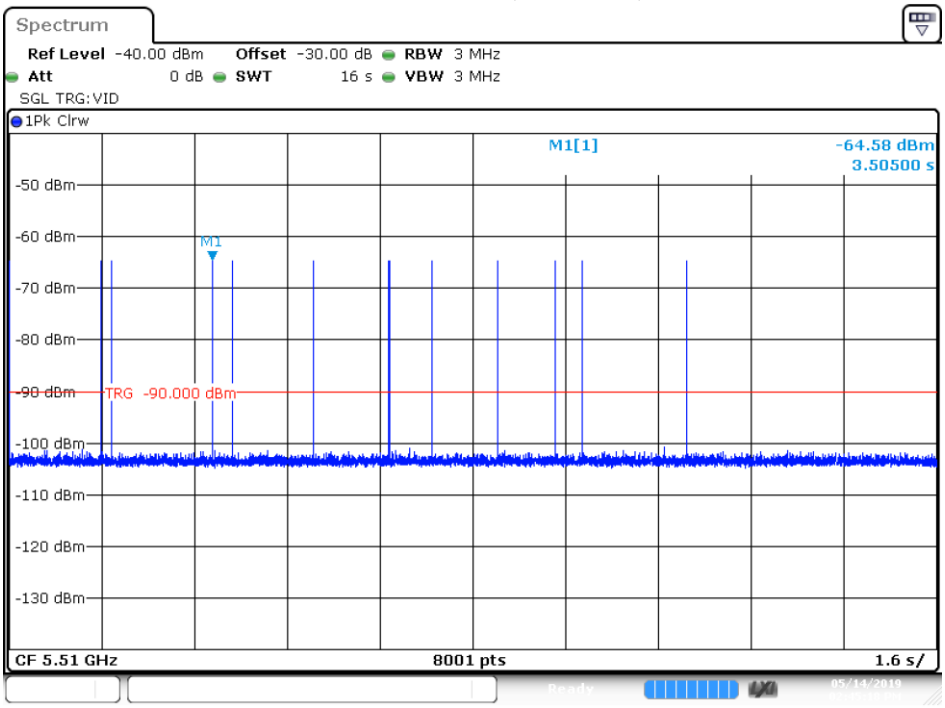
Radar Type 5

Calibration Plot (5300MHz)



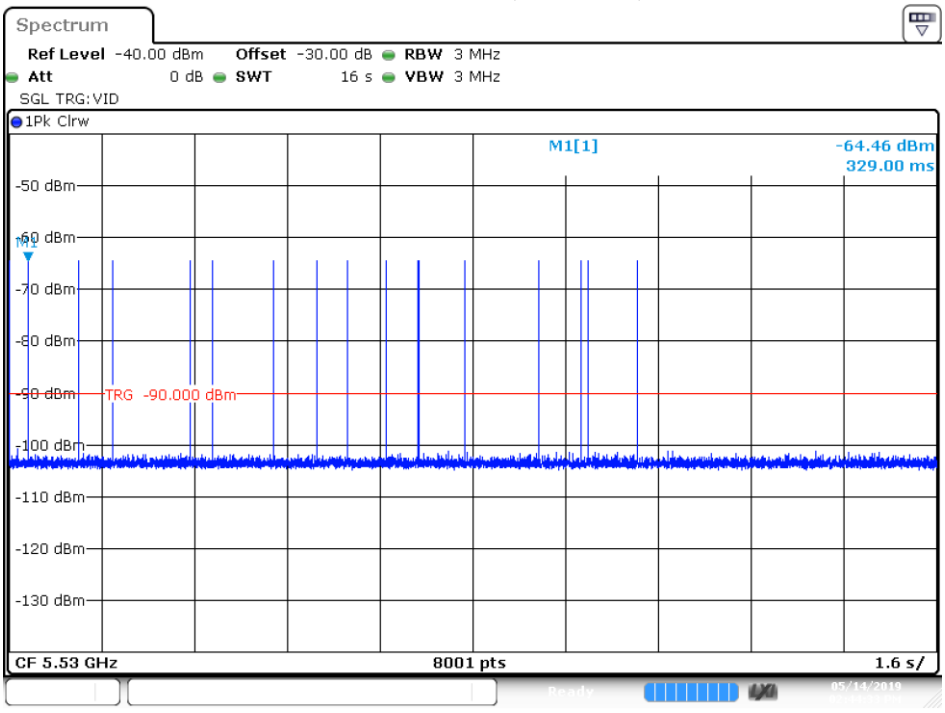
Date: 14.MAY.2019 14:46:03

Calibration Plot (5510MHz)



Date: 14.MAY.2019 14:45:18

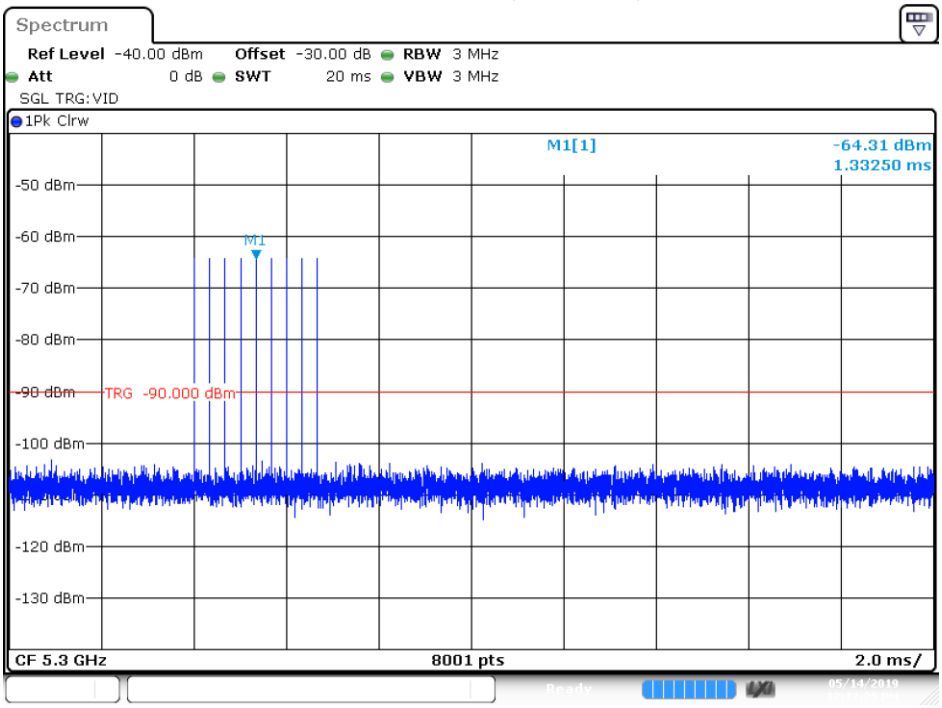
Calibration Plot (5530MHz)



Date: 14.MAY.2019 14:44:33

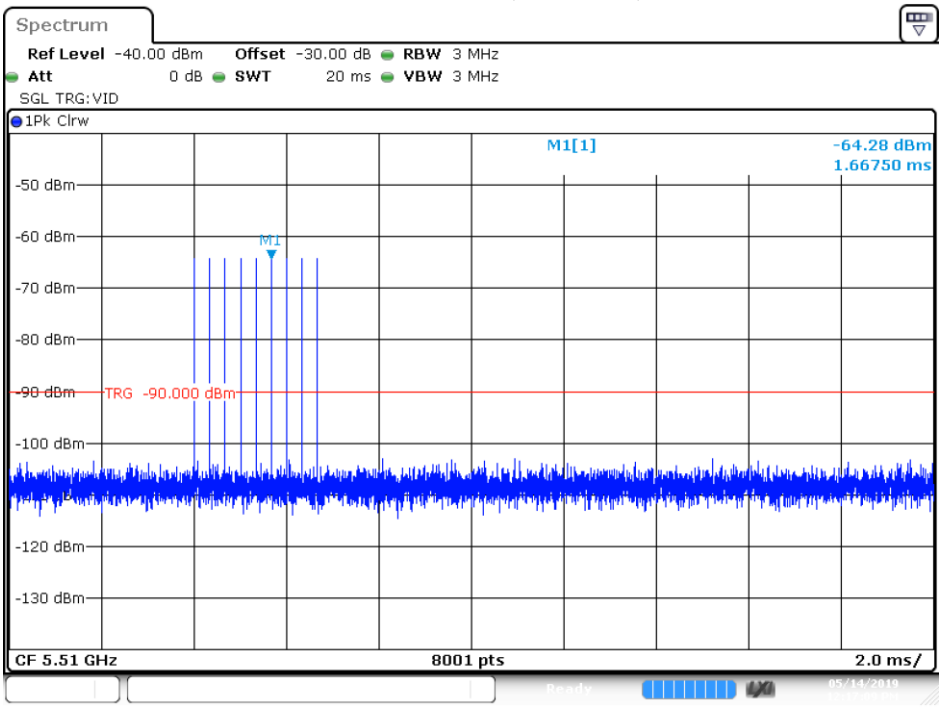
Radar Type 6

Calibration Plot (5300MHz)



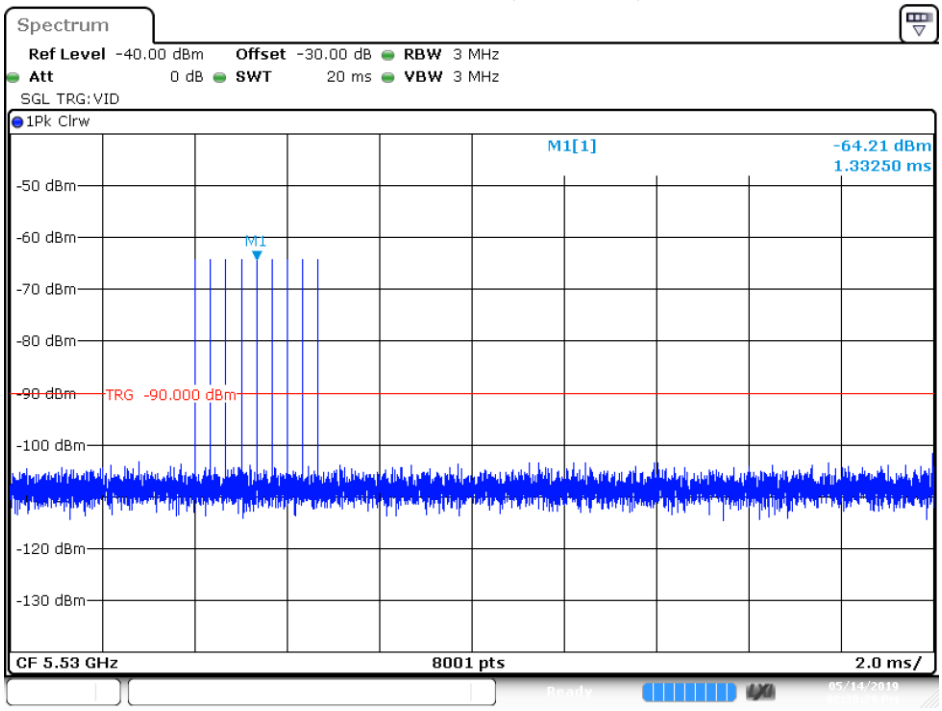
Date: 14.MAY.2019 12:12:25

Calibration Plot (5510MHz)



Date: 14.MAY.2019 12:17:09

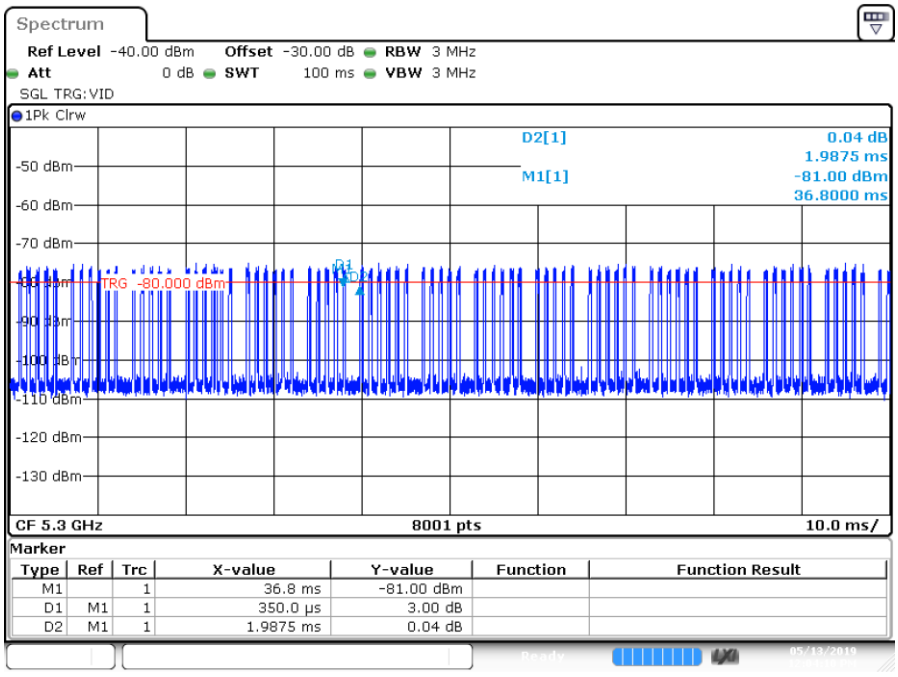
Calibration Plot (5530MHz)



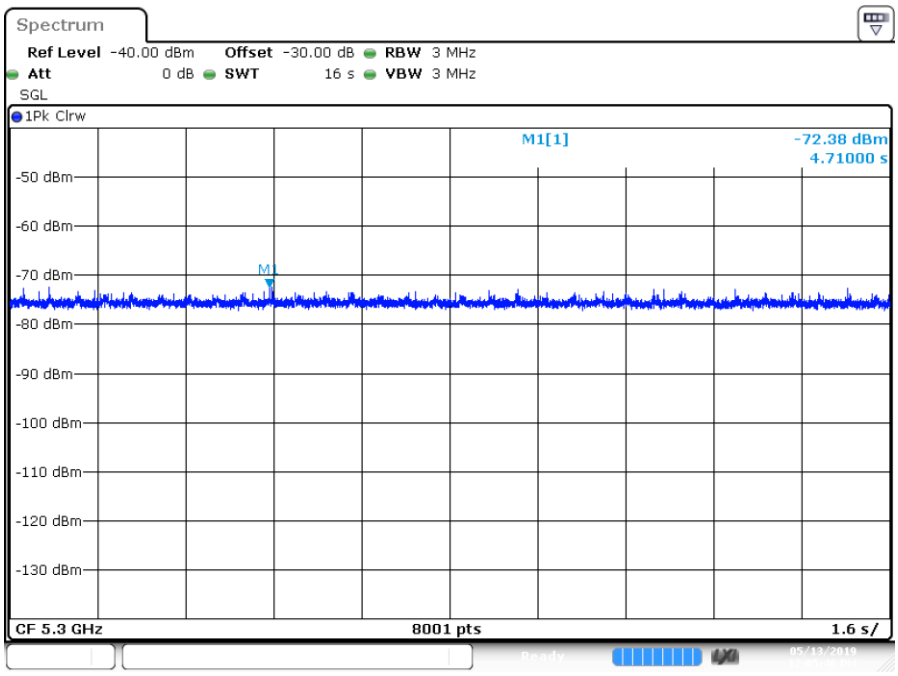
Date: 14.MAY.2019 14:39:29

1.10. Master Data Traffic Plot Result

Plot of WLAN Traffic at 5300MHz-20BW



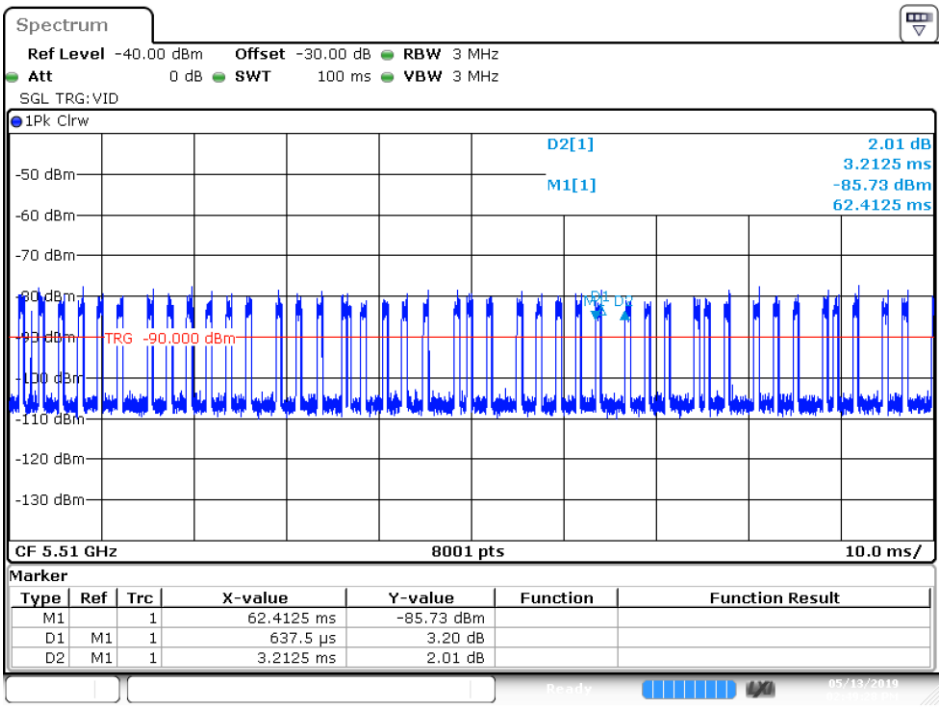
Date: 13.MAY.2019 12:04:10



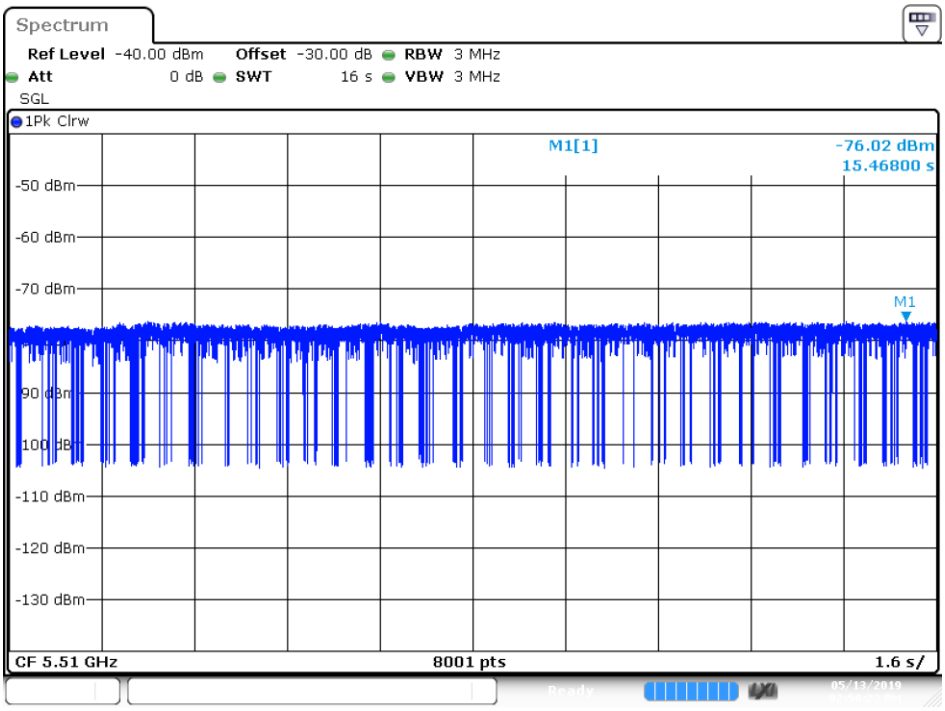
Date: 13.MAY.2019 12:05:46

Channel loading	Requirement loading
17.6%	>17%

Plot of WLAN Traffic at 5510MHz-40BW



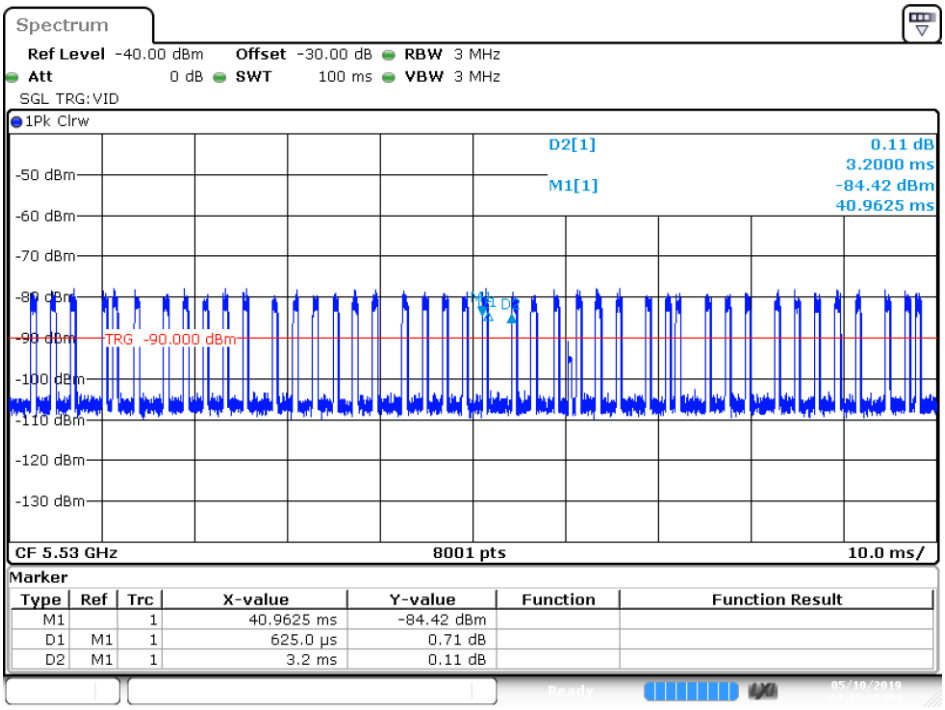
Date: 13.MAY.2019 14:49:28



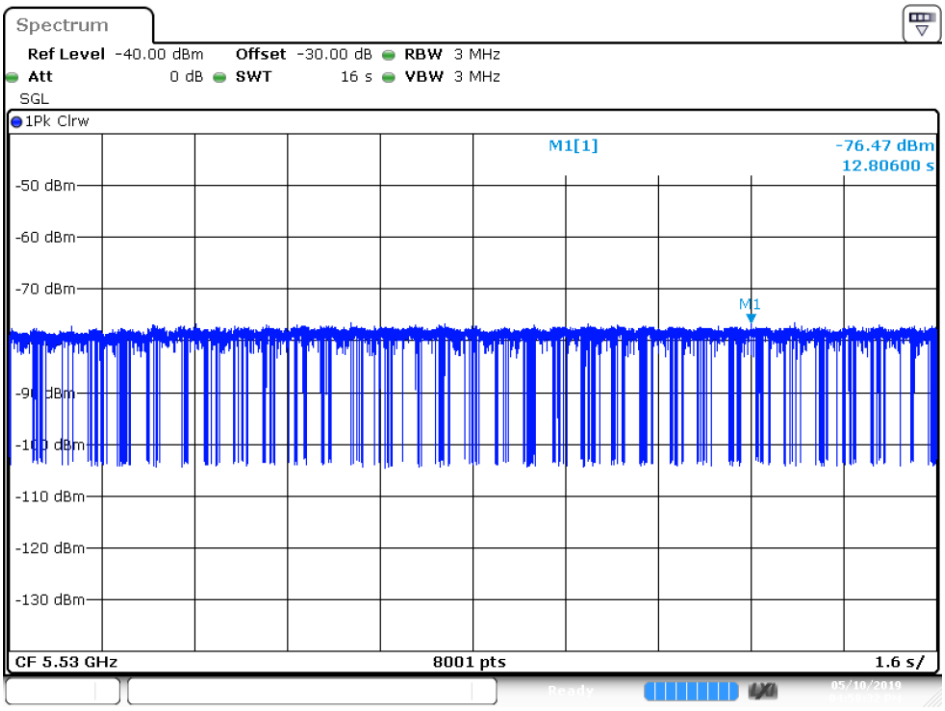
Date: 13.MAY.2019 14:50:24

Channel loading	Requirement loading
19.8%	>17%

Plot of WLAN Traffic at 5530MHz-40BW



Date: 10.MAY.2019 16:39:29



Date: 10.MAY.2019 16:58:32

Channel loading	Requirement loading
19.5%	>17%

2. UNII Detection Bandwidth

2.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

The generating equipment is configured as shown in the radiated Test Setup above. A single *Burst* of the short pulse radar type 0 is produced at 5300MHz and 5510 at a -63dBm level. The EUT is set up as a standalone device (no associated Client and no traffic).

A single radar Burst is generated for a minimum of 10 trials, and the response of the EUT is noted.

The EUT must detect the Radar Waveform 90% or more of the time. The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted as Fh.

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted as Fl.

The U-NII Detection Bandwidth is calculated as follows:

U-NII Detection Bandwidth = $F_H - F_L$

The U-NII Detection Bandwidth must be at least 100% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.

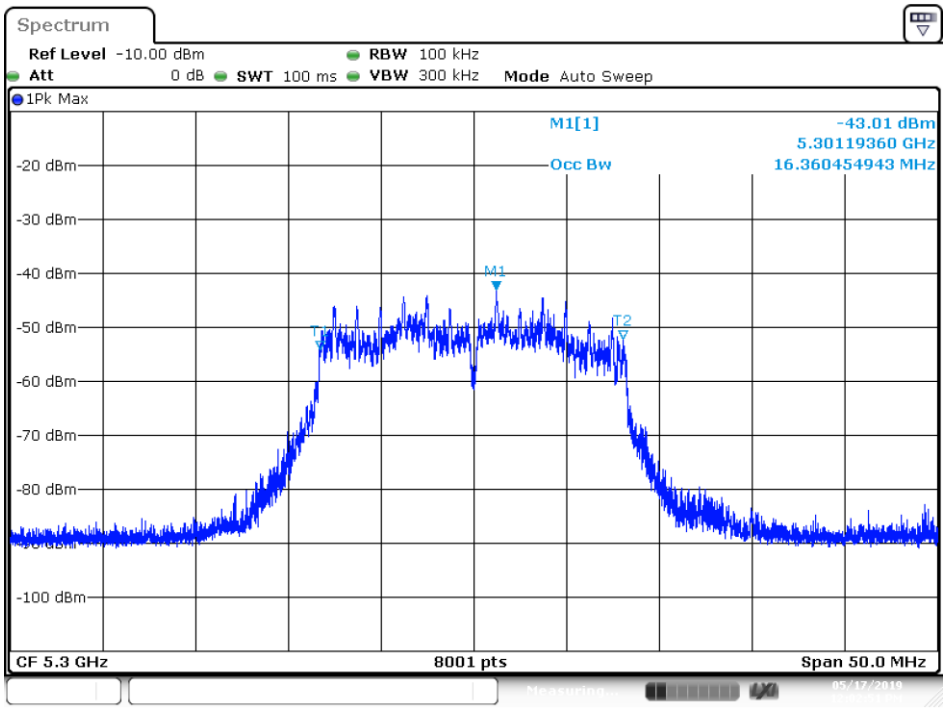
2.2. Test Requirement

All UNII 20/40MHz and 80MHz channels for this device have identical Channel bandwidths. All UNII 20/40/80MHz channels for this device also have identical Channel bandwidths. Therefore, all DFS testing was done at 5300MHz、5510MHz、5630MHz and 5690MHz. The 99% channel bandwidth for 20MHz signals is 19.116 MHz, and the 99% channel bandwidth for 40MHz signals is 36.873 MHz and 80MHz signals is 75.966MHz.

2.3. Uncertainty

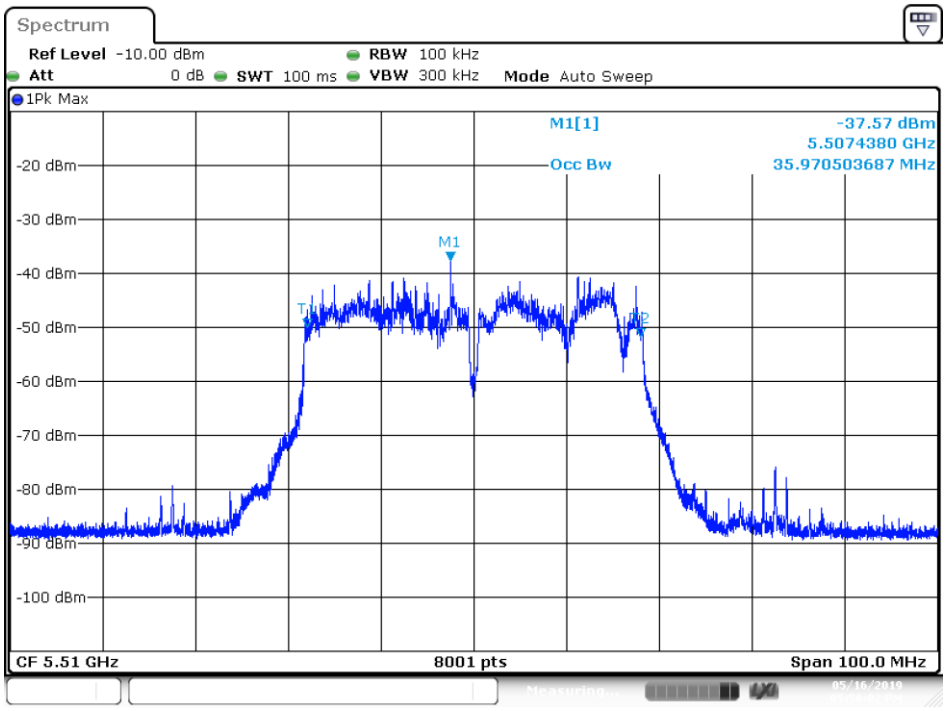
± 1ms.

802.11n-20 BW



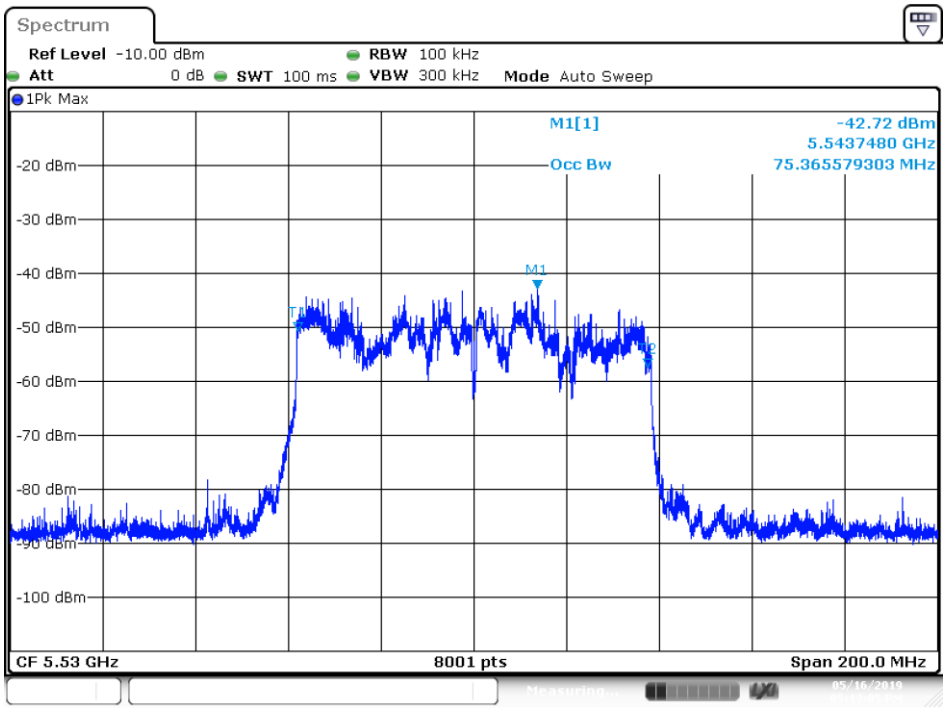
Date: 17.MAY.2019 12:02:52

802.11n-40 BW



Date: 16.MAY.2019 17:56:03

802.11ac80 BW



Date: 16.MAY.2019 17:13:05

2.4. Test Result of UNII Detection Bandwidth

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : UNII Detection Bandwidth
Radar Type : Type 1
Test Date : 2019/03/04
Test Mode : Mode 1: Transmit (802.11n-20BW)

Test Channel: 5300MHz (n-20BW)											
Radar Frequency	**DFS Detection Trials (1= Detection, 0= No Detection)**										**Detection Rate**
(MHz)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**(%)**
5290	1	0	0	1	1	0	1	0	1	1	60
5291 (FL)	1	1	1	1	1	1	1	1	1	1	100
5292	1	1	1	1	1	1	1	1	1	1	100
5293	1	1	1	1	1	1	1	1	1	1	100
5294	1	1	1	1	1	1	1	1	1	1	100
5295	1	1	1	1	1	1	1	1	1	1	100
5296	1	1	1	1	1	1	1	1	1	1	100
5297	1	1	1	1	1	1	1	1	1	1	100
5298	1	1	1	1	1	1	1	1	1	1	100
5299	1	1	1	1	1	1	1	1	1	1	100
5300	1	1	1	1	1	1	1	1	1	1	100
5301	1	1	1	1	1	1	1	1	1	1	100
5302	1	1	1	1	1	1	1	1	1	1	100
5303	1	1	1	1	1	1	1	1	1	1	100
5304	1	1	1	1	1	1	1	1	1	1	100
5305	1	1	1	1	1	1	1	1	1	1	100
5306	1	1	1	1	1	1	1	1	1	1	100
5307	1	1	1	1	1	1	1	1	1	1	100
5308	1	1	1	1	1	1	1	1	1	1	100
5309 (FH)	1	1	1	1	1	1	1	1	1	1	100
5310	1	1	1	0	1	1	0	1	1	1	80
Detection Bandwidth = FH - FL = 5309MHz - 5291MHz = 18MHz											
EUT 99% Bandwidth = 16.3604MHz											
UNII Detection Bandwidth Min. Limit = 16.3604MHz * 100% = 16.3604MHz											

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : UNII Detection Bandwidth
Radar Type : Type 1
Test Date : 2019/03/04
Test Mode : Mode 2: Transmit (802.11n-40BW)

Test Channel: 5510MHz (n-40BW)											
Radar Frequency	**DFS Detection Trials (1= Detection, 0= No Detection)**										**Detection Rate**
(MHz)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**(%)**
5490	1	1	1	1	0	1	0	1	0	1	70
5491 (FL)	1	1	1	1	1	1	1	1	1	1	100
5492	1	1	1	1	1	1	1	1	1	1	100
5493	1	1	1	1	1	1	1	1	1	1	100
5494	1	1	1	1	1	1	1	1	1	1	100
5495	1	1	1	1	1	1	1	1	1	1	100
5496	1	1	1	1	1	1	1	1	1	1	100
5497	1	1	1	1	1	1	1	1	1	1	100
5498	1	1	1	1	1	1	1	1	1	1	100
5499	1	1	1	1	1	1	1	1	1	1	100
5500	1	1	1	1	1	1	1	1	1	1	100
5501	1	1	1	1	1	1	1	1	1	1	100
5502	1	1	1	1	1	1	1	1	1	1	100
5503	1	1	1	1	1	1	1	1	1	1	100
5504	1	1	1	1	1	1	1	1	1	1	100
5505	1	1	1	1	1	1	1	1	1	1	100
5506	1	1	1	1	1	1	1	1	1	1	100
5507	1	1	1	1	1	1	1	1	1	1	100
5508	1	1	1	1	1	1	1	1	1	1	100
5509	1	1	1	1	1	1	1	1	1	1	100
5510	1	1	1	1	1	1	1	1	1	1	100
5511	1	1	1	1	1	1	1	1	1	1	100
5512	1	1	1	1	1	1	1	1	1	1	100
5513	1	1	1	1	1	1	1	1	1	1	100
5514	1	1	1	1	1	1	1	1	1	1	100
5515	1	1	1	1	1	1	1	1	1	1	100
5516	1	1	1	1	1	1	1	1	1	1	100

5517	1	1	1	1	1	1	1	1	1	1	100
5518	1	1	1	1	1	1	1	1	1	1	100
5519	1	1	1	1	1	1	1	1	1	1	100
5520	1	1	1	1	1	1	1	1	1	1	100
5521	1	1	1	1	1	1	1	1	1	1	100
5522	1	1	1	1	1	1	1	1	1	1	100
5523	1	1	1	1	1	1	1	1	1	1	100
5524	1	1	1	1	1	1	1	1	1	1	100
5525	1	1	1	1	1	1	1	1	1	1	100
5526	1	1	1	1	1	1	1	1	1	1	100
5527	1	1	1	1	1	1	1	1	1	1	100
5528	1	1	1	1	1	1	1	1	1	1	100
5529 (FH)	1	1	1	1	1	1	1	1	1	1	100
5530	1	1	1	0	1	0	1	1	1	1	80
Detection Bandwidth = FH - FL = 5529MHz - 5491MHz = 38MHz											
EUT 99% Bandwidth = 35.9705MHz											
UNII Detection Bandwidth Min. Limit = 35.9705MHz * 100% = 35.9705MHz											

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : UNII Detection Bandwidth
Radar Type : Type 1
Test Date : 2019/03/04
Test Mode : Mode 2: Transmit (802.11n-40BW)

Test Channel: 5530MHz (n-40BW)											
Radar Frequency	**DFS Detection Trials (1= Detection, 0= No Detection)**										**Detection Rate**
(MHz)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**(%)**
5490	0	0	0	0	0	0	0	1	0	1	20
5491 (FL)	1	1	1	1	1	1	1	1	1	1	100
5492	1	1	1	1	1	1	1	1	1	1	100
5493	1	1	1	1	1	1	1	1	1	1	100
5494	1	1	1	1	1	1	1	1	1	1	100
5495	1	1	1	1	1	1	1	1	1	1	100
5496	1	1	1	1	1	1	1	1	1	1	100
5497	1	1	1	1	1	1	1	1	1	1	100
5498	1	1	1	1	1	1	1	1	1	1	100
5499	1	1	1	1	1	1	1	1	1	1	100
5500	1	1	1	1	1	1	1	1	1	1	100
5501	1	1	1	1	1	1	1	1	1	1	100
5502	1	1	1	1	1	1	1	1	1	1	100
5503	1	1	1	1	1	1	1	1	1	1	100
5504	1	1	1	1	1	1	1	1	1	1	100
5505	1	1	1	1	1	1	1	1	1	1	100
5506	1	1	1	1	1	1	1	1	1	1	100
5507	1	1	1	1	1	1	1	1	1	1	100
5508	1	1	1	1	1	1	1	1	1	1	100
5509	1	1	1	1	1	1	1	1	1	1	100
5510	1	1	1	1	1	1	1	1	1	1	100
5511	1	1	1	1	1	1	1	1	1	1	100
5512	1	1	1	1	1	1	1	1	1	1	100
5513	1	1	1	1	1	1	1	1	1	1	100
5514	1	1	1	1	1	1	1	1	1	1	100
5515	1	1	1	1	1	1	1	1	1	1	100
5516	1	1	1	1	1	1	1	1	1	1	100

5518	1	1	1	1	1	1	1	1	1	1	100
5519	1	1	1	1	1	1	1	1	1	1	100
5520	1	1	1	1	1	1	1	1	1	1	100
5521	1	1	1	1	1	1	1	1	1	1	100
5522	1	1	1	1	1	1	1	1	1	1	100
5523	1	1	1	1	1	1	1	1	1	1	100
5524	1	1	1	1	1	1	1	1	1	1	100
5525	1	1	1	1	1	1	1	1	1	1	100
5526	1	1	1	1	1	1	1	1	1	1	100
5527	1	1	1	1	1	1	1	1	1	1	100
5528	1	1	1	1	1	1	1	1	1	1	100
5529	1	1	1	1	1	1	1	1	1	1	100
5530	1	1	1	1	1	1	1	1	1	1	100
5531	1	1	1	1	1	1	1	1	1	1	100
5532	1	1	1	1	1	1	1	1	1	1	100
5533	1	1	1	1	1	1	1	1	1	1	100
5534	1	1	1	1	1	1	1	1	1	1	100
5535	1	1	1	1	1	1	1	1	1	1	100
5536	1	1	1	1	1	1	1	1	1	1	100
5537	1	1	1	1	1	1	1	1	1	1	100
5538	1	1	1	1	1	1	1	1	1	1	100
5539	1	1	1	1	1	1	1	1	1	1	100
5540	1	1	1	1	1	1	1	1	1	1	100
5541	1	1	1	1	1	1	1	1	1	1	100
5542	1	1	1	1	1	1	1	1	1	1	100
5543	1	1	1	1	1	1	1	1	1	1	100
5544	1	1	1	1	1	1	1	1	1	1	100
5545	1	1	1	1	1	1	1	1	1	1	100
5546	1	1	1	1	1	1	1	1	1	1	100
5547	1	1	1	1	1	1	1	1	1	1	100
5548	1	1	1	1	1	1	1	1	1	1	100
5549	1	1	1	1	1	1	1	1	1	1	100
5550	1	1	1	1	1	1	1	1	1	1	100
5551	1	1	1	1	1	1	1	1	1	1	100

5552	1	1	1	1	1	1	1	1	1	1	100
5553	1	1	1	1	1	1	1	1	1	1	100
5554	1	1	1	1	1	1	1	1	1	1	100
5555	1	1	1	1	1	1	1	1	1	1	100
5556	1	1	1	1	1	1	1	1	1	1	100
5557	1	1	1	1	1	1	1	1	1	1	100
5558	1	1	1	1	1	1	1	1	1	1	100
5559	1	1	1	1	1	1	1	1	1	1	100
5560	1	1	1	1	1	1	1	1	1	1	100
5561	1	1	1	1	1	1	1	1	1	1	100
5562	1	1	1	1	1	1	1	1	1	1	100
5563	1	1	1	1	1	1	1	1	1	1	100
5564	1	1	1	1	1	1	1	1	1	1	100
5565	1	1	1	1	1	1	1	1	1	1	100
5566	1	1	1	1	1	1	1	1	1	1	100
5567	1	1	1	1	1	1	1	1	1	1	100
5568	1	1	1	1	1	1	1	1	1	1	100
5569 (FH)	1	1	1	1	1	1	1	1	1	1	100
5570	1	1	0	0	1	1	1	0	1	1	70
Detection Bandwidth = FH - FL = 5569MHz - 5491MHz = 78MHz											
EUT 99% Bandwidth = 75.3655MHz											
UNII Detection Bandwidth Min. Limit = 75.3655MHz * 100% = 75.3655MHz											

3. Initial Channel Availability Check Time

3.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

The U-NII device is powered on and instructed to operate at 5300/5510 MHz and 5530MHz. At the same time the UUT is powered on, the spectrum analyzer is set to zero span mode with a 3 MHz resolution bandwidth at 5300/5510 MHz and 5530MHz with a 2.5minute sweep time. The analyzer's sweep will be started the same time power is applied to the U-NII device.

The EUT should not transmit any beacon or data transmissions until at least 1 minute after the completion of the power-on cycle.

The initial power up time of the EUT is indicated by marker1 in the plot, Initial beacons/data transmissions are indicated by marker 1R.

3.2. Test Requirement

The EUT shall perform a channel availability check to ensure that there is no radar operation on the channel, after power-up sequence, receiver at least 1 minute on the intended operation frequency.

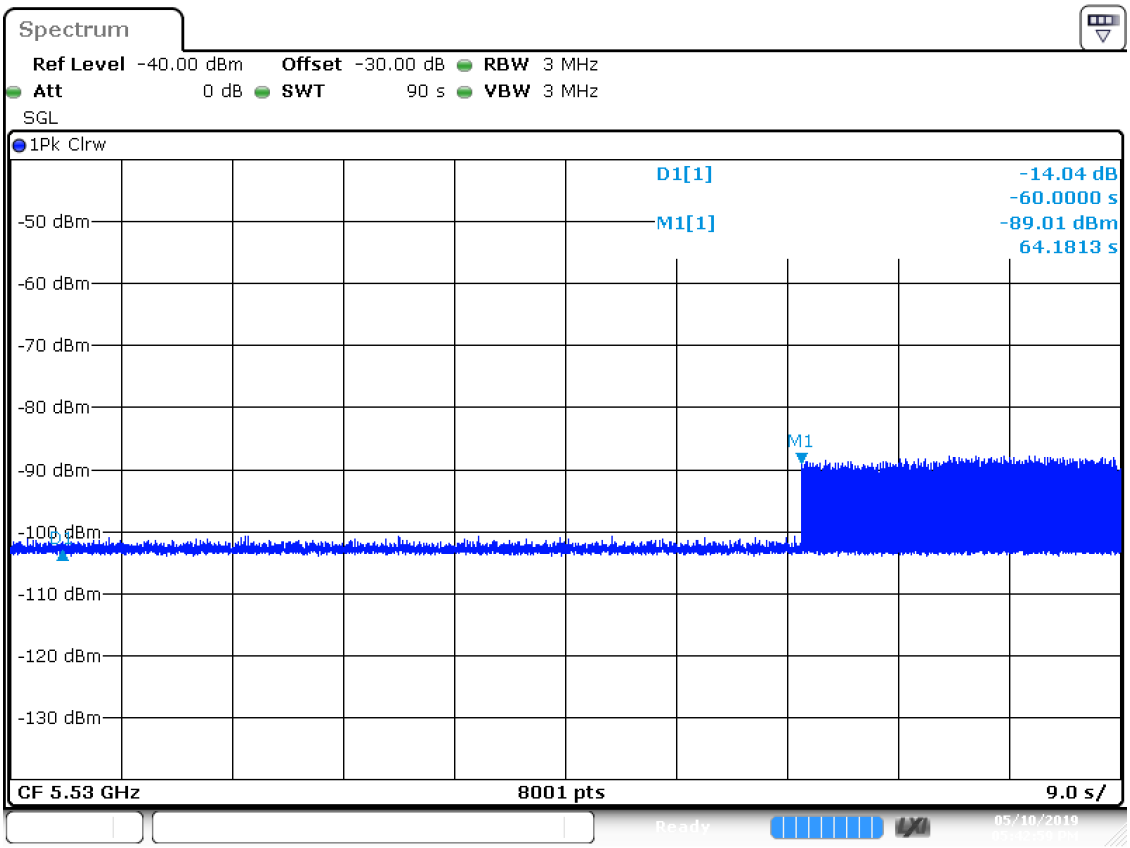
3.3. Uncertainty

± 1ms.

3.4. Test Result of Initial Channel Availability Check Time

Product	:	MOXA IEEE 802.11a/n/ac 4*4 module
Test Item	:	Initial Channel Availability Check Time
Radar Type	:	Type 1
Test Mode	:	Mode 3: Transmit (802.11ac-80BW)

The EUT does not transmit any beacon or data transmission until at least 1 minute after the completion of the power-on cycle (4.1813sec). The initial power up time of the EUT is indicated by Marker 1R (64.1813 sec) – CAC (60 sec). Initial beacons/data transmission is indicated by Marker 1R (64.1813 sec)



Date: 10.MAY.2019 17:42:59

4. Radar Burst at the Beginning of the Channel Availability Check Time

4.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB (-63dBm) occurs at the beginning of the Channel Availability Check Time.

The EUT is powered on at T0. T1 denotes the instant when the EUT has completed its power-up

sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T1 + 60 seconds.

A single Burst of short pulse of radar type 1 at -63dBm will commence within a 6 second window starting at T1.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5300MHz/5510MHz and 5630MHz will continue for 2.5 minutes after the radar Burst, Verify that during the 2.5 minute measurement window no EUT transmissions occurred at 5300MHz/5510MHz and 5630MHz.

4.2. Test Requirement

In beginning of the Channel Availability Check (CAC) Time, radar is detected on this channel, select another intended channel and perform a CAC that channel.

4.3. Uncertainty

± 1ms.

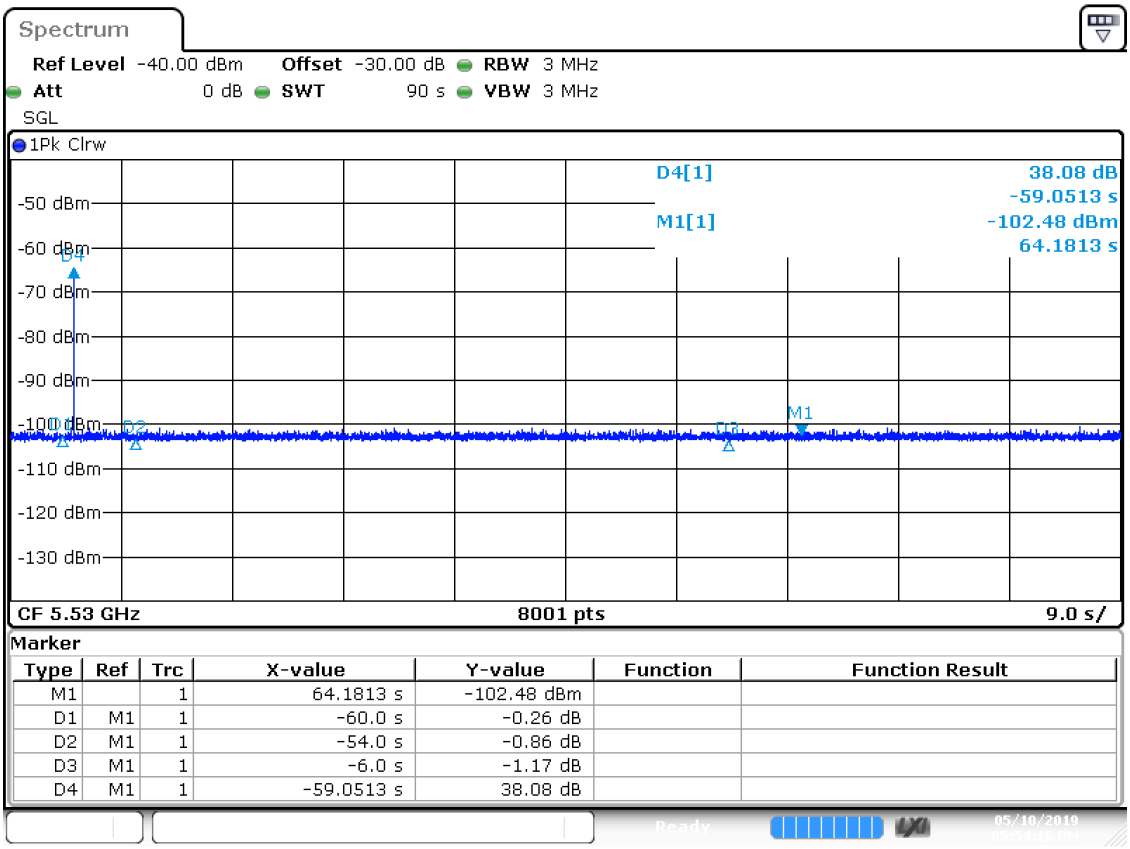
4.4. Test Result of Radar Burst at the Beginning of the Channel Availability Check Time

Product : MOXA IEEE 802.11a/n/ac 4*4 module

Test Item : Radar Burst at the Beginning of the Channel Availability Check Time

Radar Type : Type 0

Test Mode : Mode 3: Transmit (802.11ac-80BW)



Date: 10.MAY.2019 17:54:16

5. Radar Burst at the End of the Channel Availability Check Time

5.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB (-63dBm) occurs at the end of the Channel Availability Check Time.

The UUT is powered on at T_0. T_1 denotes the instant when the UUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T_1 + 60 seconds. A single Burst of short pulse of radar type 1 at -63 dBm will commence within a 6 second window starting at T_1+ 54 seconds.

Visual indication on the UUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5300MHz/5510MHz and 5630MHz will continue for 2.5 minutes after the radar Burst

has been generated.

Verify that during the 2.5 minute measurement window no UUT transmissions occurred at 5300MHz /5510MHz and 5630MHz.

5.2. Test Requirement

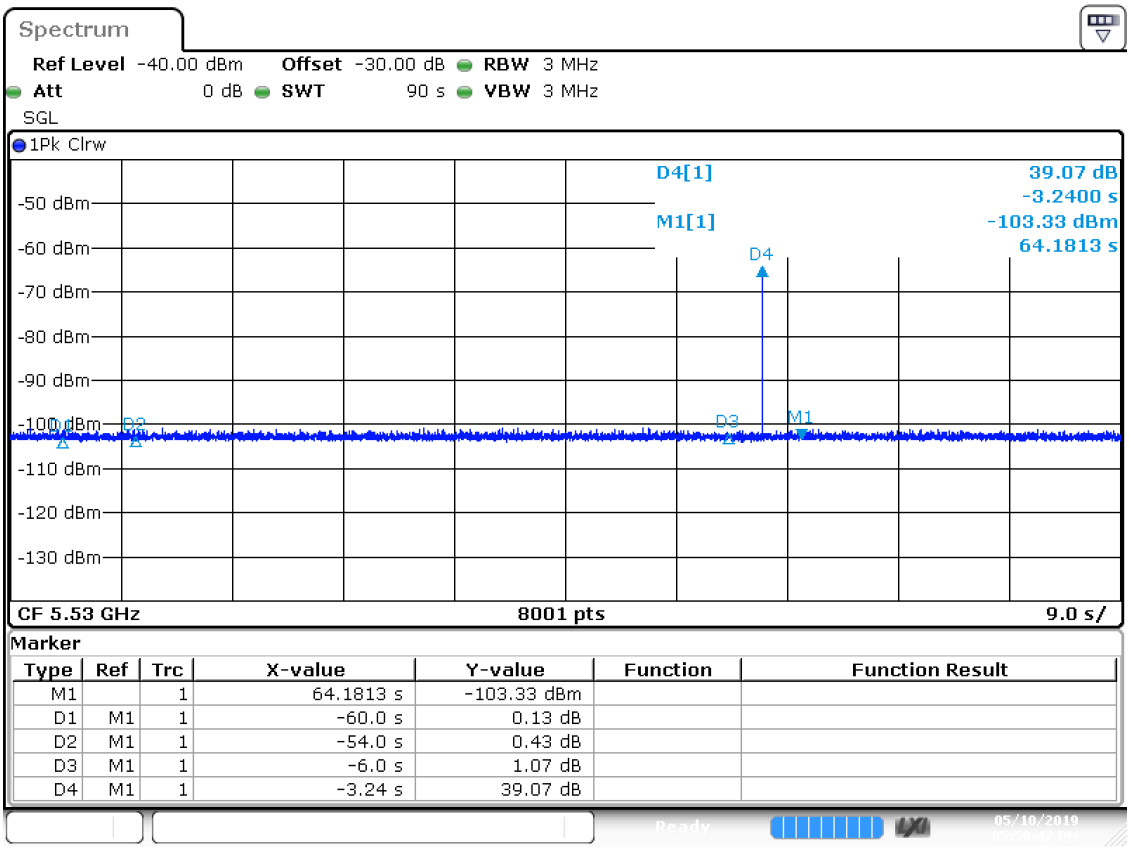
In the end of Channel Availability Check (CAC) Time, radar is detected on this channel, select another intended channel and perform a CAC that channel.

5.3. Uncertainty

± 1ms.

5.4. Test Result of Radar Burst at the End of the Channel Availability Check Time

Product	:	MOXA IEEE 802.11a/n/ac 4*4 module
Test Item	:	Radar Burst at the End of the Channel Availability Check Time
Radar Type	:	Type 0
Test Mode	:	Mode 3: Transmit (802.11ac-80BW)



Date: 10.MAY.2019 17:59:47

6. In-Service Monitoring for Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

6.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

These tests define how the following DFS parameters are verified during In-Service Monitoring;

Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.. The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB (-63dBm) is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5300MHz/ 5510MHz and 5630MHz..

Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at

-63dBm.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing

Transmission Time results to the limits defined in the DFS Response requirement values table.

Measure the UUT for more than 30 minutes following the channel close/move time to verify that the UUT does not resume any transmissions on this Channel.

6.2. Test Requirement

Parameter	Value
Channel Move Time	10 Seconds
Channel Closing Transmission Time	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period
Non-Occupancy Period	Minimum 30 minutes

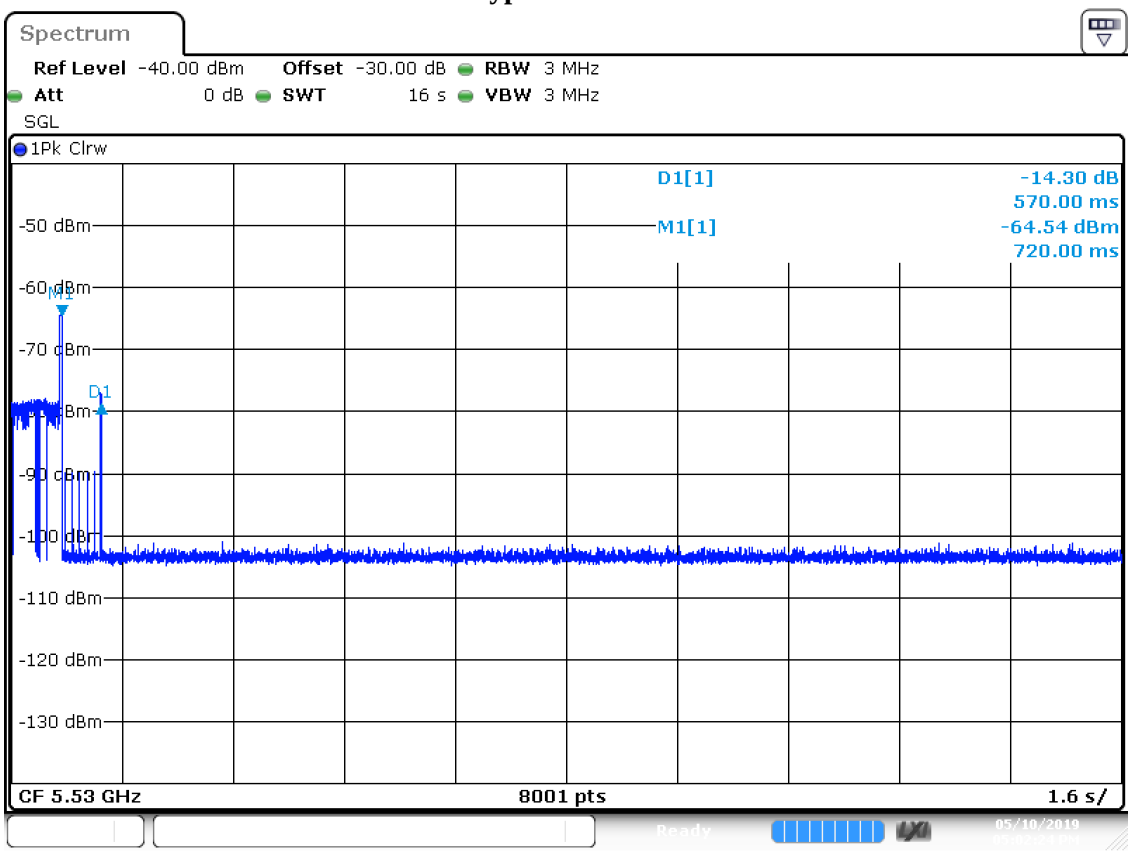
6.3. Uncertainty

± 1ms.

6.4. Test Result of Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

Product	:	MOXA IEEE 802.11a/n/ac 4*4 module
Test Item	:	Channel Move Time Test
Radar Type	:	Type 0
Test Mode	:	Mode 3: Transmit (802.11ac-80BW)

Channel Move Time for Radar Test Type 0 at 5300MHz



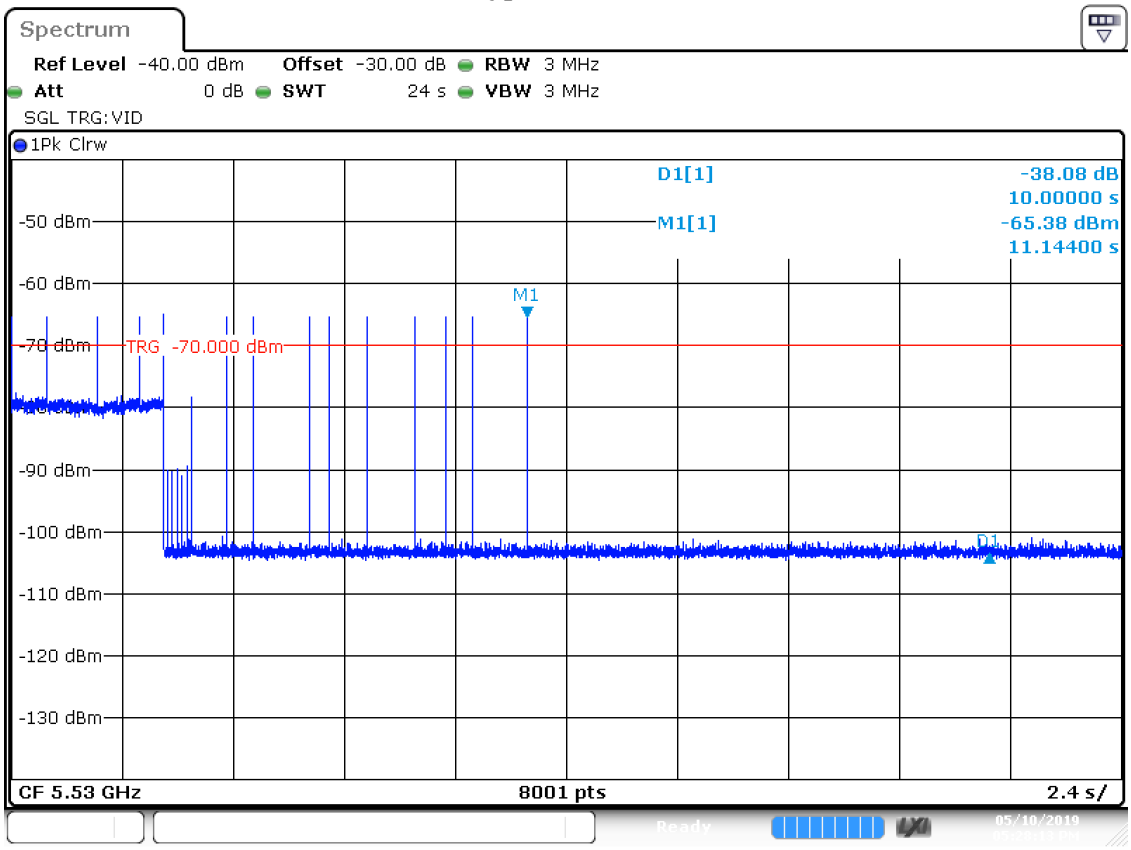
Date: 10.MAY.2019 17:02:25

Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.57	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Product	:	MOXA IEEE 802.11a/n/ac 4*4 module
Test Item	:	Channel Move Time Test
Radar Type	:	Type 5
Test Mode	:	Mode 3: Transmit (802.11ac-80BW)

Channel Move Time for Radar Test Type 5 at 5300MHz



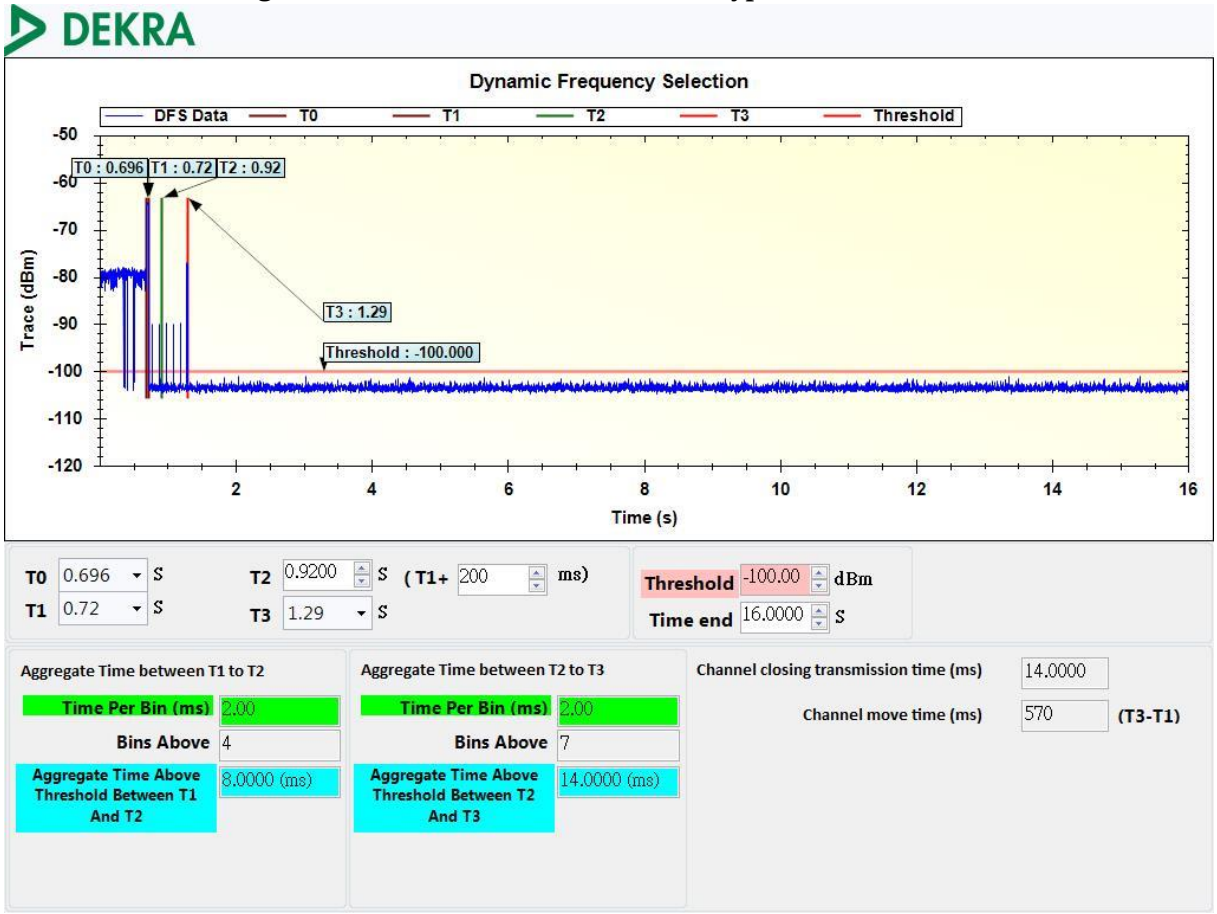
Date: 10.MAY.2019 17:28:13

Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Product	:	MOXA IEEE 802.11a/n/ac 4*4 module
Test Item	:	Channel Closing Transmission Time Test
Radar Type	:	Type 0
Test Mode	:	Mode 1: Transmit (802.11n-20BW)

Channel Closing Transmission Time for Radar Test Type 0 at 5300 MHz

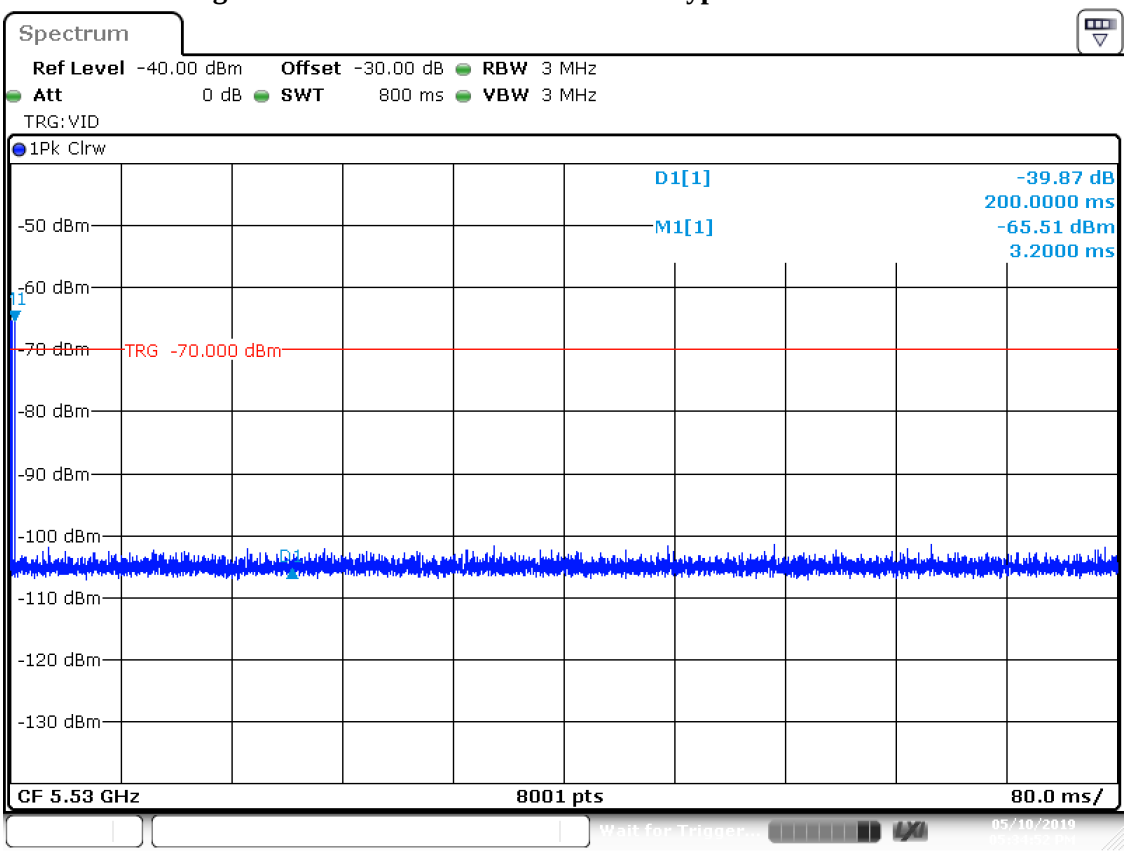


Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	0.14	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

Product	:	MOXA IEEE 802.11a/n/ac 4*4 module
Test Item	:	Channel Closing Transmission Time Test
Radar Type	:	Type 5
Test Mode	:	Mode 1: Transmit (802.11n-20BW)

Channel Closing Transmission Time for Radar Test Type 5 at 5300 MHz



Date: 10.MAY.2019 17:34:52

Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	0	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

7. Statistical Performance Check

7.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

The steps below define the procedure to determine the minimum percentage of detection when a radar burst with a level equal to the DFS Detection Threshold + 1dB (-63dBm) is generated on the

Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at5300MHz 、5510MHz and 5630MHz..

Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

The Radar Waveform generator sends the individual waveform for each of the radar types 1-6 at

-63dbm. Statistical data will be gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs.

7.2. Test Requirement

The minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Minimum percentage of successful detections

Radar Type	Minimum Percentage of Successful Detection	Minimum Number of Trials
1	60%	30
2	60%	30
3	60%	30
4	60%	30
Aggregate (Radar Types 1-4)	80%	120
5	80%	30
6	70%	30

The percentage of successful detection is calculated by:

$$\frac{TotalWaveformDetections}{TotalWaveformTrials} \times 100 \quad = \text{Probability of Detection Radar Waveform}$$

In addition an aggregate minimum percentage of successful detection across all Short Pulse Radar Types 1-4 is required and is calculated as follows:

$$\frac{P_d 1 + P_d 2 + P_d 3 + P_d 4}{4}$$

7.3. Uncertainty

± 1ms.

7.4. Test Result of Statistical Performance Check

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 1
Test Date : 2019/03/04
Test Mode : Mode 1: Transmit (802.11n-20BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5300	1	3066	18	1
2	5300	1	578	92	1
3	5300	1	658	81	1
4	5300	1	778	68	1
5	5300	1	698	76	1
6	5300	1	758	70	1
7	5300	1	738	72	0
8	5300	1	918	58	1
9	5300	1	858	62	1
10	5300	1	518	102	1
11	5300	1	838	63	1
12	5300	1	718	74	1
13	5300	1	598	89	1
14	5300	1	878	61	1
15	5300	1	678	78	1
16	5300	1	2161	25	1
17	5300	1	3015	18	1
18	5300	1	568	93	1
19	5300	1	2204	24	1
20	5300	1	1235	43	1
21	5300	1	1250	43	1
22	5300	1	2082	26	1
23	5300	1	622	85	1
24	5300	1	2850	19	1
25	5300	1	1364	39	1
26	5300	1	2374	23	1
27	5300	1	1193	45	0
28	5300	1	1800	30	1
29	5300	1	1004	53	1
30	5300	1	1142	47	1
Detection Percentage(%)					93.33%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 1
Test Date : 2019/03/04
Test Mode : Mode 2: Transmit (802.11n-40BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5510	1	698	76	1
2	5510	1	918	58	1
3	5510	1	738	72	1
4	5510	1	938	57	1
5	5510	1	898	59	1
6	5510	1	558	95	1
7	5510	1	678	78	0
8	5510	1	578	92	1
9	5510	1	858	62	1
10	5510	1	718	74	1
11	5510	1	778	68	1
12	5510	1	798	67	0
13	5510	1	818	65	1
14	5510	1	638	83	1
15	5510	1	878	61	1
16	5510	1	1603	33	1
17	5510	1	1609	33	1
18	5510	1	1755	31	1
19	5510	1	1766	30	1
20	5510	1	2045	26	1
21	5510	1	2719	20	0
22	5510	1	3001	18	1
23	5510	1	567	93	1
24	5510	1	2991	18	1
25	5510	1	1587	34	1
26	5510	1	2761	20	1
27	5510	1	2497	22	1
28	5510	1	2452	22	1
29	5510	1	1508	35	1
30	5510	1	1852	29	1
Detection Percentage(%)					90%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 1
Test Date : 2019/03/04
Test Mode : Mode 3: Transmit (802.11ac-80BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5530	1	858	62	1
2	5530	1	878	61	1
3	5530	1	838	63	1
4	5530	1	578	92	0
5	5530	1	3066	18	1
6	5530	1	638	83	1
7	5530	1	658	81	1
8	5530	1	778	68	1
9	5530	1	918	58	0
10	5530	1	738	72	1
11	5530	1	898	59	1
12	5530	1	538	98	0
13	5530	1	618	86	1
14	5530	1	598	89	1
15	5530	1	938	57	0
16	5530	1	2397	22	1
17	5530	1	2994	18	1
18	5530	1	2198	24	1
19	5530	1	577	92	0
20	5530	1	975	55	1
21	5530	1	2873	19	1
22	5530	1	1509	35	1
23	5530	1	2885	19	1
24	5530	1	1010	53	1
25	5530	1	966	55	1
26	5530	1	763	70	0
27	5530	1	884	60	1
28	5530	1	1501	36	1
29	5530	1	2627	21	1
30	5530	1	1715	31	1
Detection Percentage(%)					80%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 2
Test Date : 2019/03/04
Test Mode : Mode 1: Transmit (802.11n-20BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5300	1.90	229	24	1
2	5300	3.00	166	24	0
3	5300	1.40	224	25	1
4	5300	2.50	227	26	0
5	5300	2.40	181	27	1
6	5300	4.80	163	26	0
7	5300	4.10	187	24	1
8	5300	2.90	207	25	1
9	5300	2.90	199	26	1
10	5300	1.40	204	26	1
11	5300	1.80	162	27	1
12	5300	3.80	217	25	1
13	5300	1.80	170	27	0
14	5300	2.10	175	28	1
15	5300	1.70	210	26	1
16	5300	2.00	154	24	1
17	5300	4.90	160	26	1
18	5300	3.00	151	25	0
19	5300	1.00	210	24	1
20	5300	1.10	184	28	1
21	5300	1.70	164	29	0
22	5300	4.80	191	27	1
23	5300	2.90	225	26	0
24	5300	2.20	194	23	1
25	5300	1.30	190	23	1
26	5300	1.80	216	25	0
27	5300	5.00	215	28	1
28	5300	1.00	168	23	1
29	5300	1.00	212	26	1
30	5300	2.90	209	25	1
Detection Percentage(%)					73.33%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 2
Test Date : 2019/03/04
Test Mode : Mode 2: Transmit (802.11n-40BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5510	3.5	171	28	1
2	5510	1.6	210	25	1
3	5510	2.5	168	27	1
4	5510	2.6	162	23	1
5	5510	1.7	230	29	0
6	5510	3.4	169	27	1
7	5510	3.3	151	27	1
8	5510	4	186	27	1
9	5510	3.7	157	24	1
10	5510	3.4	207	29	1
11	5510	4	203	25	1
12	5510	2.5	203	24	1
13	5510	1.8	206	28	0
14	5510	2	196	27	1
15	5510	1.8	219	23	1
16	5510	4.7	192	28	1
17	5510	1.4	213	24	1
18	5510	3.2	194	25	1
19	5510	1	185	27	1
20	5510	3	208	26	1
21	5510	3.4	160	26	1
22	5510	2.4	207	23	1
23	5510	4.3	162	23	0
24	5510	1.7	160	28	1
25	5510	4.6	210	29	1
26	5510	3.4	153	27	1
27	5510	3.2	167	29	1
28	5510	3.4	229	28	0
29	5510	1	225	29	1
30	5510	3.7	192	24	1
Detection Percentage(%)					86.67%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 2
Test Date : 2019/03/04
Test Mode : Mode 3: Transmit (802.11ac-80BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5530	4.9	210	29	1
2	5530	2.3	185	25	1
3	5530	3	216	24	1
4	5530	4.4	170	29	0
5	5530	2.2	179	25	1
6	5530	2.6	194	25	1
7	5530	2.6	225	24	1
8	5530	3.4	207	25	1
9	5530	1.1	177	28	1
10	5530	1	166	27	1
11	5530	3.2	194	29	1
12	5530	4	176	27	1
13	5530	4.7	150	29	1
14	5530	2.2	172	27	1
15	5530	2.8	202	23	1
16	5530	3	198	23	1
17	5530	4.5	228	24	0
18	5530	3.8	213	29	1
19	5530	1	180	26	1
20	5530	2.6	189	25	1
21	5530	2.4	200	25	1
22	5530	3.6	210	24	1
23	5530	3.1	168	26	1
24	5530	1	196	23	1
25	5530	2.9	202	24	1
26	5530	2.2	215	29	1
27	5530	3.7	175	23	0
28	5530	4.4	206	28	1
29	5530	1.1	151	28	1
30	5530	2.6	196	24	1
Detection Percentage(%)					90%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 3
Test Date : 2019/03/04
Test Mode : Mode 1: Transmit (802.11n-20BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5300	9.90	350	17	1
2	5300	7.80	225	17	1
3	5300	8.20	253	18	1
4	5300	7.70	405	17	1
5	5300	6.70	303	18	0
6	5300	7.90	363	17	0
7	5300	9.80	376	16	0
8	5300	9.10	289	16	1
9	5300	6.70	204	18	1
10	5300	8.80	264	16	1
11	5300	6.30	371	18	1
12	5300	6.90	462	18	1
13	5300	8.00	241	17	1
14	5300	6.30	316	17	0
15	5300	9.20	422	17	1
16	5300	7.90	339	16	1
17	5300	9.20	385	18	0
18	5300	6.20	484	16	1
19	5300	9.30	226	17	1
20	5300	8.80	271	17	0
21	5300	6.60	355	17	1
22	5300	8.70	273	17	1
23	5300	6.80	454	18	0
24	5300	9.70	296	17	1
25	5300	6.30	481	17	1
26	5300	9.40	381	17	0
27	5300	7.20	251	17	1
28	5300	9.40	318	17	1
29	5300	9.50	339	17	1
30	5300	9.50	282	17	0
Detection Percentage(%)					70%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 3
Test Date : 2019/03/04
Test Mode : Mode 2: Transmit (802.11n-40BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5510	7.6	351	17	1
2	5510	7.6	366	17	1
3	5510	6.6	332	17	1
4	5510	6.5	258	18	1
5	5510	8.1	216	17	1
6	5510	7.9	407	17	0
7	5510	9.3	280	17	1
8	5510	6.1	221	17	1
9	5510	9.4	294	17	1
10	5510	9.9	266	18	1
11	5510	9.3	245	16	1
12	5510	8.5	226	17	1
13	5510	6	212	16	1
14	5510	7.6	337	18	1
15	5510	8.5	350	18	1
16	5510	6.2	225	18	1
17	5510	9.9	326	16	1
18	5510	8.5	486	17	1
19	5510	6.4	487	16	0
20	5510	7.7	462	16	1
21	5510	6	493	18	1
22	5510	6.6	466	16	1
23	5510	6.7	349	17	1
24	5510	8.6	343	16	1
25	5510	6.8	263	17	1
26	5510	7.9	461	17	1
27	5510	7.1	250	17	1
28	5510	7.6	403	17	1
29	5510	6	316	17	1
30	5510	6.9	335	17	1
Detection Percentage(%)					93.33%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 3
Test Date : 2019/03/04
Test Mode : Mode 3: Transmit (802.11ac-80BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5530	8.1	330	17	1
2	5530	6.6	485	17	0
3	5530	8.3	409	17	1
4	5530	7.3	211	17	1
5	5530	7.8	219	16	1
6	5530	7.5	430	18	1
7	5530	7.4	297	17	0
8	5530	6.5	366	17	1
9	5530	9.7	457	17	1
10	5530	8.2	269	16	1
11	5530	8	355	16	1
12	5530	7.5	279	16	1
13	5530	9.3	276	17	1
14	5530	6.6	373	17	1
15	5530	6.9	350	17	0
16	5530	9.9	203	18	1
17	5530	8.2	350	16	1
18	5530	9.4	319	16	1
19	5530	7.1	421	18	1
20	5530	6.3	216	18	0
21	5530	8	282	17	1
22	5530	9.8	262	18	1
23	5530	7.9	468	17	0
24	5530	9.5	262	16	1
25	5530	6.9	297	17	0
26	5530	9.8	248	17	1
27	5530	8.6	362	17	1
28	5530	6.6	478	18	0
29	5530	9.7	223	16	1
30	5530	8.2	236	16	1
Detection Percentage(%)					76.67%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 4
Test Date : 2019/03/04
Test Mode : Mode 1: Transmit (802.11n-20BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5300	15.20	200	14	1
2	5300	16.00	481	14	1
3	5300	17.50	441	13	1
4	5300	19.40	307	12	1
5	5300	12.20	486	14	1
6	5300	16.80	286	15	0
7	5300	14.30	294	12	1
8	5300	12.80	303	13	1
9	5300	19.70	494	14	1
10	5300	17.50	463	14	1
11	5300	14.60	496	16	1
12	5300	15.80	280	13	1
13	5300	16.30	491	15	1
14	5300	19.10	239	15	1
15	5300	18.30	438	13	1
16	5300	18.70	467	15	1
17	5300	19.80	405	14	1
18	5300	13.60	406	14	1
19	5300	19.90	346	14	0
20	5300	11.40	429	13	1
21	5300	15.10	365	14	1
22	5300	19.80	303	14	0
23	5300	17.60	225	15	1
24	5300	15.70	308	12	1
25	5300	17.00	461	14	0
26	5300	19.90	460	14	1
27	5300	18.30	396	15	1
28	5300	16.20	482	16	0
29	5300	11.80	211	15	1
30	5300	13.00	423	15	1
Detection Percentage(%)					83.33%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 4
Test Date : 2019/03/04
Test Mode : Mode 2: Transmit (802.11n-40BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5510	14.2	376	15	1
2	5510	12	282	15	1
3	5510	12	273	14	1
4	5510	11.7	357	15	1
5	5510	13.2	402	13	0
6	5510	18	304	13	1
7	5510	12.8	226	14	1
8	5510	12.2	322	13	1
9	5510	19.5	404	14	1
10	5510	12.5	215	12	1
11	5510	12.6	279	14	1
12	5510	14.5	295	12	0
13	5510	18.3	364	13	1
14	5510	11.8	325	12	1
15	5510	16.3	333	13	1
16	5510	12.5	326	13	1
17	5510	14.3	240	14	0
18	5510	17.7	382	16	1
19	5510	12.6	348	14	1
20	5510	18.8	267	14	1
21	5510	14.2	312	16	1
22	5510	13.4	295	13	0
23	5510	18.9	311	12	1
24	5510	18.8	296	14	1
25	5510	14.9	360	15	0
26	5510	12.8	252	16	1
27	5510	14.3	452	14	1
28	5510	18.8	251	14	0
29	5510	14.7	423	13	1
30	5510	11.5	452	14	1
Detection Percentage (%)					80%

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Statistical Performance Check
Radar Type : Type 4
Test Date : 2019/03/04
Test Mode : Mode 3: Transmit (802.11ac-80BW)

Trial #	Frequency (MHz)	Pulse Width (us)	PRI (us)	Pulses/Burs	1= Detection 0= No Detection
1	5530	14.8	306	14	1
2	5530	14.8	317	15	1
3	5530	11.7	485	13	1
4	5530	16.8	366	15	0
5	5530	14.2	397	16	1
6	5530	15.6	266	14	1
7	5530	13.9	216	15	1
8	5530	11.4	474	15	1
9	5530	14.3	234	13	0
10	5530	18.7	305	13	1
11	5530	12.7	488	13	1
12	5530	17.6	343	13	1
13	5530	13.2	447	15	1
14	5530	14	406	16	0
15	5530	12.5	429	13	1
16	5530	14.1	243	13	1
17	5530	11.6	403	14	1
18	5530	13	473	13	1
19	5530	18.7	379	16	1
20	5530	14.7	249	14	1
21	5530	16.4	320	14	1
22	5530	19.7	339	15	1
23	5530	16.9	287	14	1
24	5530	11.1	248	13	1
25	5530	12.6	334	13	0
26	5530	15.6	334	16	1
27	5530	13	446	14	1
28	5530	16.1	362	12	1
29	5530	14.2	415	13	1
30	5530	18.2	322	14	0
Detection Percentage (%)					83.33%

Mode1 –802.11n20

Total Type 1~4 Radar Statistical Performance			
Radar Type	Detection Percentage (%)	Limit (%)	Result
1	93.33	>60%	Pass
2	73.33	>60%	Pass
3	70.00	>60%	Pass
4	83.33	>60%	Pass
Total Type 1~4	80.00	>80%	Pass

Mode2 –802.11n40

Total Type 1~4 Radar Statistical Performance			
Radar Type	Detection Percentage (%)	Limit (%)	Result
1	90.00	>60%	Pass
2	86.67	>60%	Pass
3	93.33	>60%	Pass
4	80.00	>60%	Pass
Total Type 1~4	87.50	>80%	Pass

Mode3 –802.11ac80

Total Type 1~4 Radar Statistical Performance			
Radar Type	Detection Percentage (%)	Limit (%)	Result
1	80.00	>60%	Pass
2	90.00	>60%	Pass
3	76.67	>60%	Pass
4	83.33	>60%	Pass
Total Type 1~4	82.50	>80%	Pass

8. 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

8.1. DFS requirements during normal operation

Requirement	Operational Mode		
	Master	**Client Without 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

8.2. DFS Detection Thresholds

(1) Interference Threshold value, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥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. **Note3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

(2) DFS Response requirement values

Parameter	Value
Non-Occupancy Period	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.

8.3. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

(1) 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 $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ sec, with a minimum increment of 1 μ sec, 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 905462 D02 UNII DFS Compliance Procedures v01 Page 10 generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

(2) Long Pulse Radar Test Signal

Radar Waveform	Bursts	Pulses Per Burst	Pulse Width (usec)	Chirp Width (MHz)	PRI (usec)	Minimum Percentage of Successful Detection	Minimum Trials
5	8-20	1-3	50-100	5-20	1000-2000	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the long pulse radar test signal. If more than 30 waveforms are used for the long pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

Each waveform is defined as follows:

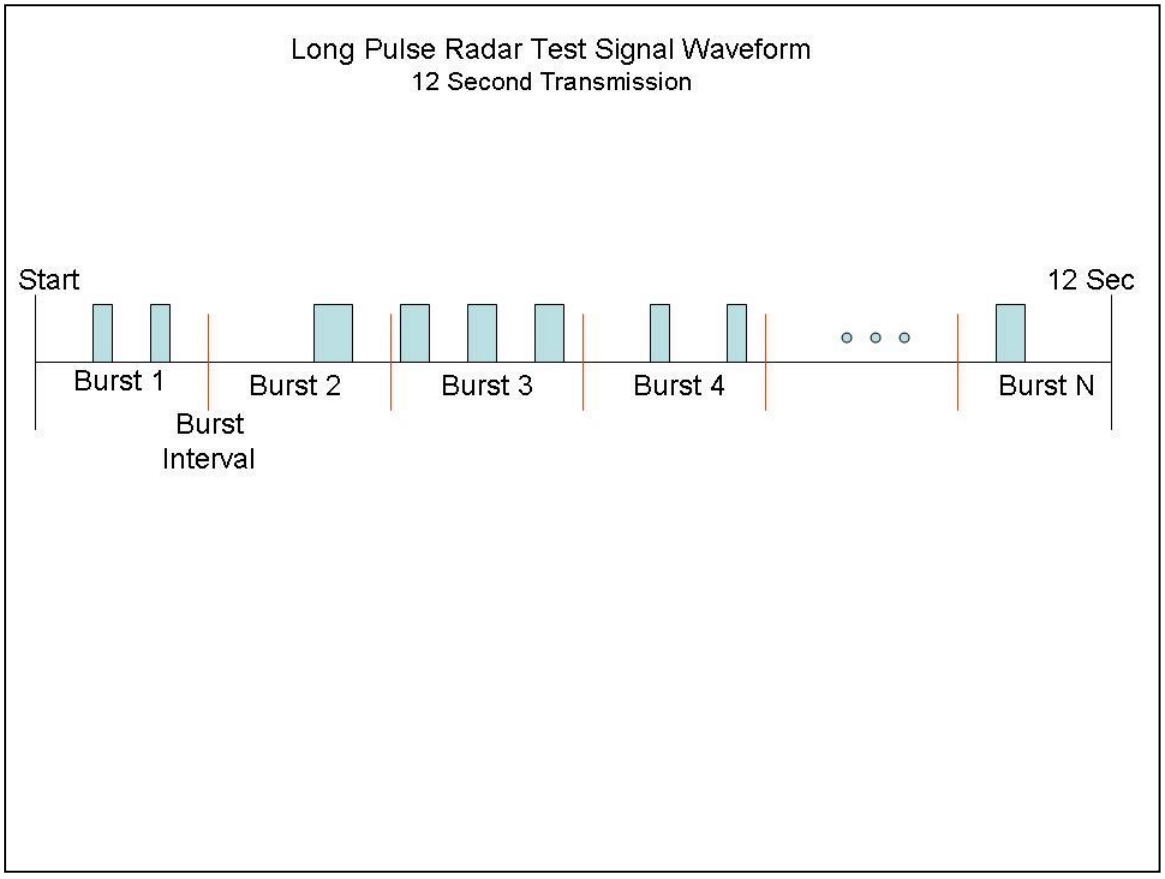
1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with radar frequency of 5310 MHz and a 20 MHz chirped signal, the chirp starts at 5300 MHz and ends at 5320 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

A representative example of a Long Pulse radar test waveform:

1) The total test signal length is 12 seconds.
2) 8 Bursts are randomly generated for the Burst_Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) Bursts 2 through 8 are generated using steps 3 – 5.

7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

Graphical Representation of a Long Pulse radar Test Waveform



(3) Frequency Hopping Radar Test Signal

Radar Waveform	Pulse Width (μsec)	PRI (μsec)	Hopping Sequence Length (msec)	Pulses Per Hop	Hopping Rate (kHz)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	300	9	0.333	70%	30

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected1 from the hopping sequence defined by the following algorithm:

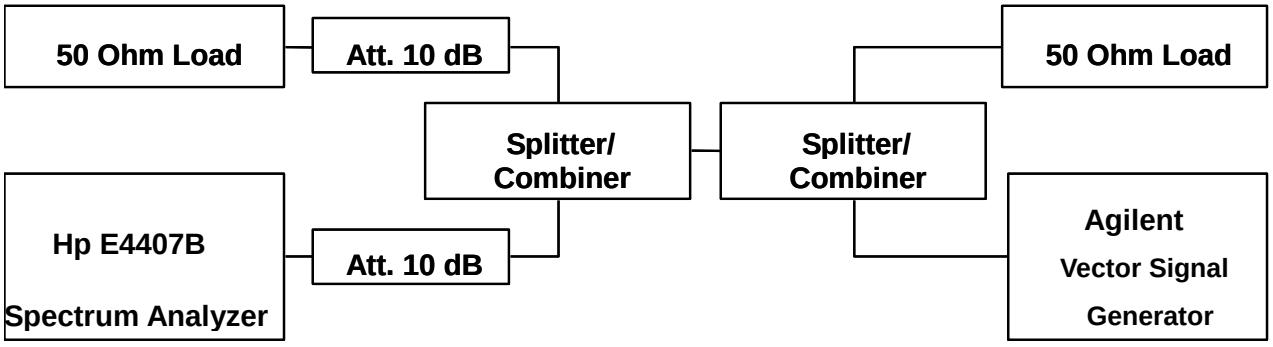
The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

8.4. Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted radar waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were replace 50ohm terminal from master and client device and no transmissions by either the master or client device. The spectrum analyzer was switched to the zero span (time domain) at the frequency of the radar waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3MHz and 3 MHz.

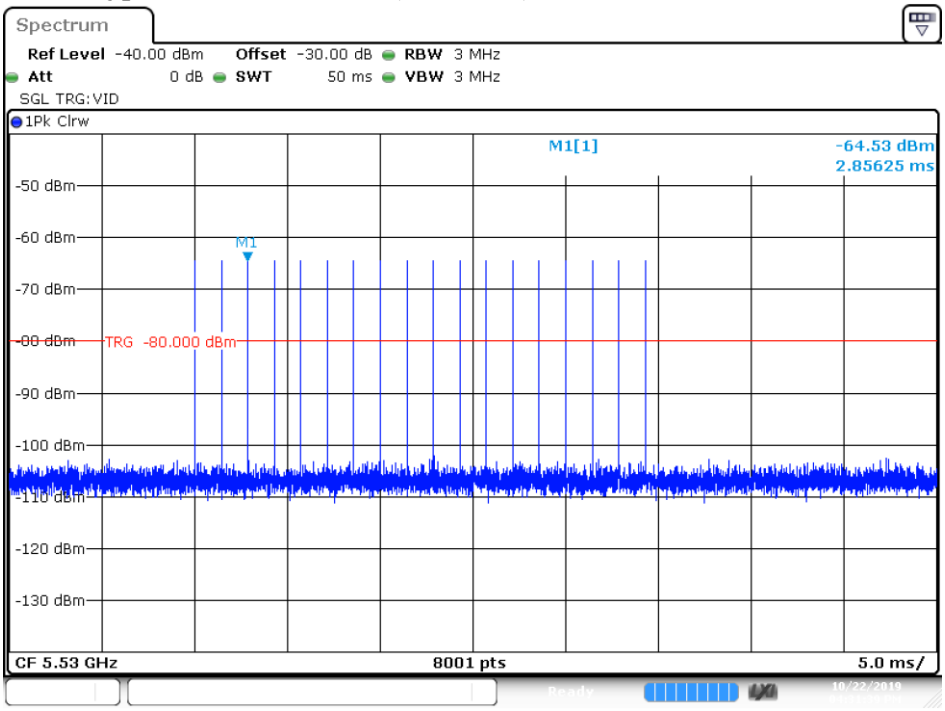
The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -64dBm due to the interference threshold level is not required.

Conducted Calibration Setup



8.5. Radar Waveform Calibration Result

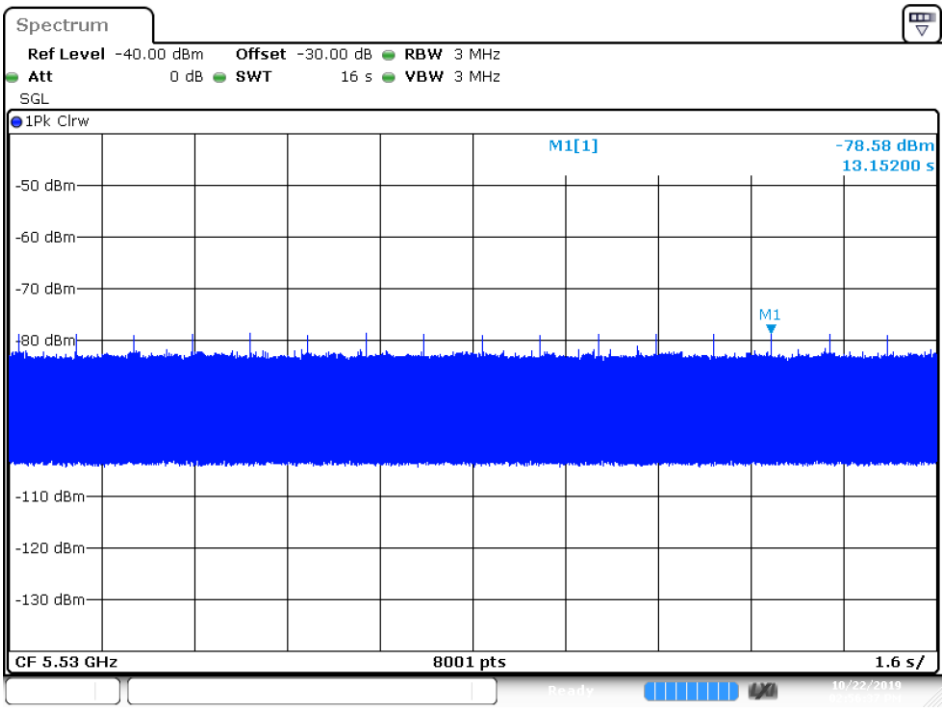
Radar Type 0 Calibration Plot (5530MHz)



Date: 22.OCT.2019 16:31:40

8.6. Slave Data Traffic Plot Result

Plot of Slave Traffic at 5530MHz



9. In-Service Monitoring for Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

9.1. Test Procedure

These tests define how the following DFS parameters are verified during In-Service Monitoring;

Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.. The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB (-63dBm) is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Master Device will associate with the UUT (Client) at 5300 MHz and 5500MHz.

Stream the MPEG test file from the Client (TX) Device to the Master (RX) Device on the selected Channel for the entire period of the test.

At time T_0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at -63dBm.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing

Transmission Time results to the limits defined in the DFS Response requirement values table.

Measure the UUT for more than 30 minutes following the channel close/move time to verify that the UUT does not resume any transmissions on this Channel.

9.2. Test Requirement

Parameter	Value
Channel Move Time	10 Seconds
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 seconds period
Non-Occupancy Period	Minimum 30 minutes

9.3. Uncertainty

± 1ms.

9.4. Test Result of Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

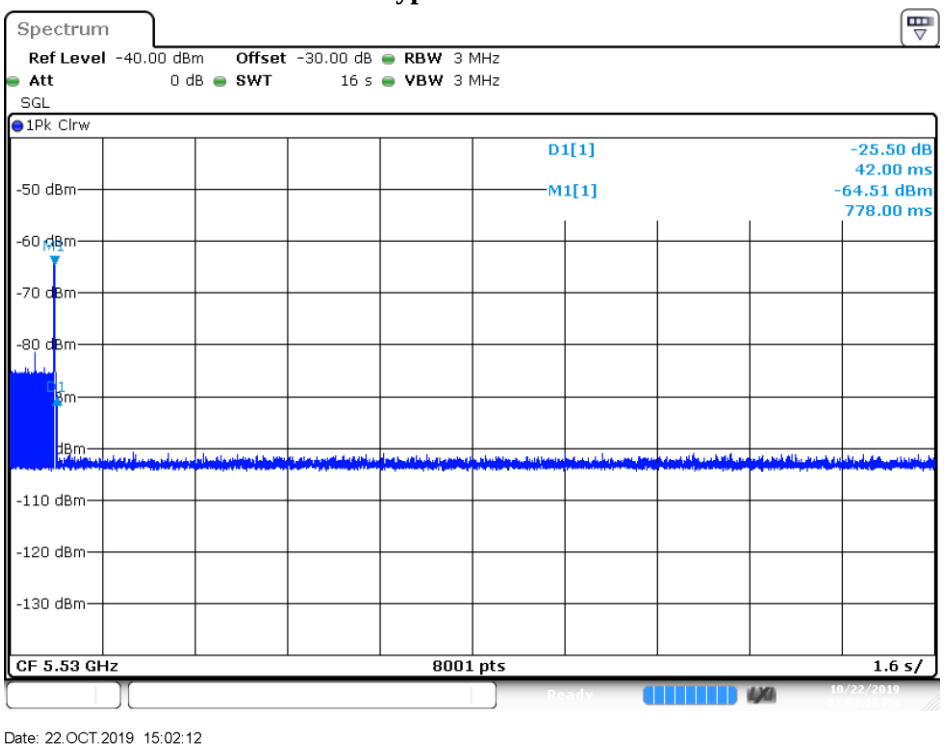
Product : MOXA IEEE 802.11a/n/ac 4*4 module

Test Item : Channel Move Time Test

Radar Type : Type 0

Test Mode : Mode 3: Transmit (802.11ac-80BW)

Channel Move Time for Radar Test Type 0 at 5530MHz

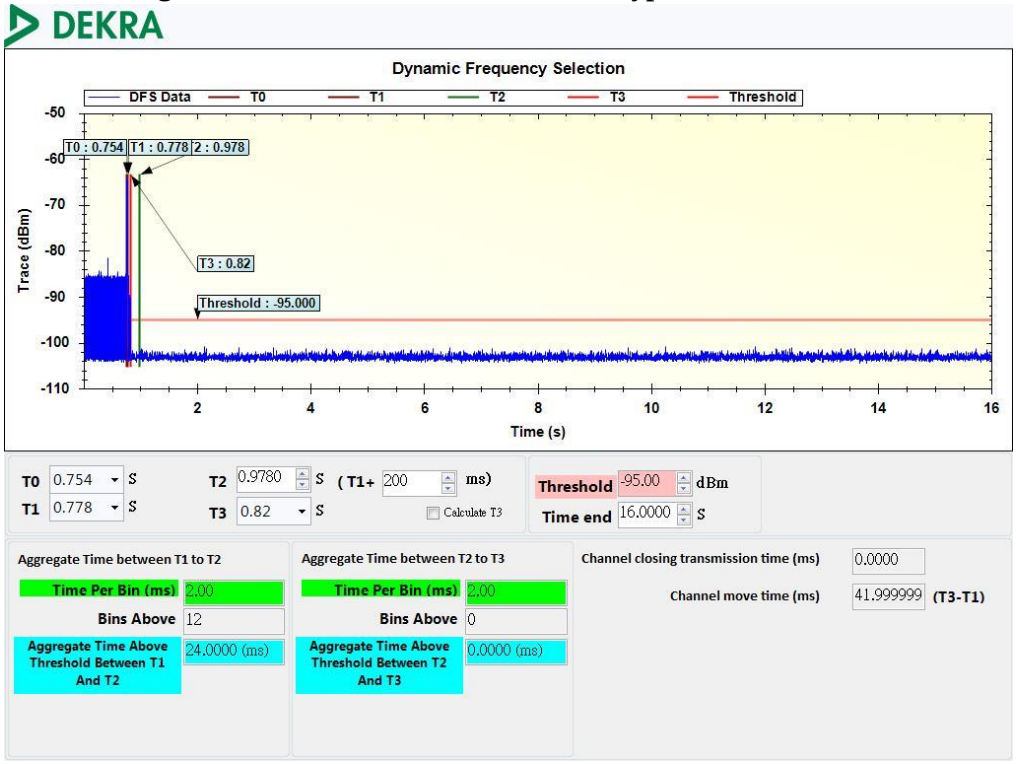


Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.042	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item : Channel Closing Transmission Time Test
Radar Type : Type 0
Test Mode : Mode 3: Transmit (802.11ac-80BW)

Channel Closing Transmission Time for Radar Test Type 0 at 5530 MHz



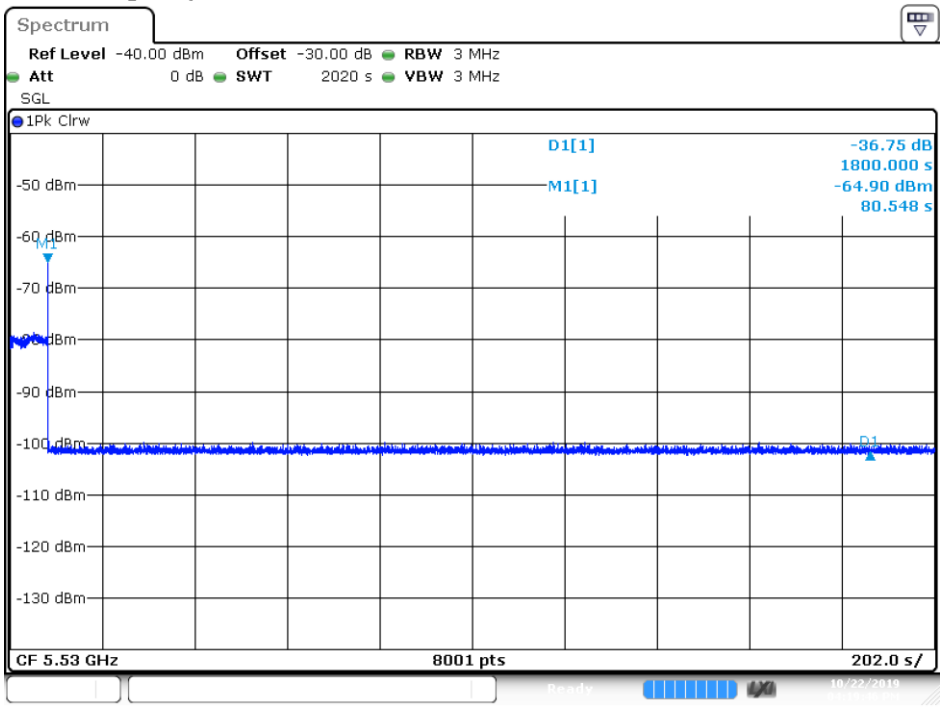
Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	41.99	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

*Note: The test result is “bin number X time per bin (600 ms / 8000)”

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
Test Item Non-Occupancy Period
Radar Type : Type 0
Test Mode : Mode 3: Transmit (802.11ac-80BW)

Non-Occupancy Period at 5530 MHz



Test Item	Test Result (Minutes)	Limit (Minutes)
Non-Occupancy Period	60	>30

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