TEST REPORT

DT&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2005-0124
2. Customer
   - Name : HYUNDAI MOBIS CO., LTD.
   - Address : 203, Teheran-ro Gangnam-gu, Seoul, South Korea, 135-977
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : DISPLAY CAR SYSTEM / ADC20S2FN0
   FCC ID : TQ8-ADC20S2FN0
5. Test Method Used : KDB905462 D02v02 , KDB905462 D03v01r02
   Test Specification : FCC Part 15.407
6. Date of Test : 2020.03.26
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
8. Testing Environment : See appended test report.
9. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name : JaeHyeok Bang (Signature)	Reviewed by Name : GeunKi Son (Signature)

2020 . 05 . 11 .

DT&C Co., Ltd.

Not abided by KS Q ISO / IEC 17025 and KOLAS accreditation.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2005-0124	May. 11, 2020	Initial issue	JaeHyeok Bang	Geunki Son

Table of Contents

1. GENERAL INFORMATIONEUT DESCRIPTION

1.1. EUT Description

FCC equipment class	Unlicensed National Information Infrastructure (UNII)		
Product	DISPLAY CAR SYSTEM		
Model name	ADC20S2FN0		
Add model name Note3	ADC40S2AN, ADC10S1GG, ADC11S1GG, ADC12S1GG, ADC13S1GG, ADC10S1MG, ADC10S1GN, ADC10S1GL, ADC10S1GP		
EUT capabilities	DFS		
Power supply	DC 14.4V		
Test condition	☒ Conducted	☐ Radiated	
Channel bandwidth	802.11a/n/ac: 20 MHz	802.11n/ac: 40 MHz	802.11ac: 80 MHz
Frequency Range	**U-NII 2A(5250 ~ 5350 MHz)**	**U-NII 2C(5470 ~ 5725 MHz)**	
	▪ 802.11a/n(HT20)/ac(VHT20): 5260 ~ 5320 MHz ▪ 802.11n(HT40)/ac(VHT40): 5270 ~ 5310 MHz ▪ 802.11ac(VHT80): 5290 MHz	▪ 802.11a/n(HT20)/ac(VHT20): 5500 ~ 5580, 5660 ~ 5720 MHz ▪ 802.11n(HT40)/ac(VHT40): 5510 ~ 5550, 5670 ~ 5710 MHz ▪ 802.11ac(VHT80): 5530, 5690 MHz	
Modulation type	OFDM		
Operational mode	☐ Master mode ☒ Client mode without radar detection ☐ Client mode with radar detection		
Antenna specification	Antenna type: PCB Pattern Antenna		
	Antenna gain	U-NII-2A	-0.18 dBi
		U-NII-2C	-0.77 dBi

Note1: The above EUT information was declared by the manufacturer.
Note2: Refer to UNII report
Note3: Difference between models

	Model Name	Difference
Base model	ADC20S2FN0	NA
Add model	ADC40S2AN	This model contains module approved under Part 22/24/27.(FCC ID: YZP-VL3010)
Add models	ADC10S1GG, ADC11S1GG, ADC12S1GG, ADC13S1GG, ADC10S1MG, ADC10S1GN, ADC10S1GL, ADC10S1GP	Same as base model (There is no difference of electrical and circuit performance.)

1.2. Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
Access Point (Master)	DIR-868L	R3X81E6000093	D-Link	FCC ID: KA2IR868LA1 Contains FCC ID: RRK2012060056-1

1.3. Testing environment

Ambient Condition	
▪ Temperature	+22 ℃ ~ +23 ℃
▪ Relative Humidity	43 % ~ 44 %

2. DYNAMIC FREQUENCY SELECTION TEST DESCRIPTION

2.1. Applicability of DFS requirements prior to use of a channel

Requirement	Operational mode		
	Master	Client without radar detection	Client with radar detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

2.2. Applicability of DFS requirements during normal operation

Requirement	Operational mode	
	Master or client with radar detection	Client without radar detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Operational mode	
	Master or client with radar detection	Client without radar detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

The EUT was tested according to the following specification:
905462 D02 UNII DFS Compliance Procedure New Rules v02
905462 D03 UNII Client Without Radar Detection New Rules v01r02

2.3. Requirements of client devices

a) A Client Device will not transmit before having received appropriate control signals from a Master Device.

b) A Client Device will stop all its transmissions whenever instructed by a Master Device to which it is associated and will meet the Channel Move Time and Channel Closing Transmission Time requirements. The Client Device will not resume any transmissions until it has again received control signals from a Master Device.

c) If a Client Device is performing In-Service Monitoring and detects a Radar Waveform above the DFS Detection Threshold, it will inform the Master Device. This is equivalent to the Master Device detecting the Radar Waveform and d) through f) of section 5.1.1 apply.

d) Irrespective of Client Device or Master Device detection the Channel Move Time and Channel Closing Transmission Time requirements remain the same.

e) The client test frequency must be monitored to ensure no transmission of any type has occurred for 30 minutes. Note: If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear.

2.4. DFS response requirement values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel availability check time	60 seconds
Channel move time	10 seconds See Note 1.
Channel closing transmission time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.

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.

2.5. DFS detection thresholds

Below provides the DFS Detection Thresholds for Master Devices as well as Client Devices incorporating In-Service Monitoring.

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP ≥ 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.

2.6. 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 section 2.6.2.	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	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

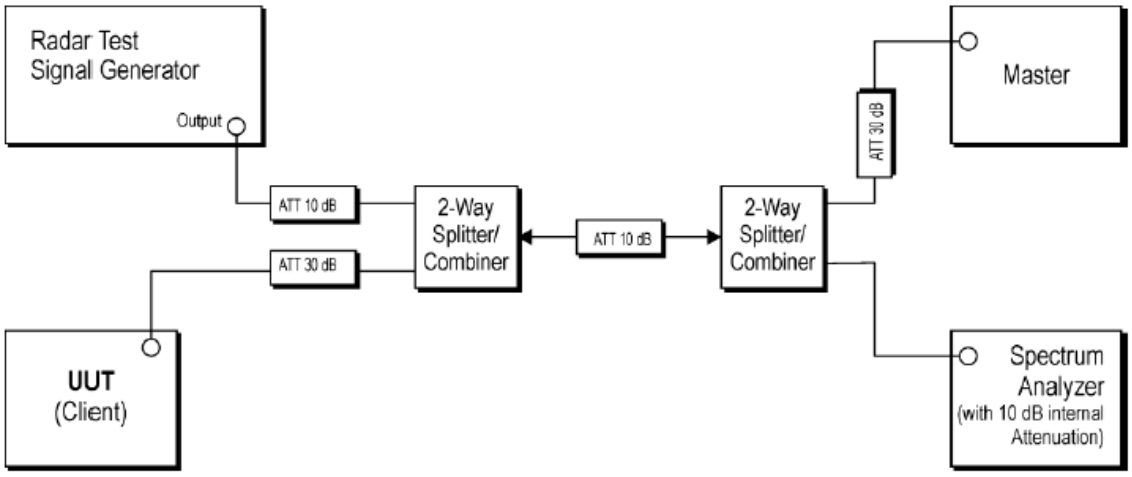
Note 1: As the EUT is a Client Device without Radar Detection, only one type of radar pulse is required for testing. The Radar Pulse type 0 was used to evaluate the Client device to measure the Channel Move Time and the Channel Closing Transmission Time.

Note 2: This report was applied Short Pulse Radar Type 0.

3. Test procedure

3.1. Setup for Client with injection at the Master

The setup method is shown below diagram. The method according to the 905462 D02 UNII DFS Compliance Procedure New Rules v02 - section 7.2



3.2. Spectrum analyzer setting parameter

The setting parameter is shown below and it according to the 905462 D02 UNII DFS Compliance Procedure New Rules v02 - section 7.5

1) **RBW /VBW ≥ 3MHz**
2) **Detector = Peak**
3) **Span = zero span**
4) **Sweep time ≥ 12s**

3.3. Conducted test procedure

1) One frequency will be chosen from the Operating Channels of the UUT within the 5250-5350 MHz or 5470-5725 MHz bands.
2) The Client Device (EUT) is set up the above diagram and communications between the Master device and the Client is established.
3) Stream the channel loading test file from the Master Device to the Client Device on the test Channel for the entire period of the test. (The MPEG file specified by the FCC (*"6 ½ Magic Hours"*))
4) An additional 1 dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.
5) Observe the transmissions of the UUT at the end of the Burst on the Operating Channel for duration greater than 12 seconds for Radar Type 0 to ensure detection occurs.
6) After the initial radar burst the channel is monitored for 30 minutes to ensure no transmissions or beacons occur. A second monitoring setup is used to verify that the Master and Client have both moved to different channels.

4. SUMMARY OF TESTS

Parameter	Limit	Status Note 1
Channel move time	10 seconds	C Note 2
Channel closing transmission time	200ms + aggregate of 60ms over remaining 10 second period	C Note 2, 3
Non-occupancy period	30 minutes	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: 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 3: 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.

5. LIST OF EQUIPMENTS

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY50410357
DC Power Supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43000211
Multimeter	FLUKE	17B	19/12/16	20/12/16	26030065WS
DFS Bridge System	DTNC	DFS-01	19/12/16	20/12/16	T001
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-1
PXIS-2670(G)	ADLINK	3025C	19/06/25	20/06/25	302581/834
PXIS-2670(G)	ADLINK	3035C	19/06/25	20/06/25	303581/927
Cable	DT&C	CABLE	20/01/16	21/01/16	DFS-1
Cable	DT&C	CABLE	20/01/16	21/01/16	DFS-2
Cable	DT&C	CABLE	20/01/16	21/01/16	DFS-3
Cable	DT&C	CABLE	20/01/16	21/01/16	DFS-4
Cable	DT&C	CABLE	20/01/16	21/01/16	DFS-5
Test Software	Aeroflex.,Ltd	DFS Radar simulator and Analyzer	NA	NA	Version 2.5.2

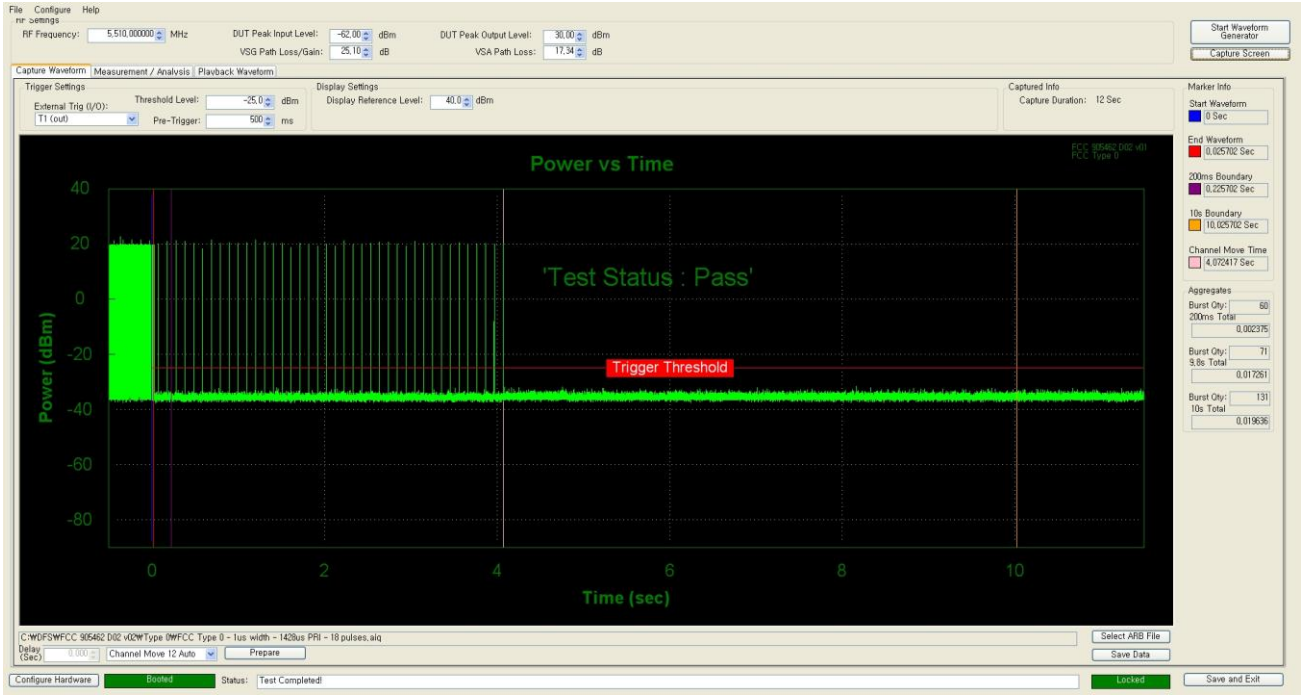
Note: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

6. TEST RESULTS

6.1. Move time and aggregate time

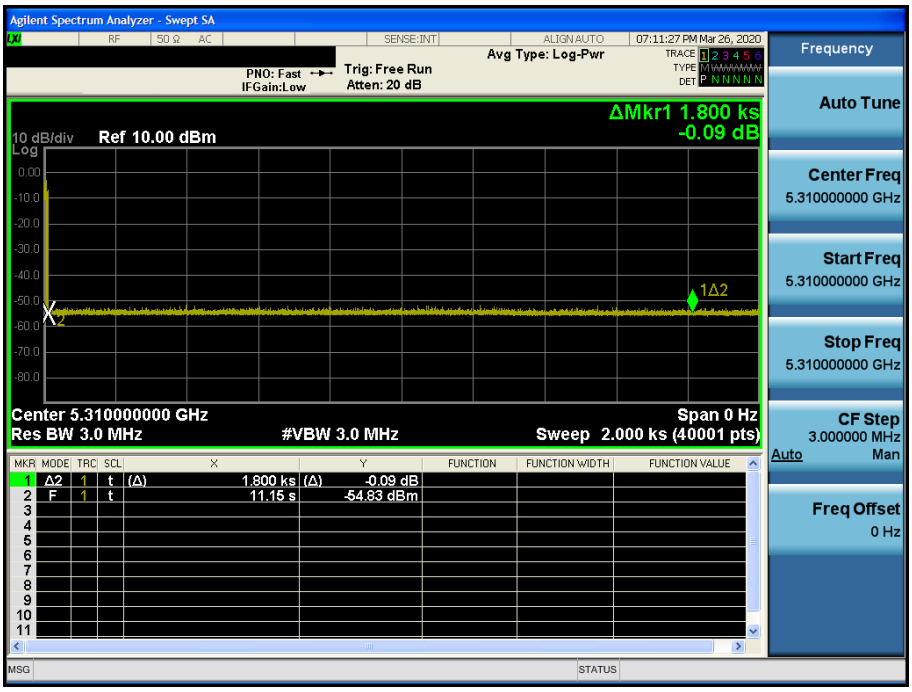
6.1.1. U-NII-2A: 5310 MHz

6.1.2. U-NII-2C: 5510 MHz

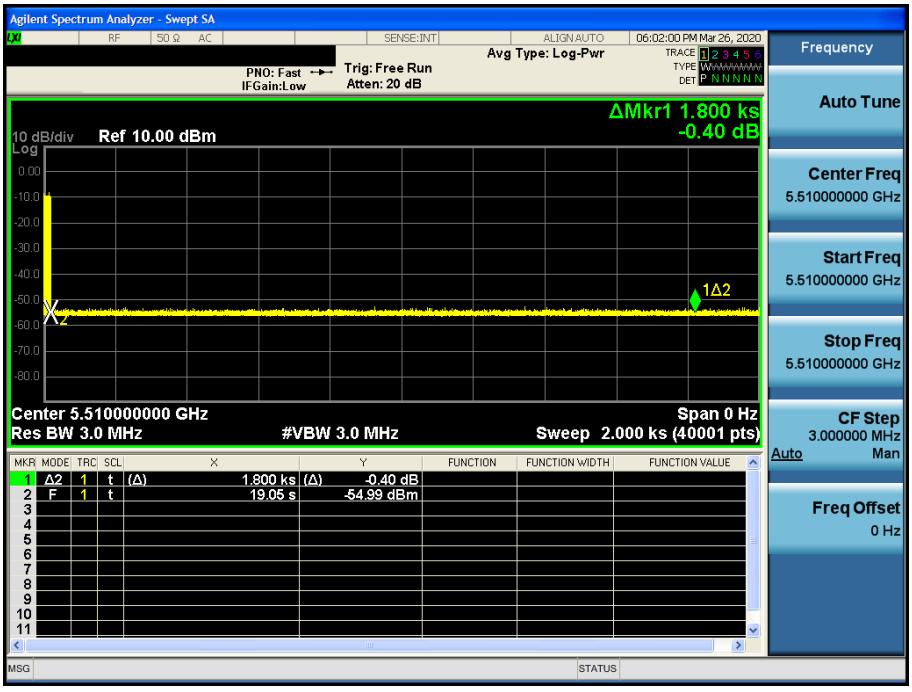


6.2. Non-occupancy period

6.2.1. U-NII-2A: 5310 MHz



6.2.2. U-NII-2C: 5510 MHz

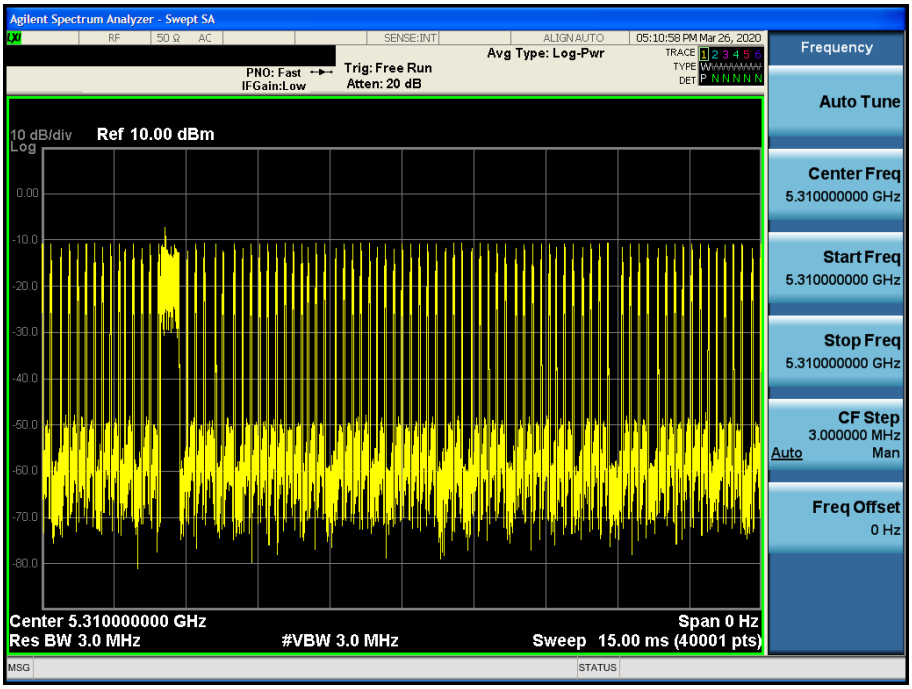


APPENDIX I

Channel loading

U-NII-2A: 5310 MHz

Timing plots: A minimum channel loading of approximately 17% or greater



- Spectrum Analyzer setting

1) Span: Zero

2) Sweep points: 40001

Calculation:

Channel loading = (Channel loading sweep points / Total sweep points) x 100

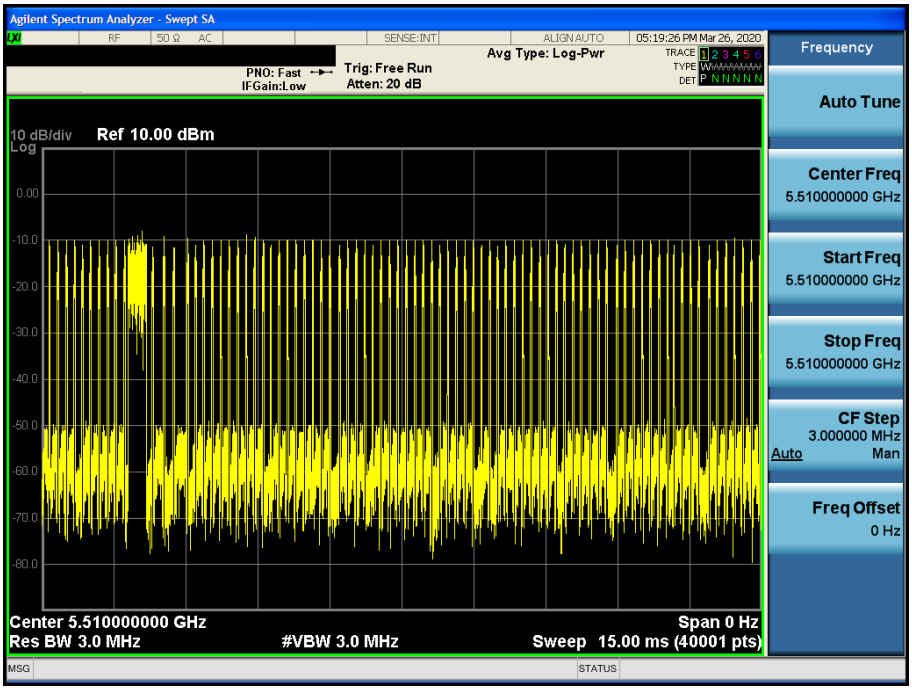
= (7883 / 40001) x 100 = 19.71 %

Note: The Channel loading sweep points were extracted from the spectrum and calculated.

Channel loading

U-NII-2C: 5510 MHz

Timing plots: A minimum channel loading of approximately 17% or greater



- Spectrum Analyzer setting

1) Span: Zero

2) Sweep points: **40001**

Calculation:

Channel loading = (Channel loading sweep points / Total sweep points) x 100
= (7998 / 40001) x 100 = 19.99 %

Note: The Channel loading sweep points were extracted from the spectrum and calculated.

