Test Report # 317347 B

Equipment Under Test:	PHC-11AC1-A
Requirement	FCC 15.407 (h), ISED Canada RSS-247 Section 6.3 for a 5 GHz WLAN device
Test Date(s):	7/25/2019
Prepared for:	Mark Nolin Philips North America LLC 3000 Minuteman Road Andover, MA 1810

Report Issued by: Shane Dock, EMC Engineer

Signature:

Date: 4/15/2020

Report Reviewed by: Adam Alger, Quality Manager

Signature:

Date: 4/15/2020

Report Constructed by: Shane Dock, EMC Engineer

Signature:

Date: 9/12/2019

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Laird Connectivity Test Services in Review

The Laird Connectivity, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

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Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Government of Canada

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 Test Report Summary

During **7/25/2019** the Equipment Under Test (EUT), **PHC-11AC1-A**, as provided by **Philips North America LLC** was tested to the following requirements:

FCC	ISED Canada	Test Description	Method	Result
15.407 (h)(2)	RSS-247 Section 6.3	Dynamic Frequency Selection	FCC KDB 905462 D02	Pass[Note 1]
15.407 (h)(2)(ii)	RSS-247 Section 6.3	Channel Availability Check Time	FCC KDB 905462 D02	N/A[Note 1]
15.407 (h)(2)(iii)	RSS-247 Section 6.3	Channel Move Time	FCC KDB 905462 D02	Pass
15.407 (h)(2)(iv)	RSS-247 Section 6.3	Non-Occupancy period	FCC KDB 905462 D02	Pass

Note: The EUT is a client only device.

Notice:

The results relate only to the item tested and described in this report. Any modifications made to the equipment under test after the specified test date(s) may invalidate the data herein.

If the resulting measurement margin is seen to be within the uncertainty value, as listed in this report, the possibility exists that this unit may not meet the required limit specification if subsequently tested.

2 CLIENT INFORMATION

Company Name	Philips North America LLC
Contact Person	Mark Nolin
Address	3000 Minuteman Road Andover, MA 1810

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	PHC-11AC1-A
Model Number	PHC-11AC1-A
Serial Number	Engineering Samples
Additional Information	FCC ID: 2ATC9-PHC-11AC1 IC ID: 25528- PHC11AC1

2.2 Product Description

Combined 802.11 a/b/g/n/ac WLAN and Bluetooth module.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Additional Information

EUT powered with 3.3VDC. EUT tested with test software programmed via serial connection facilitated with the Cypress/Broadcom WL_Tool Linux-Based Commands. EUT tested as a client-only device in a conducted test setup per the diagram below (from KDB 905462). Firmware version is 7.45.151. Worst Case Antenna gain is 5 dBi. The USI part number for this module is 8501-601900-01.

7.2.2 Setup for Client with injection at the Master

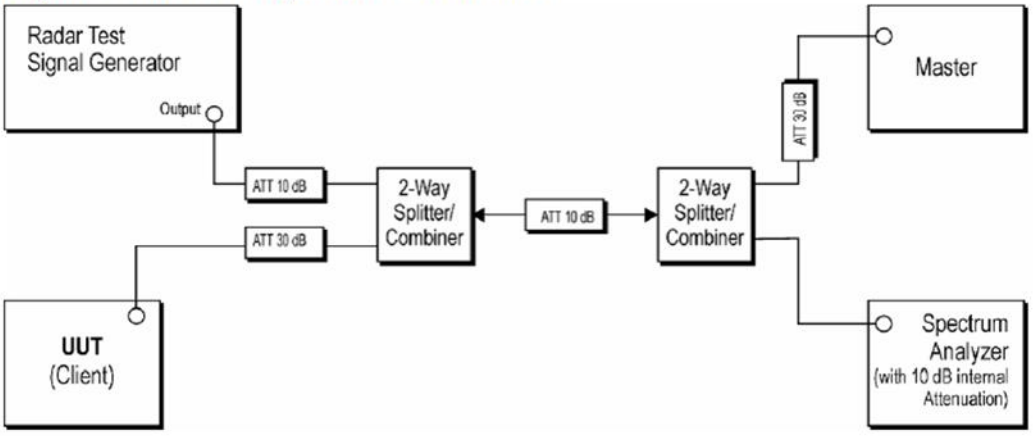


Figure 3: Example Conducted Setup where UUT is a Client and Radar Test Waveforms are injected into the Master

2.6 Channel Plans

Below are the channels used for this 5 GHz WLAN radio, along with their respective center frequencies and power settings.

UNII 1 Power Settings	20 MHz Channels				40 MHz Channels		80 MHz Channels
Channel	36	40	44	48	38	46	42
Frequency (MHz)	5180	5200	5220	5240	5190	5230	5210
802.11a	13.5	13.5	13.5	13.5	N/A	N/A	N/A
802.11n	14.0	14.0	14.0	14.0	11.5	11.5	N/A
802.11ac	14.0	14.0	14.0	14.0	11.5	11.5	10.5

NOTE: For ISED, Channel 48 is not used. Channels 36-44 are used in this band.

UNII 2A Power Settings	20 MHz Channels				40 MHz Channels		80 MHz Channels
Channel	52	56	60	64	54	62	58
Frequency (MHz)	5280	5300	5320	5340	5290	5330	5310
802.11a	15.5	15.5	15.5	15.0	N/A	N/A	N/A

802.11n	15.5	15.5	15.5	13.5	14.0	12.5	N/A
802.11ac	15.5	15.5	15.5	13.5	14.0	12.5	12.5

UNII 2C Power Settings	20 MHz Channels			40 MHz Channels			80 MHz Channels
Channel	100	116	140	102	110	134	106
Frequency (MHz)	5500	5580	5700	5510	5550	5670	5530
802.11a	15.5	15.5	15.5	N/A	N/A	N/A	N/A
802.11n	15.5	15.5	15.5	13.5	14.0	14.0	N/A
802.11ac	15.5	15.5	15.5	13.5	14.0	14.0	11.5

UNII 3 Power Settings	20 MHz Channels			40 MHz Channels		80 MHz Channels
Channel	149	157	165	151	159	155
Frequency (MHz)	5745	5785	5825	5755	5795	5775
802.11a	16.0	16.0	16.0	N/A	N/A	N/A
802.11n	16.0	16.0	16.0	14.0	14.0	N/A
802.11ac	16.0	16.0	16.0	14.0	14.0	14.0

2.7 KDB 905462 Information

Section 8.1

8.1 Complete description of the U-NII device	
a) The operating frequency range(s) of the equipment.	5180-5240 MHz, 5260-5320MHz, 5500-5700MHz, 5745-5825 MHz
b) The operating modes (Master and/or Client) of the U-NII device. Bridge modes and MESH modes, as applicable, must be included in the description.	Client with no radar detection capability
c) For Client devices, indicate whether or not it has radar detection capability and indicate the FCC identifier for the Master U-NII Device that is used with it for DFS testing.	Client with no radar detection capability. Master used with testing, FCC ID: LDK102061, LDK102062 IC: 2461B-102061, 2461B-102062
d) List the highest and the lowest possible power level (equivalent isotropic radiated power (EIRP)) of the equipment.	Highest EIRP = 13.3 dBm + 5.0 dBi = 18.3 dBm Lowest EIRP = 6.1 dBm + 1.9 dBi = 8.0 dBm
e) List all antenna assemblies and their corresponding gains.	Refer to section 2.5 of this report
1) If radiated tests are to be performed, the U-NII Device should be tested with the lowest gain antenna assembly (regardless of antenna type). The report should indicate which antenna assembly was used for the tests. For devices with adjustable output power, list the output power range and the maximum EIRP for each antenna assembly.	Not Applicable
2) If conducted tests are to be performed, indicate which antenna port/connection was used for the tests and the antenna assembly gain that was used to set the DFS Detection Threshold level during calibration of the test setup.	Not Applicable- EUT Client only
i) Indicate the calibrated conducted DFS Detection Threshold level.	Not Applicable- EUT Client only
ii) For devices with adjustable output power, list the output power range and the maximum EIRP for each antenna assembly.	No adjustable power. Maximum EIRP = 18.3 dBm
iii) Indicate the antenna connector impedance. Ensure that the measurement instruments match (usually 50 Ohms) or use a minimum loss pad and take into account the conversion loss.	50 ohms
3) Antenna gain measurement verification for tested antenna.	Not Applicable- EUT Client only
i) Describe procedure	Not Applicable- EUT Client only
ii) Describe the antenna configuration and how it is mounted	Not Applicable- EUT Client only
iii) If an antenna cable is supplied with the device, cable loss needs to be taken into account. Indicate the maximum cable length and either measure the gain with this cable or adjust the measured gain accordingly. State the cable loss.	Antenna cable was accounted in the gain measurement.

f) Test sequences or messages that should be used for communication between Master and Client Devices, which are used for Channel loading.	EUT and Master running 'Iperf' to stream data
1) Stream the test file from the Master Device to the Client Device for IP based systems or frame based systems which dynamically allocate the talk/listen ratio.	EUT and Master running 'Iperf' to stream data
2) For frame based systems with fixed talk/listen ratio, set the ratio to the worst case (maximum) that is user configurable during this test as specified by the manufacturer and stream the test file from the Master to the Client.	Not applicable
3) For other system architectures, supply appropriate Channel loading methodology.	Not applicable
g) Transmit Power Control description—Provide a description.	Not Applicable
h) System architectures, data rates, U-NII Channel bandwidths — Indicate the type(s) of system architecture (e.g. IP based or Frame based) that the U-NII device employs. Each type of unique architecture must be tested.	Channel bandwidths: 20MHz Data rates: 6 MBPS - MCS7
i) The time required for the Master Device and/or Client Device to complete its power-on cycle.	Client device takes less than 10 seconds to boot up
j) Manufacturer statement confirming that information regarding the parameters of the detected Radar Waveforms is not available to the end user.	See Software security exhibit
k) The manufacturer is permitted to select the first channel either manually or randomly. The manufacturer may also block DFS channels from use.	Not applicable-EUT client device only

Section 8.2

8.2 Complete description of the Radar Waveform calibration	
a) Description of calibration setup—Block diagram of equipment setup, clearly identifying if a radiated or conducted method was used.	Not Applicable- EUT client device only
b) Description of calibration procedure	Not Applicable- EUT client device only
1) Verify DFS Detection Threshold levels	Not Applicable- EUT client device only
i) Indicate DFS Detection Threshold levels used.	Not Applicable- EUT client device only
ii) Consider output power range and antenna gain.	Not Applicable- EUT client device only
2) For the Short Pulse Radar Types, spectrum analyzer plots of the burst of pulses on the Channel frequency should be provided.	Supplied in this report
3) For the Long Pulse Radar Type, spectrum analyzer plot of a single burst (1-3 pulses) on the Channel frequency should be provided.	Not Applicable- EUT client device only
4) Describe method used to generate frequency hopping signal.	Not Applicable- EUT client device only
5) The U-NII Detection Bandwidth	Not Applicable- EUT client device only
6) For the Frequency Hopping waveform, a spectrum analyzer plot showing 9 pulses on one frequency within the U-NII Detection Bandwidth should be provided.	Not Applicable- EUT client device only
7) Verify use of vertical polarization for testing when using a radiated test method.	Not applicable- testing performed conducted
c) When testing a Client Device with radar detection capability, verify that the Client Device is responding independently based on the Client Device's self-detection rather than responding to the Master Device. If required, provide a description of the method used to isolate the client from the transmissions from the Master Device to ensure Client Device self-detection of the Radar Waveform.	Not Applicable- EUT client device only without radar detection capability

Section 8.3

8.3 Complete description of test procedure	
a) Description of deviations to the procedures or equipment described in this document.	No deviations during test
b) Description of DFS test procedure and test setup used to monitor the U-NII device and Radar Waveform transmissions. Provide a block diagram of the signal monitoring equipment setup.	Provided in this report
1) List of equipment	In report
2) Test setup photos	Test setup photos exhibit
c) Description of DFS test procedure and test setup used to generate the Radar Waveforms.	In report
1) Block diagram of equipment setup	In report
2) List of equipment	In report
3) Test setup photos	Test setup photos exhibit
4) For each of the waveforms that were used for each signal type, supply the characteristics (pulse width, pulse repetition interval, number of pulses per burst, modulation).	Radar type 0 in KDB905462 D02
5) For selecting the waveform parameters from within the bounds of the signal type, describe how they were selected (i.e., manually or randomly).	Manually using arbitrary waveform generator and signal generator
6) Channel loading description including data type, timing plots, percentage of channel loading calculation, and protocol.	In report
d) The DFS tests are to be performed on U-NII Channel(s). Refer to Table 2 for additional requirements for devices with multiple bandwidth modes.	Testing performed on UNII channel with 20MHz bandwidth
1) List each Channel frequency that was used for the tests.	5520, 5660, 5500 MHz
2) Data Sheet showing the U-NII Detection Bandwidth for the Channel(s) used during the test.	Not Applicable-EUT client device only
3) Plot of RF measurement system showing its nominal noise floor in the same bandwidth which is used to perform the Channel Availability Check, initial radar bursts, In-Service Monitoring, and 30 minute Non-Occupancy Period tests.	Not Applicable-EUT client device only
e) Timing plot(s) showing compliance with the Channel Availability Check Time requirement of 60 seconds at start up.	Not Applicable-EUT client device only
1) The plot should show the Initial Tpower-up time.	Not Applicable-EUT client device only
2) The plot should include the Initial Tpower-up period in addition to 60 second period.	Not Applicable-EUT client device only

f) Timing plot(s) showing compliance with the Initial DFS radar detection requirements during the 60 second initial Channel Availability Check at start up.	Not Applicable-EUT client device only
1) Plot for DFS radar detection for Radar Waveforms applied 6 seconds after the Initial Tpower-up time period. The minimum length of the plot should be 1.5 minutes after the Tpower-up time period. The plot should show the radar burst at the appropriate time. This test is only required once and Radar Type 0 should be used for the test.	Not Applicable-EUT client device only
2) Plot for DFS radar detection for Radar Waveforms applied 6 seconds before end of the 60 second Channel Availability Check Time. The minimum length of the plot should be 1.5 minutes after the Tpower-up time period. The plot should show the radar burst at the appropriate time. This test is only required once and Radar Types 0 should be used for the test.	Not Applicable-EUT client device only
3) The minimum time resolution of the plots should be sufficient to show the Radar Waveform bursts (overall, not individual pulses within the burst).	In report
g) Verification that when the device is "off" that the RF energy emitted is below the FCC rules for unintentional radiators:	Verified
For the plots of U-NII RF activity versus time, the device is considered to be "off" or not transmitting when intentional U-NII signals (beacons, data packets or transmissions, or control signals) are below the FCC rules for unintentional radiation due to device leakage, oscillator noise, clocks, and other unintentional RF generators.	
h) Spectrum Analyzer, VSA, or some other data gathering Instrument plots showing compliance with the Channel Move Time requirements during in the In-Service Monitoring. The plots need to show U-NII device transmissions on the Channel in the form of RF activity on the vertical axis versus time on the horizontal axis. Only one 10 second plot needs to be reported for Radar Type 0. The plot for the Short Pulse Radar Types should start at the end of the radar burst. The Channel Move Time will be calculated based on the plot of Radar Type 0. The plots need to show U-NII device transmissions on the Channel in the form of RF activity on the vertical axis versus time on the horizontal axis. Sufficient resolution should be used.	In report
1) The plots and/or data must show the U-NII Device's compliance with the 200 milliseconds limit on data transmission and compliance with the 60 millisecond aggregate limit found in Table 4.	In report
2) Indicate the total number of times the test was performed.	Not Applicable-EUT client device only
3) Indicate a detect/not detect for each waveform within a signal type and the number of failures and the number of successful radar detection times within the time limit. Sample data sheets are shown in Tables 8-11.	Not Applicable-EUT client device only
4) Verify compliance with the minimum percentage of successful detection requirements found in Tables 5-7.	Not Applicable-EUT client device only
i) Spectrum Analyzer plot(s) showing compliance with the 30 minute Non-Occupancy Period requirement. Only one plot is required. This is a separate test that is performed in addition to the other In-Service Monitoring tests.	In report

3 REFERENCES

Publication	Edition	Date
47 CFR, Parts 0-15 (FCC)		2020
RSS 247	2	2017
RSS GEN	5	2018
ANSI C63.10		2013
FCC KDB 905462 D02 v02	-	2016

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

5.1.1 Antenna Port Conducted Emissions – DFS

Operator	Zach Wilson
QA	Adam Alger
Test Date	7/25/2019
Location	Conducted Radio Bench
Temp. / R.H.	48.4%RH, 21.7°C
Rule	FCC Part 15.407 (h) / RSS-247 6.3
Method	FCC KDB 905462 D02

Requirements

Client without Radar Detection Requirements Prior to Use of a Channel

1. Non-Occupancy Period

    minimum 30 minutes

Client without Radar Detection Requirements During Normal Operation

1. Channel Closing Time

    200 ms + an aggregate of 60 ms over remaining 10 second period using Radar Type 0 starting at beginning of Channel move time plus any additional control signals not counting quiet periods during the remaining 10 second period.

2. Channel Move Time

    10 seconds using Radar Type 0

Radar Type 0

    Pulse width = 1 µsec

    PRI = 1428 µsec

Number of Pulses = 18

Test Parameters

Frequency	5520, 5660, 5500 MHz
Settings	RBW 3 MHz, VBW 3 MHz
Settings	Peak Detector
EUT Spec	Client with no monitoring; Conducted Setup for Client with injection at the Master
EUT Spec	Battery operated
Notes	EUT Setup to connect to Master and perform data streaming using 'I-Perf'. Channel loading shown to be greater than 17%.

Instrumentation

Date : 12-Apr-2019 Test : DFS Job : C-3160

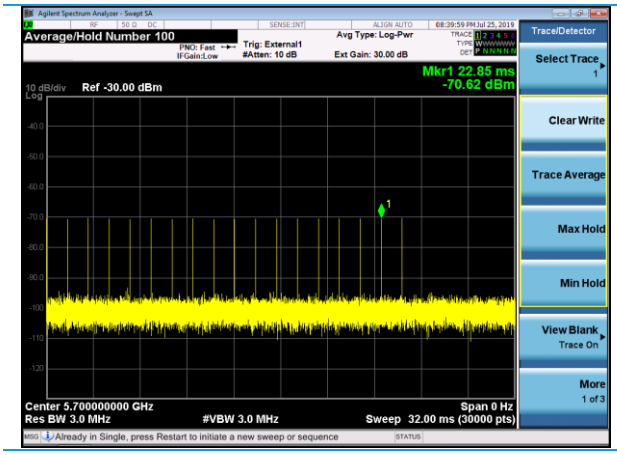
PE : Shane Dock Customer : Philips Healthcare Quote : 319013

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	CC 000259C	Generator - Function / Arbitrary Waveform	Agilent	33250A	US40000583	4/24/2019	4/24/2020	Active Calibration
2	CC 000314C	Vector Signal Generator	Agilent	E4438C	US 41469143	5/4/2017	5/4/2020	Active Calibration
3	CC 000710C	Oscilloscope	Agilent	MSO8104A	MY 45001068	4/24/2019	4/24/2020	Active Calibration
4	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY 53400296	4/24/2019	4/24/2020	Active Calibration
5	EE 960183	RF Splitter/Combiner	mini-circuits	ZFSC-2-10G +	S F707601702	6/8/2018	6/8/2020	Active Verification
6	EE 960093	RF Splitter/Combiner	mini-circuits	ZFSC-2-10G	SF702900616	6/7/2018	6/7/2020	Active Verification

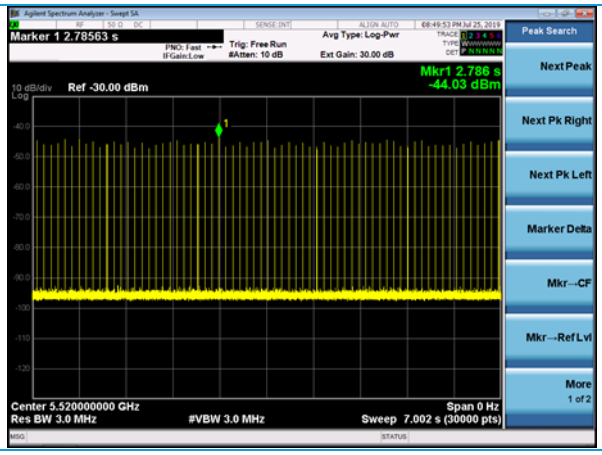
Master:

Master Info	FCC ID: LDK102061, LDK102062 IC: 2461B-102061, 2461B-102062

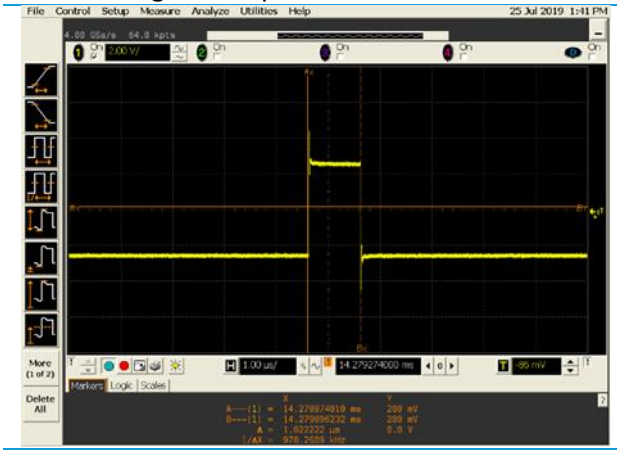
Setup Plots



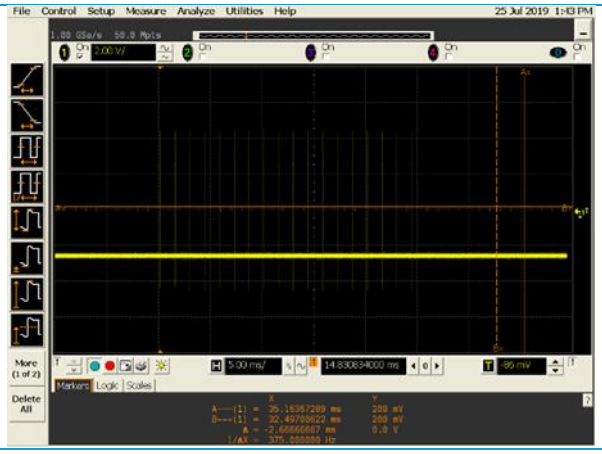
DFS Signal at input of master 5700 MHz



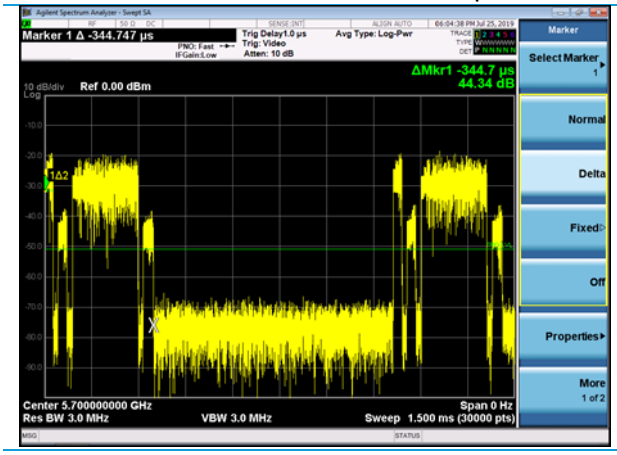
Level of AP Beacon without EUT



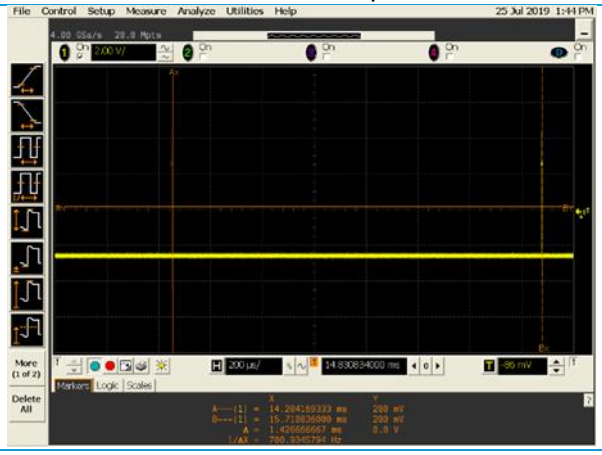
Radar Pulse 0: Pulse width 1 µs



Radar Pulse 0: 18 pulses

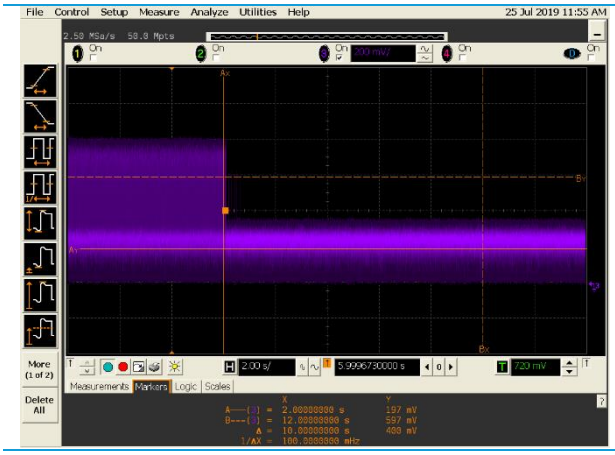


Duty Cycle 45.2%

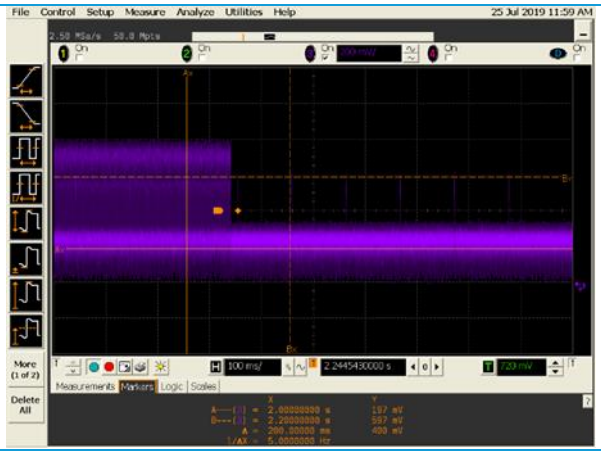


Radar Pulse 0: PRI 1.428 ms

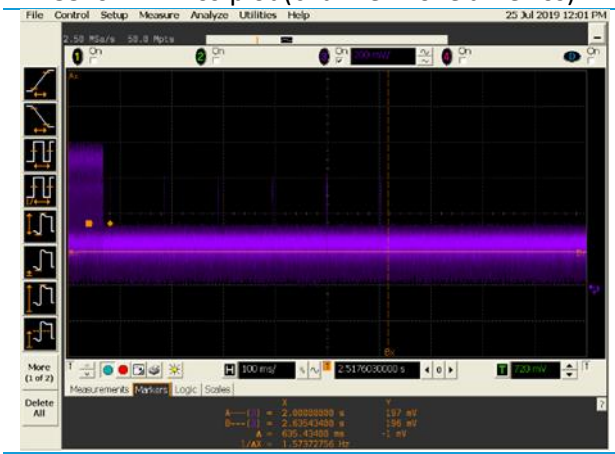
Results (With radar pulse applied)



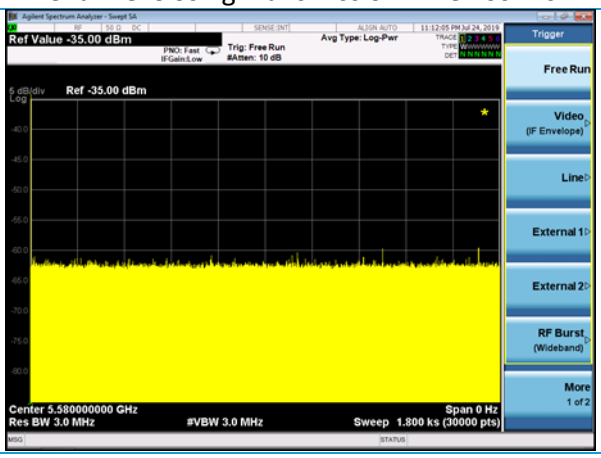
5520 MHz 20s plot (channel move time 10s)



Channel Closing Transmission Time 200 ms



5 pulses of 400 µs after 200 ms = 2 ms total



Channel Non-Occupancy Period (30 minutes)

6 Revision History

Version	Date	Notes	Person
0	9/12/19	First Draft	Shane Dock
1	10/31/19	Second Draft	Shane Dock
2	1/20/20	Third Draft	Shane Dock
3	3/18/20	Fourth Draft	Shane Dock
4	4/14/20	Review Concluded	Shane Dock

END OF REPORT