ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART E AND INDUSTRY CANADA RSS 247 REQUIREMENT DFS TEST REPORT

OF

FCC Applicant:	Honeywell International Inc. 9680 Old Bailes Road, Fort Mill, SC 29707, USA
IC Applicant:	Honeywell International Inc. 9680 Old Bailes Road, Fort Mill, SC 29707, USA
Product Name:	Vehicle Mount Computer
Brand Name:	Honeywell
Model No.:	VM1A-L0N
Model Difference:	N/A
FCC ID:	HD5-VM1AL0N
IC	1693B-VM1AL0N
Report No.:	ER/2018/90027
FCC Rule Part:	§15.407, Cat: NII
IC Rule Part:	RSS-247 issue 2 Feb. 2017
Issue Date:	Oct. 05, 2018
Date of Test:	Sep. 12, 2018 ~ Sep. 28, 2018
Date of EUT Received:	Sep. 04, 2018

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.
The test results of this report relate only to the tested sample identified in this report.

Tested By: Louis Chen

Louis Chen / Sr. Engineer

Approved By: CHUN-CHIEH CHEN

CHUN-CHIEH CHEN / Asst. Supervisor

Testing Laboratory
0513

Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
ER/2018/90027	Rev.00	Initial creation of document	All	Oct. 05, 2018	Elle Chang

Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Vehicle Mount Computer	
Brand Name:	Honeywell	
Model No.:	VM1A-L0N	
Model Difference:	N/A	
Product HW/SW version:	VM1AL0N / 85.00.00-0322	
Radio HW/SW version:	V1.0 / V5.1.1.28U	
Power Supply:	10.8Vdc from Rechargeable Li-ion Battery or 15Vdc from AC/DC Adapter.	
	Battery:	Model No.: 163176-0001 Rev C / OVT310L1R00 C, Supplier: TOTEX
	Adapter:	Model No.: GT-46600-6015-T3, Supplier: GlobTek, Inc.

Antenna Designation	Dipole Antenna, Supplier: LAIRD Model No.: WTS2450 5150~5250MHz Peak Gain: 2.6dBi 5250~5350MHz Peak Gain: 2.6dBi 5470~5725MHz Peak Gain: 2.6dBi 5725~5850MHz Peak Gain: 3.4dBi Dipole Antenna, Supplier: LARSEN Model No.: R380500314 5150~5250MHz Peak Gain: 5dBi 5250~5350MHz Peak Gain: 5dBi 5470~5725MHz Peak Gain: 5dBi 5725~5850MHz Peak Gain: 5dBi Printed Antenna, Supplier: N/A Model No.: N/A Chain0: 5150~5250MHz Peak Gain: 4.7dBi 5250~5350MHz Peak Gain: 4.6dBi 5470~5725MHz Peak Gain: 4.8dBi 5725~5850MHz Peak Gain: 4.7dBi Chain 1: 5150~5250MHz Peak Gain: 4.4dBi 5250~5350MHz Peak Gain: 4.7dBi

	5470~5725MHz Peak Gain: 4.9dBi 5725~5850MHz Peak Gain: 3.4dBi
Modulation type	64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 802.11ac only
Transition Rate:	802.11 a: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 144.4Mbps 802.11 n_40MHz: 13.5 - 300.0Mbps 802.11 ac_20MHz: 6.5 –144.4Mbps 802.11 ac_40MHz: 13.5 -300.0Mbps 802.11 ac_80MHz: 29.3 – 650Mbps

FCC WLAN 5GHz:

Wi-Fi	Frequency Range	Channels	Avg. Power (dBm)	Modulation Technology
11a	5150~5250	4	13.95	OFDM
	5250~5350	4	20.93	
	5470~5725	12	20.77	
	5725-5850	5	20.97	
11n_HT / ac_VHT 20M	5150~5250	4	HT: 13.81	OFDM
	5250~5350	4	HT: 20.92	
	5470~5725	12	HT: 20.77	
	5725-5850	5	HT: 21.15	
11n_HT / ac_VHT 40M	5150~5250	2	HT: 13.70	OFDM
	5250~5350	2	HT: 21.16	
	5470~5725	6	HT:21.07	
	5725-5850	2	HT: 21.27	
11ac VHT80M	5150~5250	1	13.21	OFDM
	5250~5350	1	9.25	
	5470~5725	2	20.56	
	5725-5850	1	20.05	

IC WLAN 5GHz:

Wi-Fi	Frequency Range	Channels	Avg. or EIRP	Rated Power(dBm) (Worst Case)	Modulation Technology
11a	5150~5250	4	EIRP	21.96	OFDM
	5250~5350	4	Avg.	20.93	
	5470~5725	12	Avg.	20.77	
	5725-5850	5	Avg.	20.97	
11n_HT / ac_VHT 20M	5150~5250	4	EIRP	HT: 21.82	OFDM
	5250~5350	4	Avg.	HT: 20.92	
	5470~5725	12	Avg.	HT: 20.77	
	5725-5850	5	Avg.	HT: 21.15	
11n_HT / ac_VHT 40M	5150~5250	2	EIRP	HT: 21.71	OFDM
	5250~5350	2	Avg.	HT: 21.16	
	5470~5725	6	Avg.	HT: 21.07	
	5725-5850	2	Avg.	HT: 21.27	
11ac VHT80M	5150~5250	1	EIRP	21.22	OFDM
	5250~5350	1	Avg.	9.25	
	5470~5725	2	Avg.	20.56	
	5725-5850	1	Avg.	20.05	

1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart E §15.407

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

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

RSS-247 issue 2 Feb. 2017

All test items have been performed and record as per the above standards.

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)

FCC Registration Numbers and Designation number are: 509634 / TW0001

Canada Registration Number: 4620A-4

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

2 SUMMARY OF TEST RESULT

FCC / IC Rules	Description Of Test	Result
§15.407(h) IC RSS-247 issue 2 §6.3	TPC and DFS Measurement	Compliant

3 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
TPC and DFS Measurement	+/- 123.36 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC=+/- 0.2%

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4 TPC AND DFS MEASUREMENT

4.1 TPC: Standard Applicable

According to §15.407(h)(1), Transmit power control (TPC). 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 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

4.1.1 Result: N/A, The output power is less than 500mW.

4.2 DFS: Standard Applicable

According to §15.407(h)(2) and FCC KDB 905462 D02 , Radar Detection Function of Dynamic Frequency Selection (DFS).

Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth 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. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is −64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is −62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

(A) The requirement for channel availability check time applies in the master operational mode.

(B) The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

(iii) Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

According to RSS 247 §6.3), Note: For the band 5600-5650 MHz, no operation is permitted. Until further notice, devices subject to this annex shall not be capable of transmitting in the band 5600-5650 MHz. This restriction is for the protection of Environment Canada weather radars operating in this band. Devices operating in the bands 5250-5350 MHz, 5470-5600 MHz and 5650-5725 MHz band shall comply with the following:

(a) Devices shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems (see Note below). The minimum DFS radar signal detection threshold is -62 dBm for devices with a maximum e.i.r.p. less than 200 mW, and -64 dBm for devices with a maximum e.i.r.p. of 200 mW to 1 W. The detection threshold power is the received power, averaged over a 1-microsecond reference to a 0 dBi antenna. The DFS process shall provide a uniform spreading of the loading over all the available channels.

Note: Test procedures for demonstrating compliance with the DFS radar detection requirements set out in this section are being evaluated by Industry Canada. As an interim measure, the Department will, until further notice, accept utilization of the DFS test procedures published by the U.S. Federal Communications Commission (FCC)3 to demonstrate compliance with the requirements of this section.

(b) Operational requirements: the requirement for channel availability check time applies in the master operational mode. The requirement for channel move time applies in both the master and slave operational modes.

(i) In-service monitoring: an LE-LAN device should be able to monitor the operating channel to check that a co-channel radar has not moved or started operation within range of the LE-LAN device.During in-service monitoring, the LE-LAN radar detection function continuously searches for radar signals between normal LE-LAN transmissions.

(ii) Channel availability check time: the device shall check if there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in A9.3 (a) above is detected within 60 seconds.

(iii) Channel move time: after a radar's signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds. Transmission during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. Intermittent management and control signals may also be sent during the remaining time to facilitate vacating the operating channel.

(iv)Channel closing time: the maximum channel closing time is 260 ms. (v) Non-occupancy period: a channel that has been flagged as containing a radar signal, either by a channel availability check or in-service monitoring, is subject to a 30-minute non-occupancy period where the channel cannot be used by the LE-LAN device. The non-occupancy period starts from the time that the radar signal is detected.

4.2.1 Limit

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	Operational Mode		
	Master	Client(without radar detection)	Client(with radar detection)
Non-occupancy Period	Yes	Not required	Yes
DFS Detection Thresh-old	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Cannel Closing Transmission time	Yes	Yes
Channel Move time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth mode	Master Device 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.		

Table 3: Interference Threshold values, Master or Client 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.	

Table 4: DFS Response requirement values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 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.

Table 5: Radar Test Waveforms

Short Pulse Radar

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 $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot10^6}{PRI_{\mu sec}}\right)\right\}$	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.					

Long Pulse Radar

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

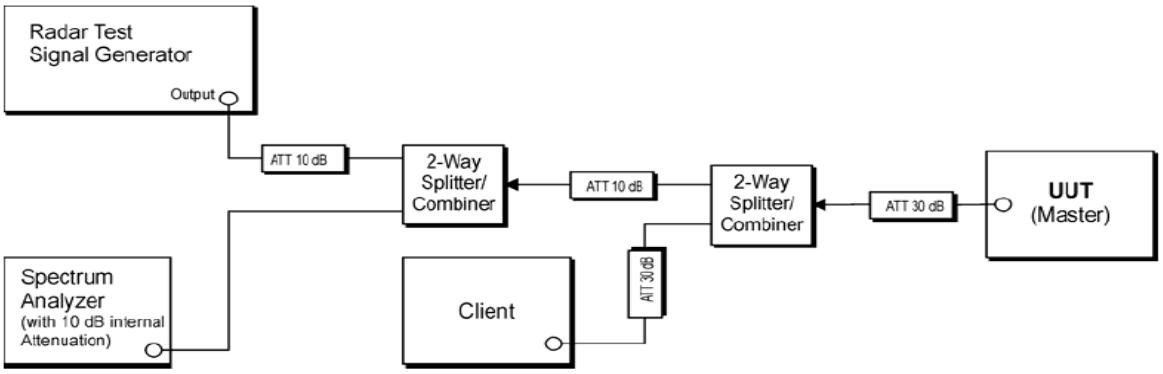
Frequency Hopping Radar

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

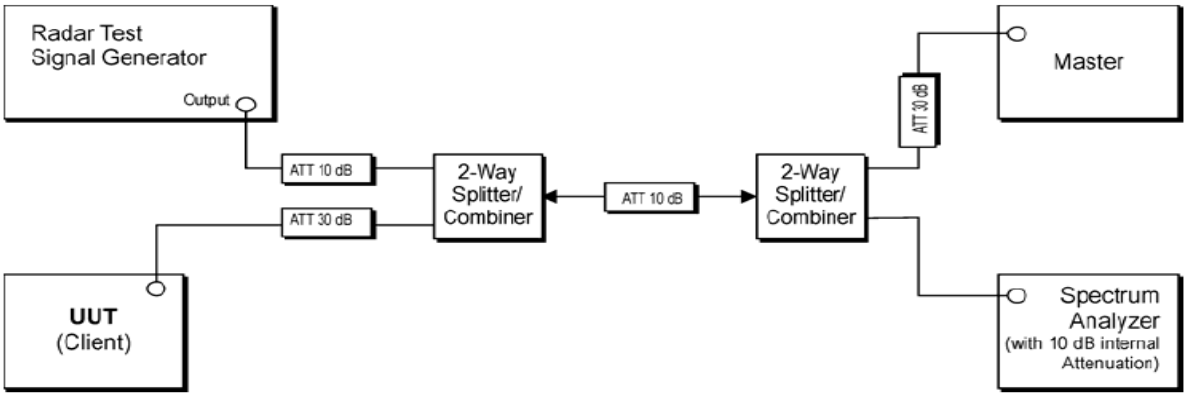
The applicant of this given application confirms that information regarding the parameters of the detected Radar Waveforms is not available to the end user.

4.2.2 Test Setup

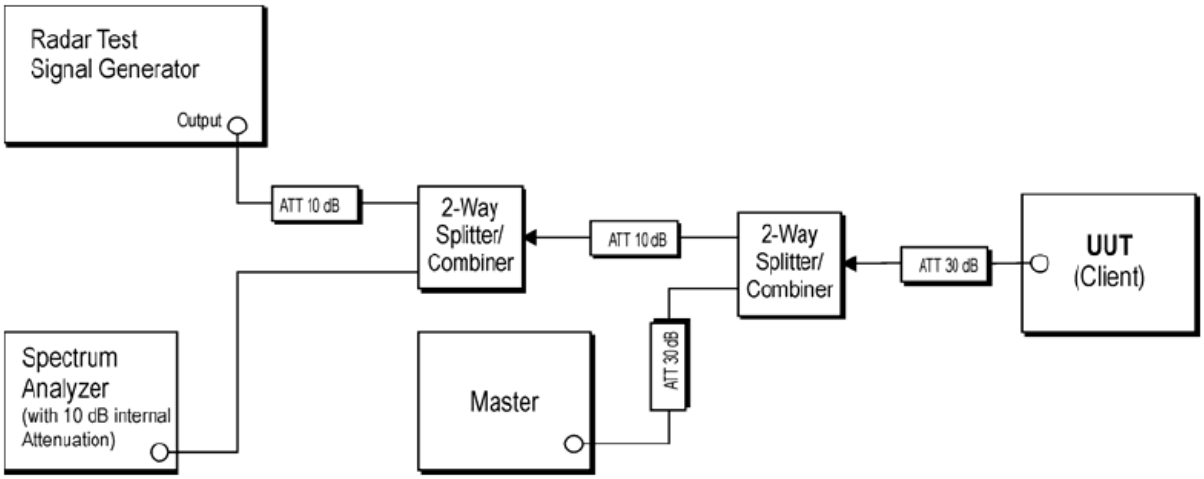
Setup for Master with injection at the Master



Setup for Client with injection at the Master



Setup for Client with injection at the Client



4.2.3 Test Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	2018/04/09	2019/04/08
Signal Generator	Agilent	N5172B	MY53050661	2018/04/05	2019/04/04
Power Splitter	Mini-Circuits	ZN2PD-9G-S+	N/A	2018/01/02	2019/01/01
Power Splitter	Mini-Circuits	ZN2PD-9G-S+	N/A	2018/01/02	2019/01/01
Attenuator	Agilent	8495B	3308A22470	2018/01/02	2019/01/01
Attenuator	HP	8494B	2812A170605	2018/01/02	2019/01/01
Notebook	Lenovo	T440P	P0000564	N/A	N/A
Accece Ponit	Cisco	AIR-LAP1262N-A-K9	FTX1605E1G1 FCC ID:LDK102073	N/A	N/A

4.2.4 Description of EUT:

EUT operates over the 5250-5350MHz and 5470-5725MHz ranges and EUT is a slave device (client equipment) w/o radar detection and DFS capability.

EUT has no TPC mechanism implemented with no adjustment of lowest, and highest power, but the level of power emission stays at fixed level.

WLAN traffic is generated by streaming the mpeg file from the master to slave in full monitor video mode using the media player.

The rated output power of the master unit is >23dBm(EIRP).therefore the required interference threshold level is -64dBm.after correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is -64dBm, and the master device as employed for the applicable DFS test is CISCO router whose FCC ID= LDK102061

While calibrate the path on antenna port of DFS test equipment (master), measurements equipments (spectrum) is ensured to be 50 Ohms, and therefore verification on antenna gain measurement can be ignored.

Conducted test was performed with appropriate adjustment, and calibration to ensure power from DFS simulator injects to antenna port of DFS test equipment (DFS) is -64dBm

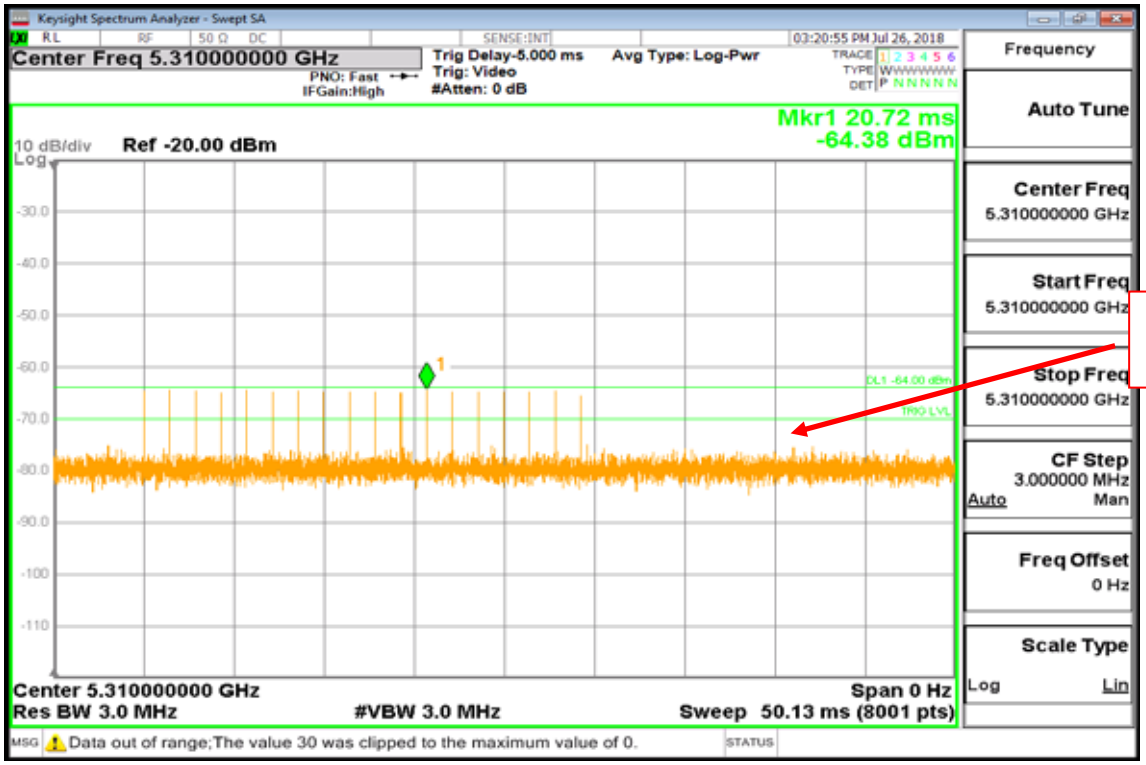
Message or files that is used for communication between Master and Client:

IP based system:

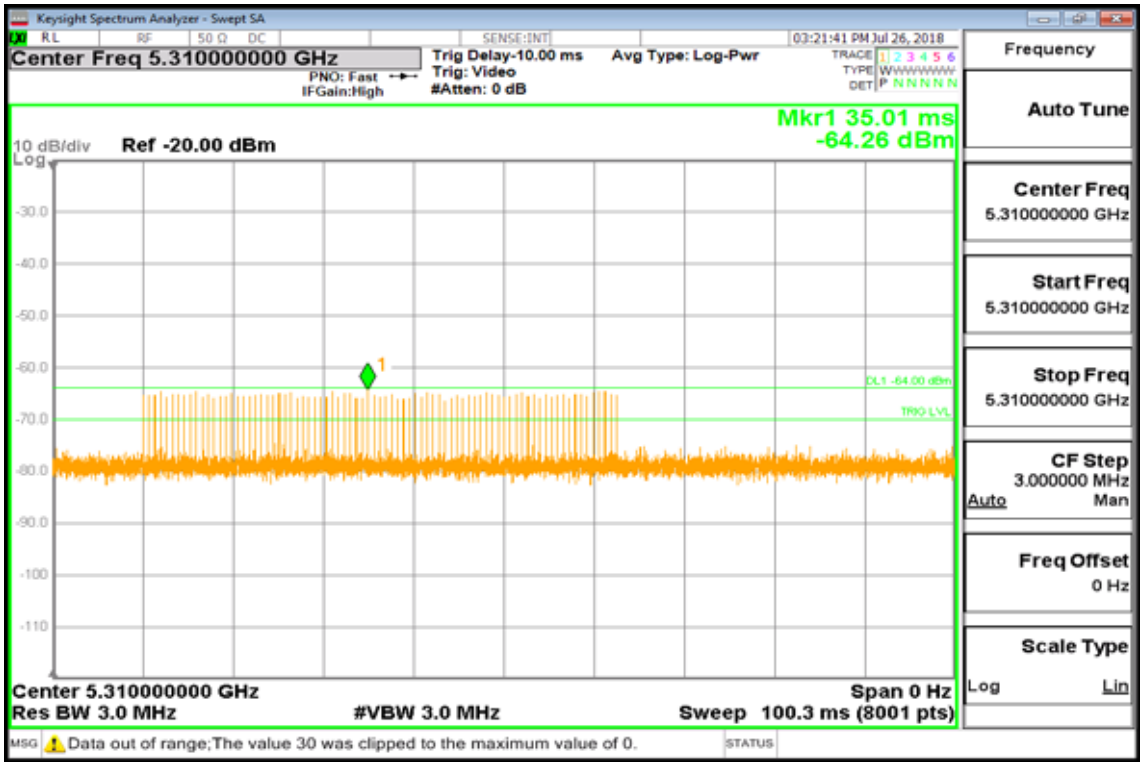
For the required channel loading, the full motion, 30 frames per second MPEG video file from http://ntiacsd.ntia.doc.gov/dfs/ was streamed from a network on a test bench (server of the storage to download the mandatory format of Video file), via the DFS Master device, to the UE (mobile phone).

4.2.5 Test results

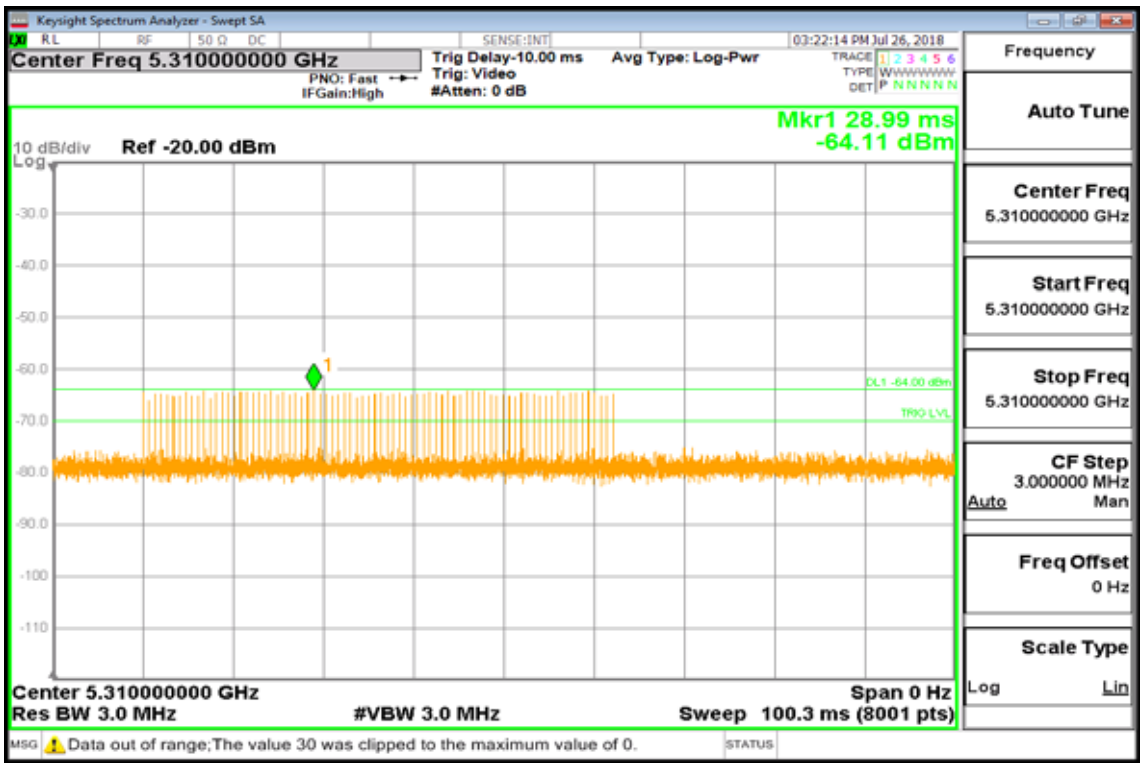
Calibration plots for each of the required radar waveforms
5310
Radar type 0



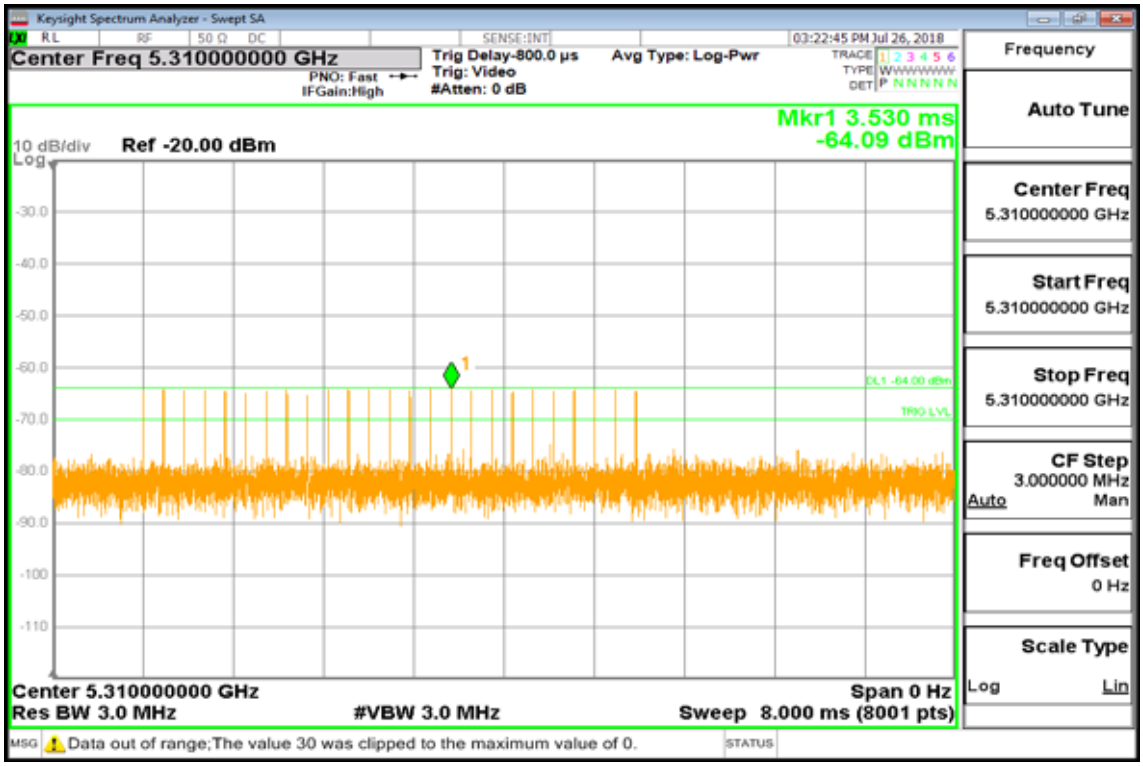
Radar type 1 A



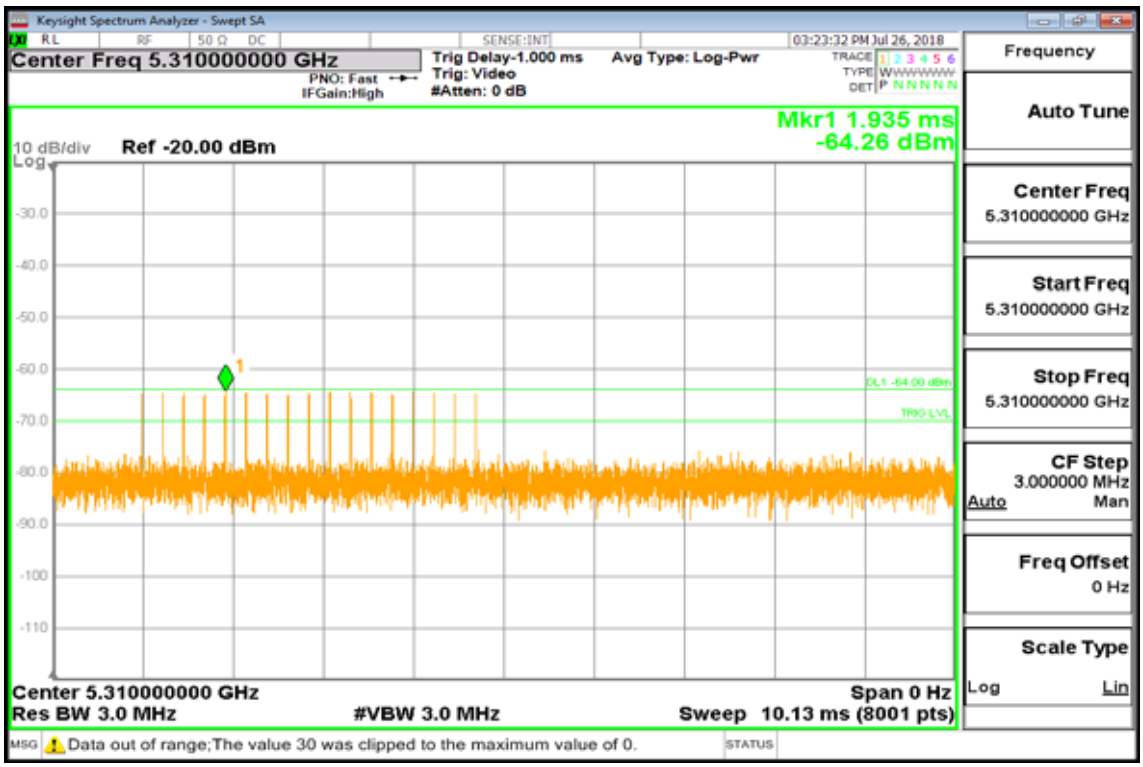
Radar type 1 B



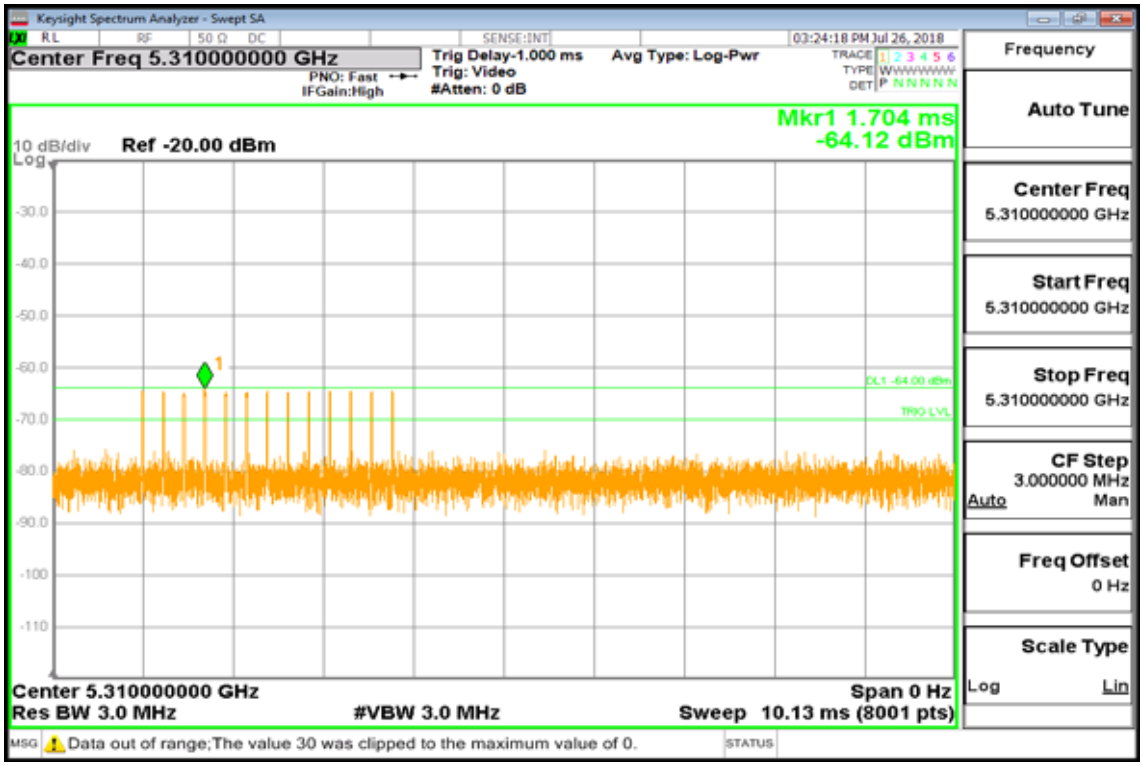
Radar type 2



Radar type 3

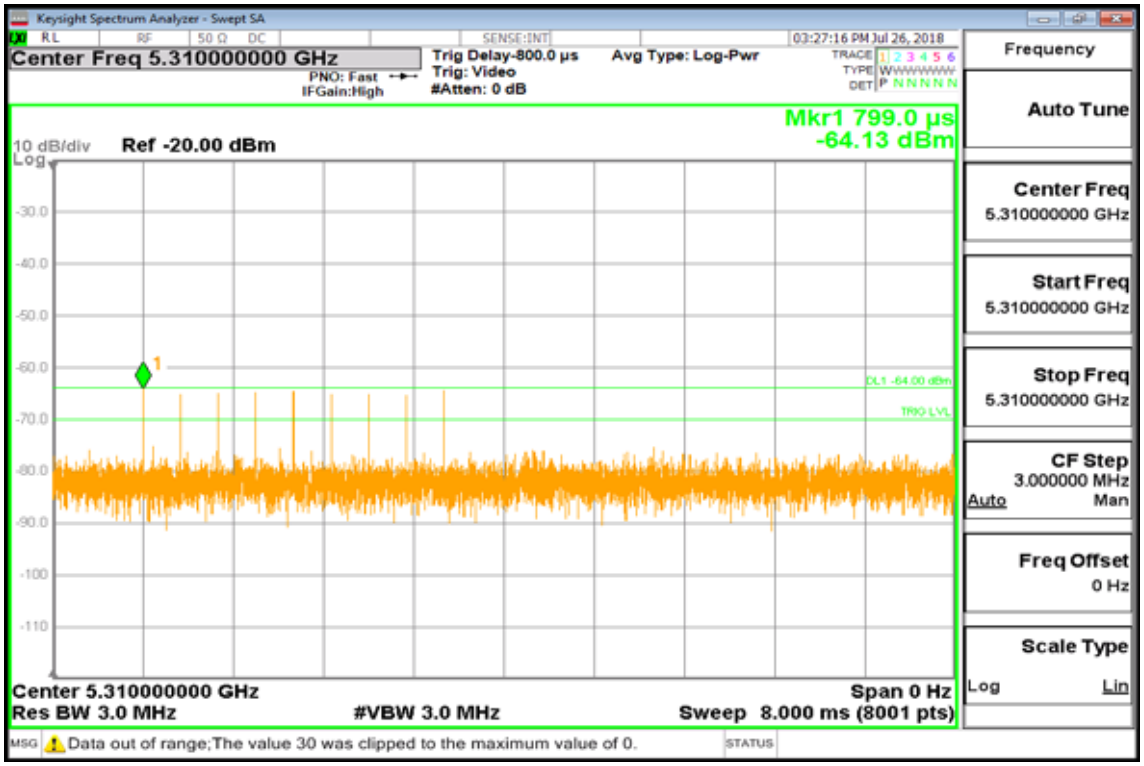


Radar type 4

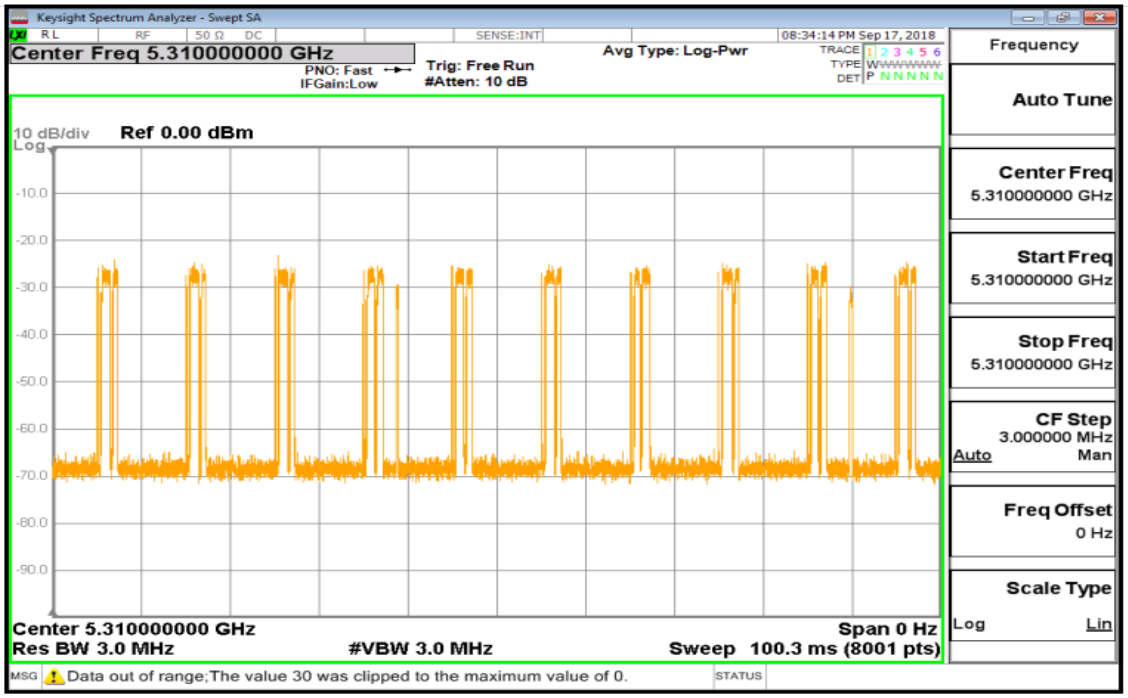


Radar type 5

Radar type 6



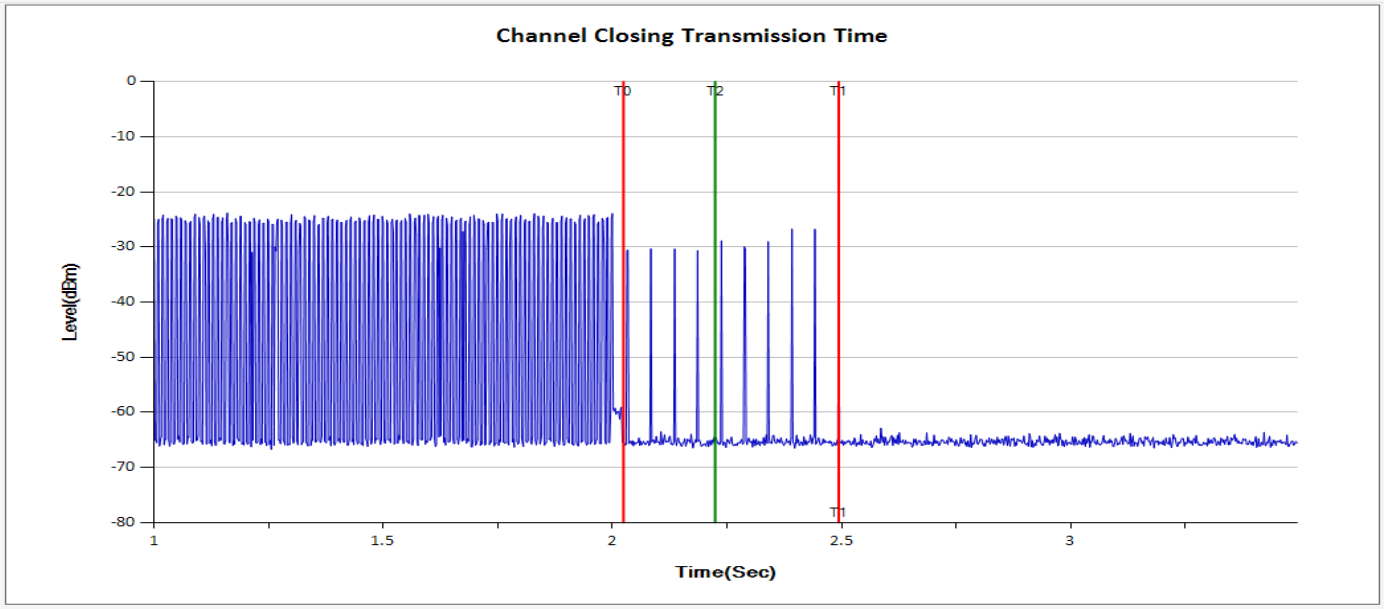
WLAN traffic



Duty Cycle: 17.54781 %

** The Channel Loading must be more than 17%*

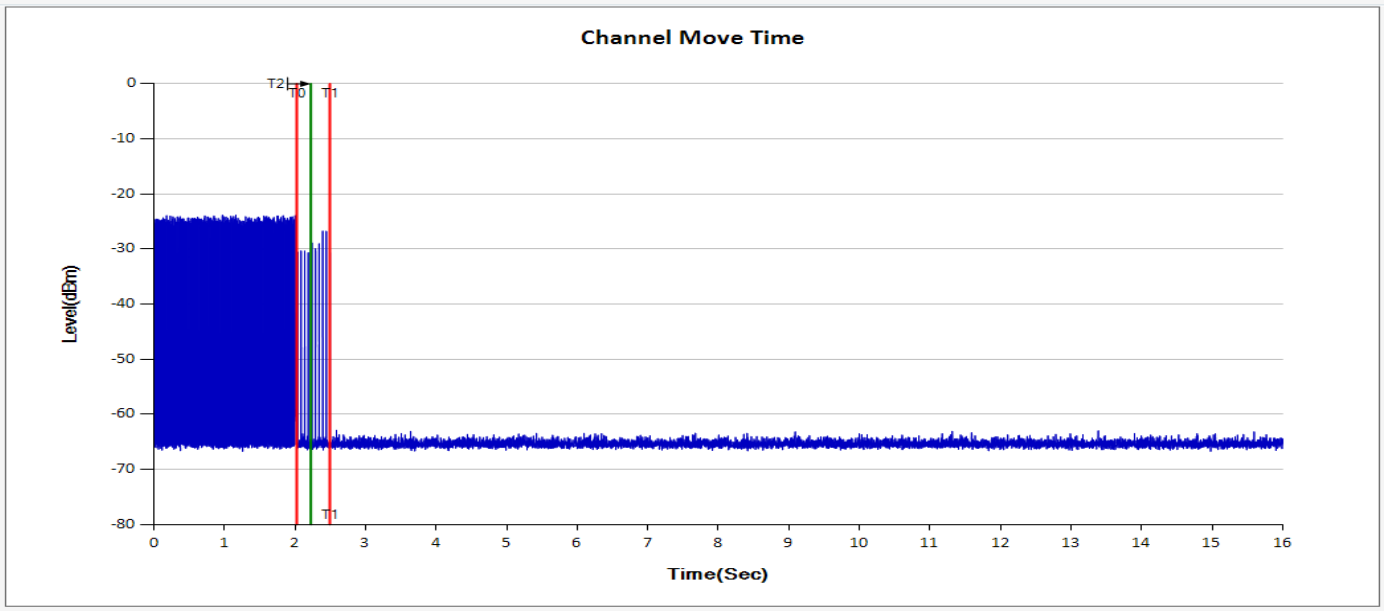
Radar Type 1 Channel Move and Closing Transmission Time - 1



T0: 2.02428 Sec(Radar Injection)
T1: 2.494 Sec(Eut Move Time)
T2: 2.22428 Sec(200ms Interval)

Channel Move Time: 0.47 Sec
Channel Closing Transmission Time: 0.012 Sec

Radar Type 1 Channel Move and Closing Transmission Time - 2

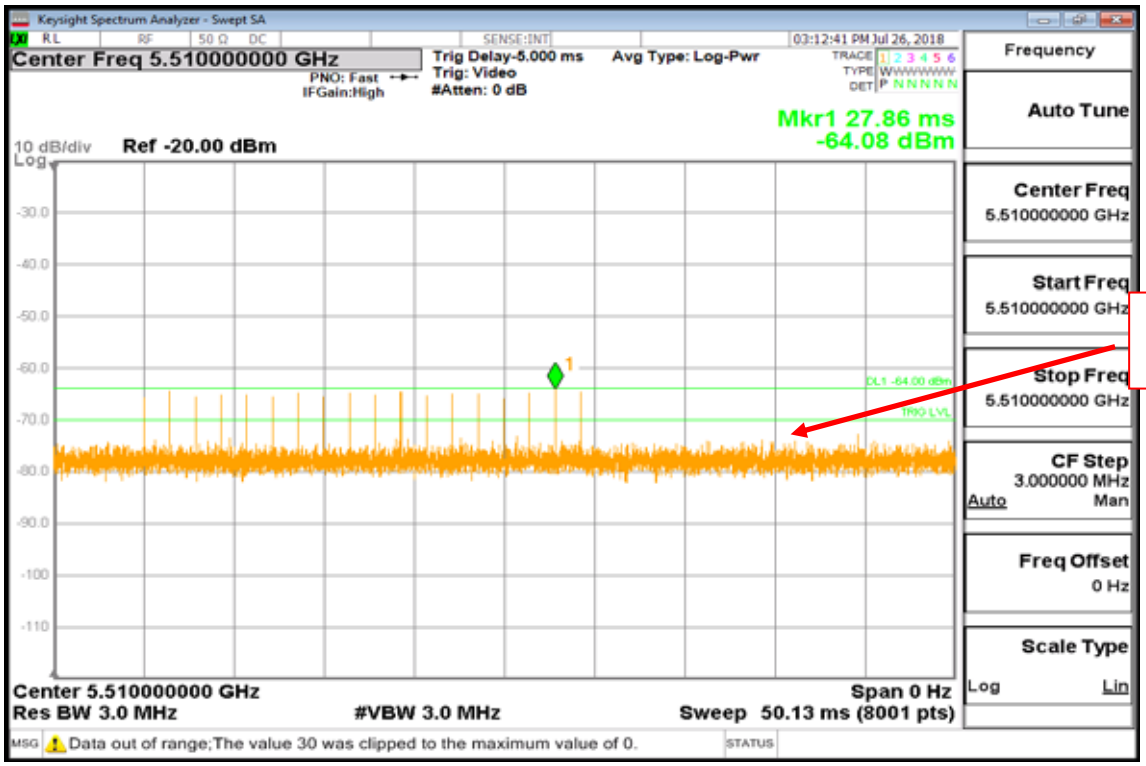


T0: 2.02428 Sec(Radar Injection)
T1: 2.494 Sec(Eut Move Time)
T2: 2.22428 Sec(200ms Interval)

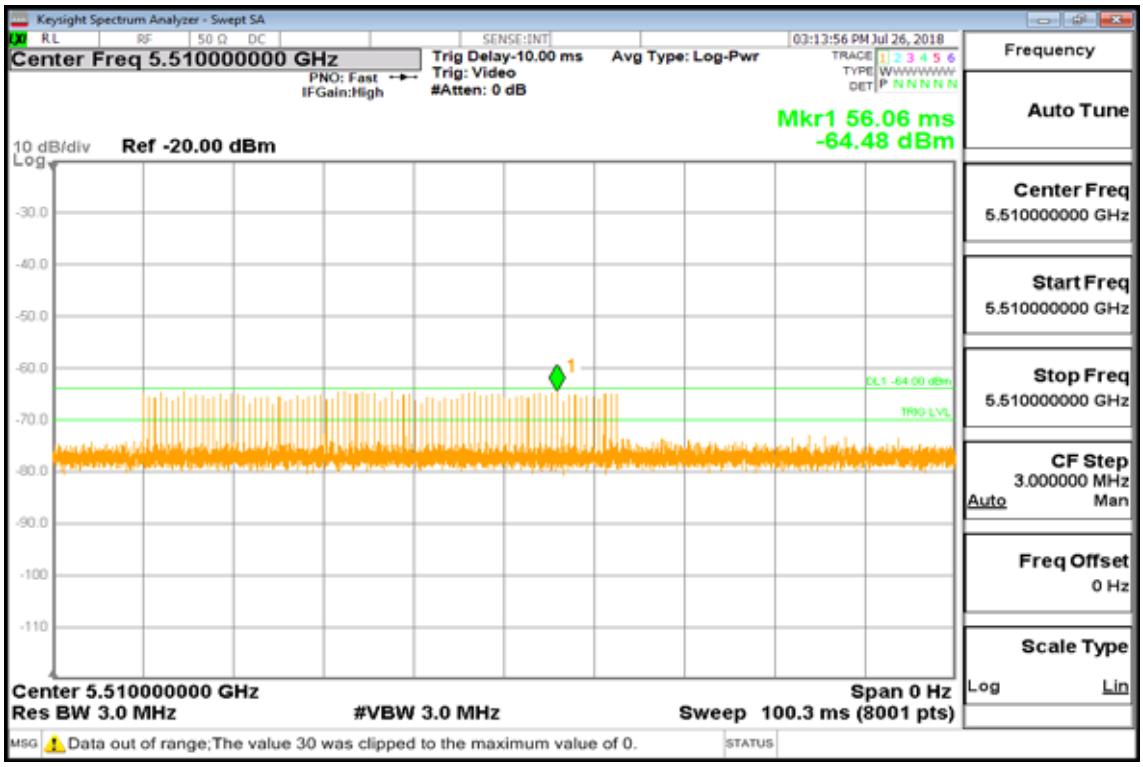
Channel Move Time: 0.47 Sec
Channel Closing Transmission Time: 0.012 Sec

Verdict: *Note: narrowing the sweep time as the good engineering process for the verification of transmission closing in 200ms*

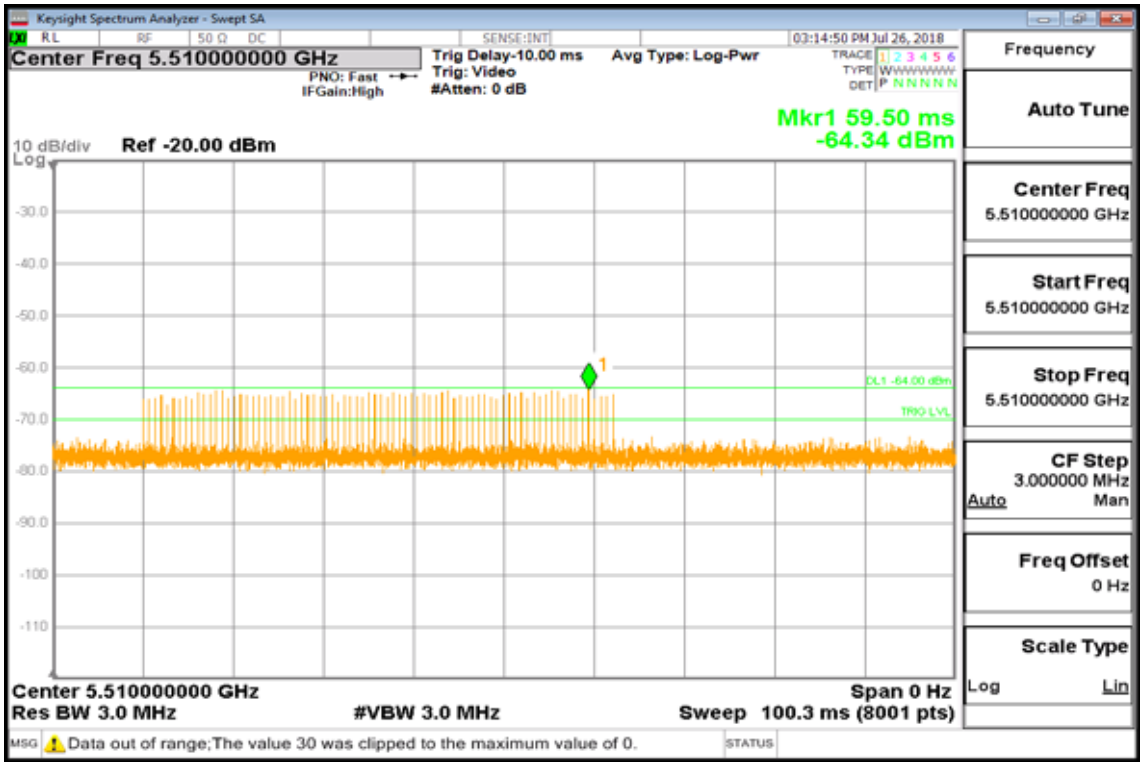
5510
Radar type 0



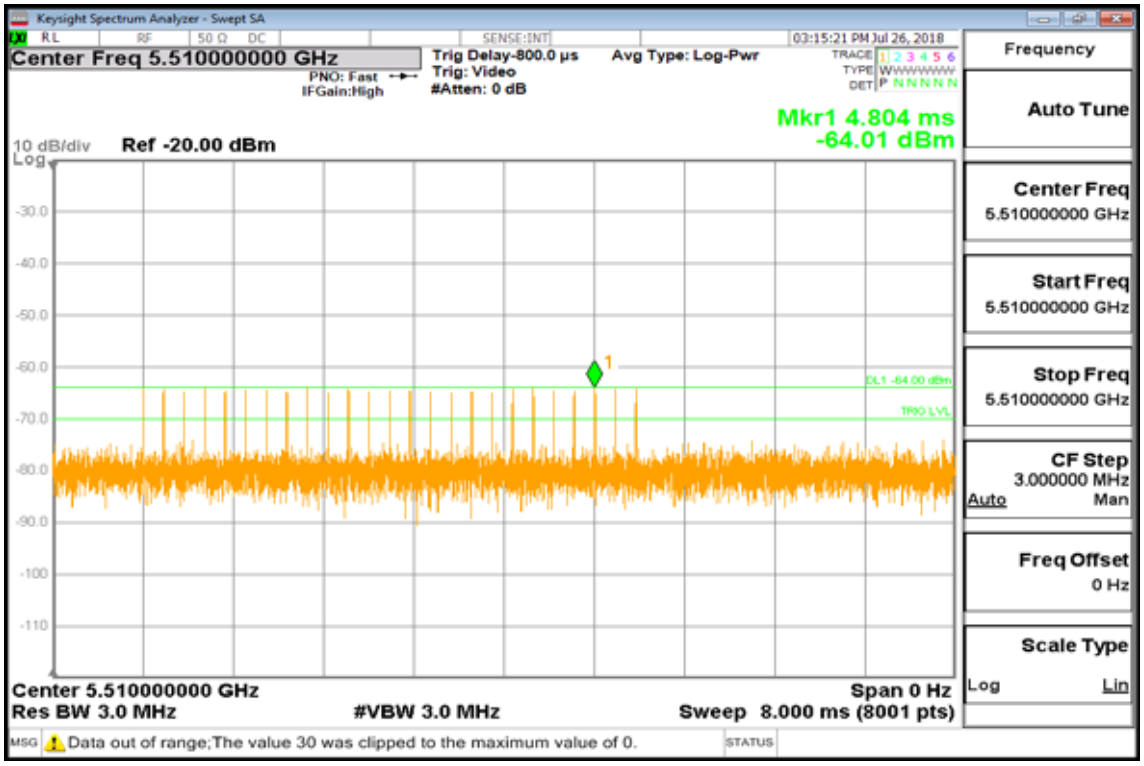
Radar type 1 A



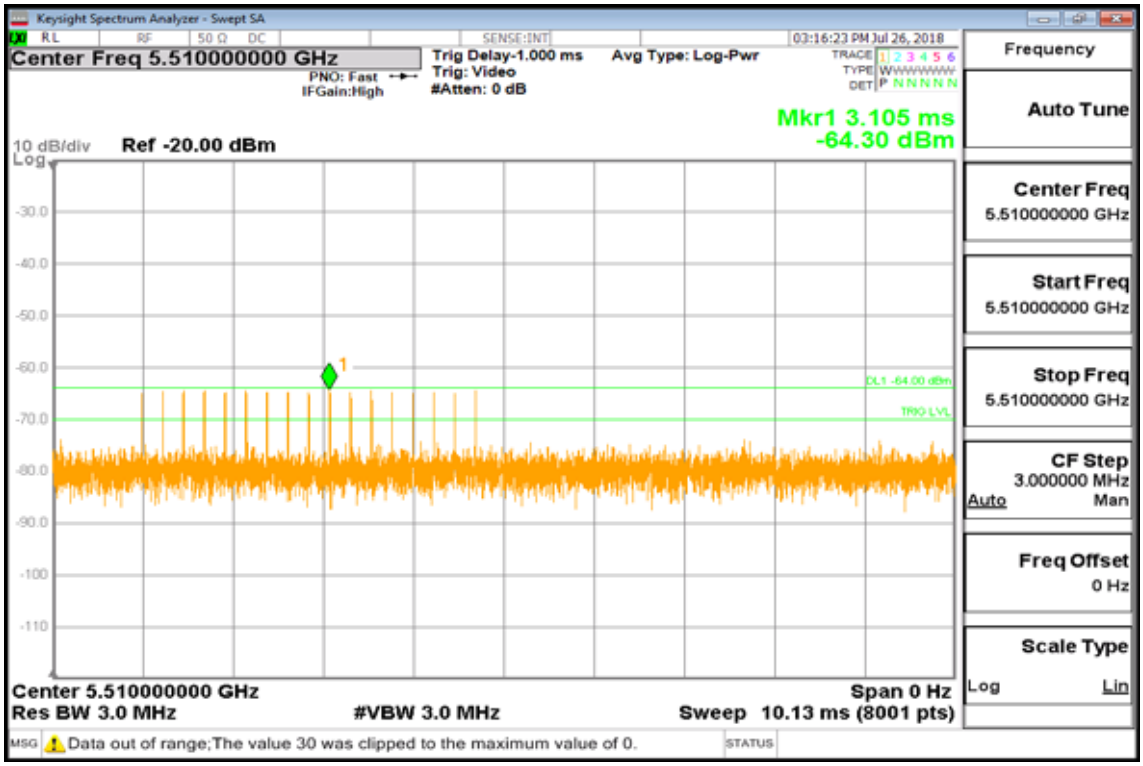
Radar type 1 B



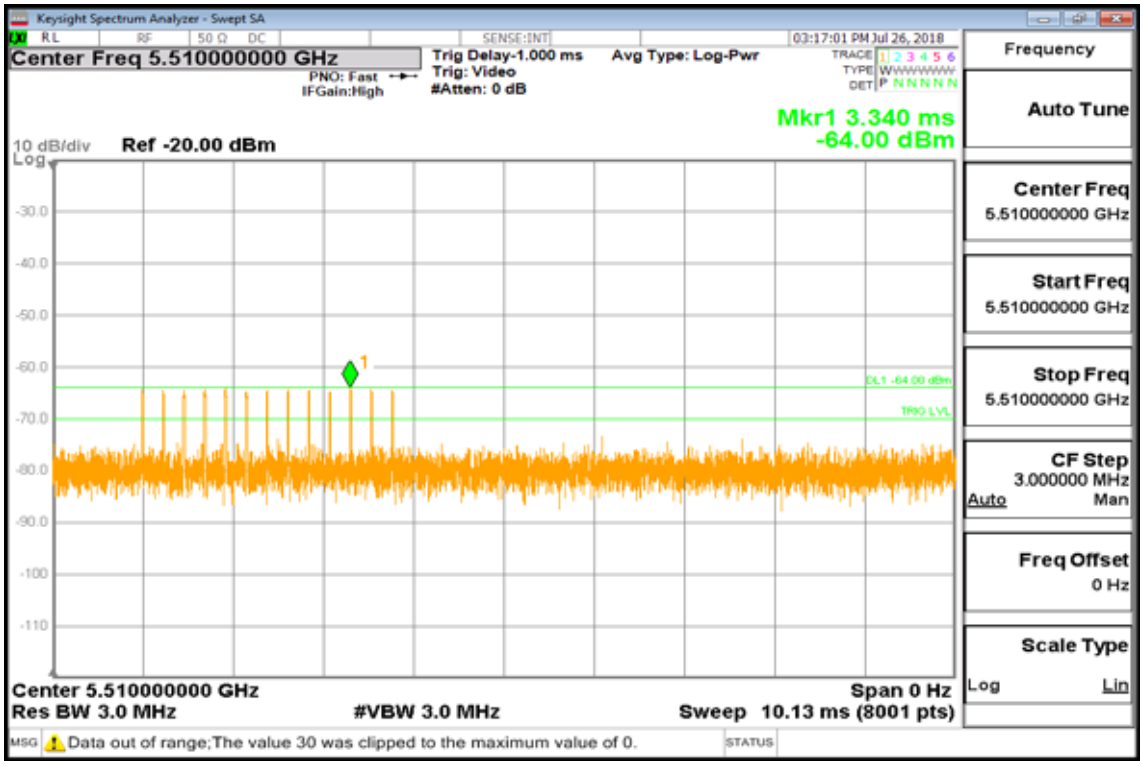
Radar type 2



Radar type 3

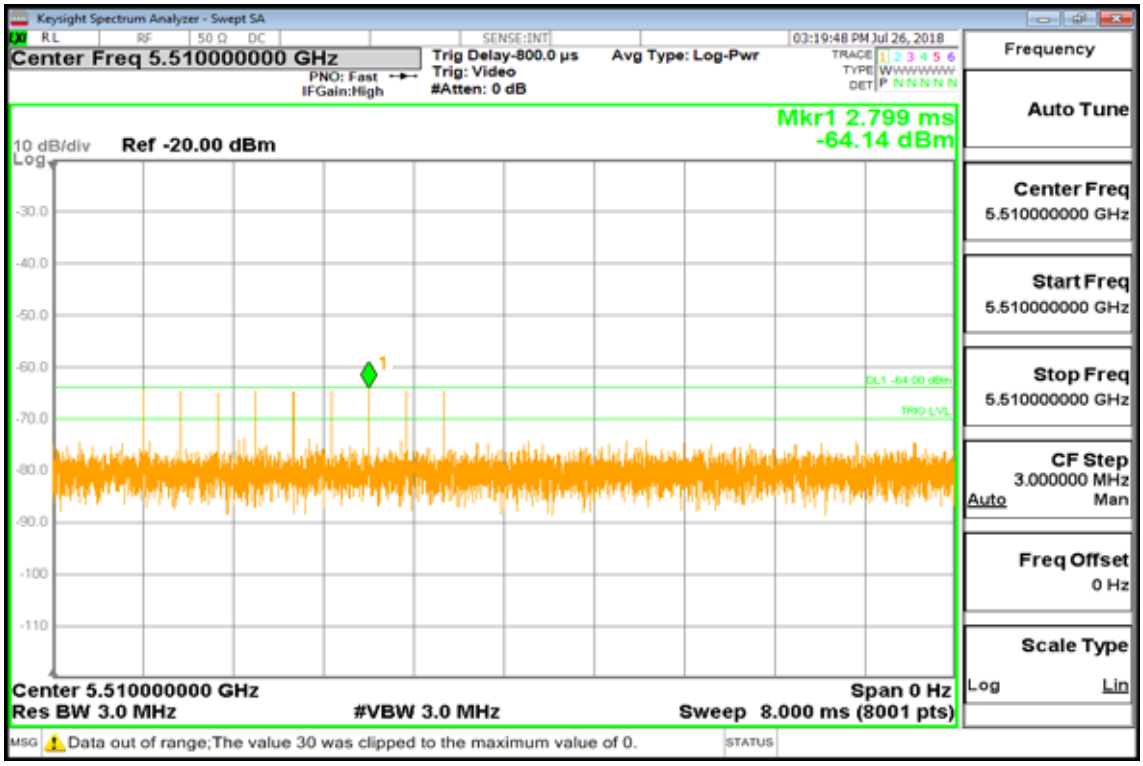


Radar type 4

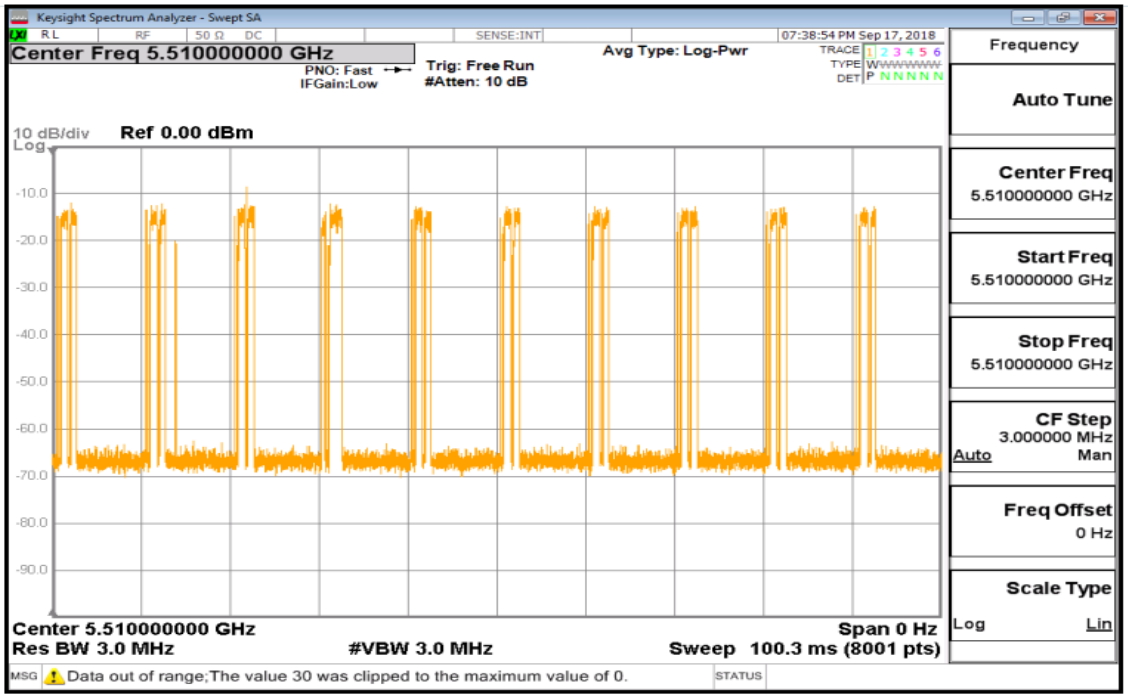


Radar type 5

Radar type 6



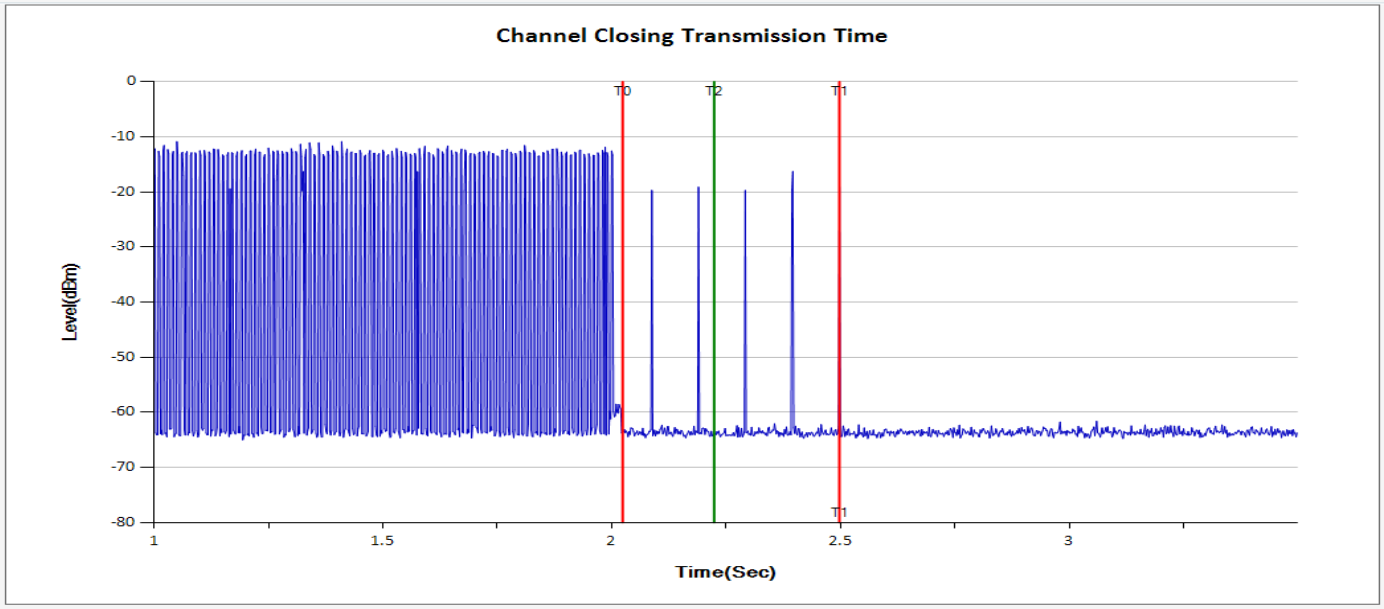
WLAN traffic



Duty Cycle: 17.17285 %

** The Channel Loading must be more than 17%*

Radar Type 1 Channel Move and Closing Transmission Time - 1

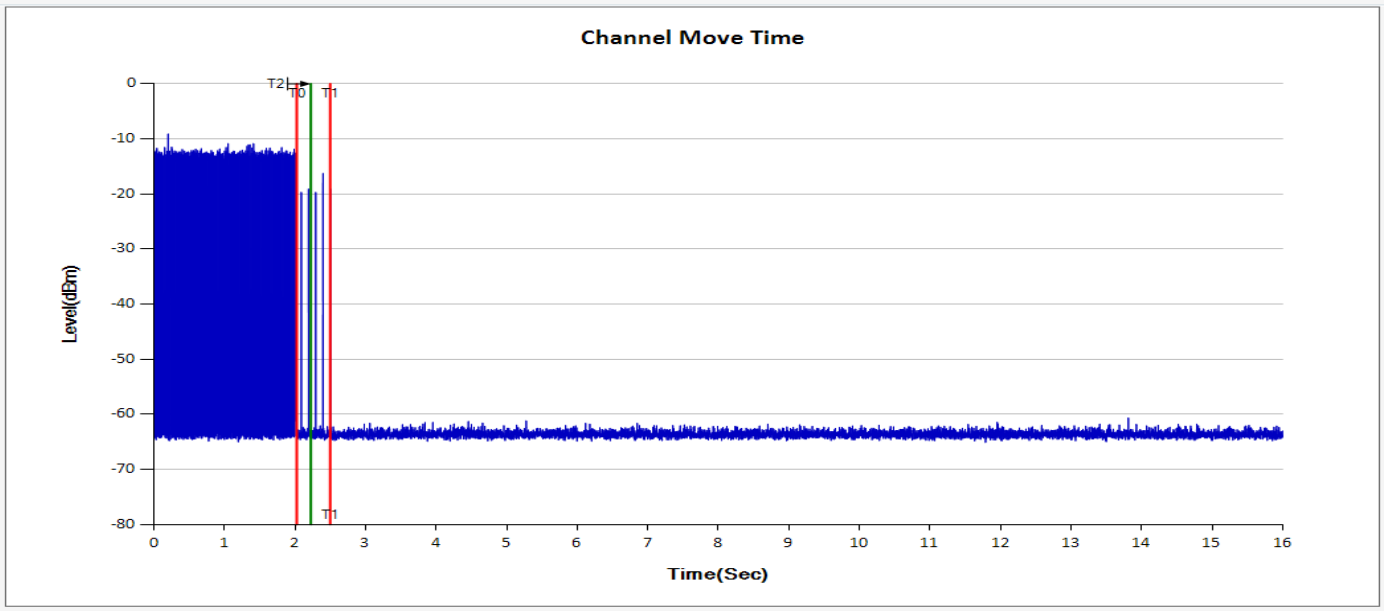


T0: 2.02428 Sec(Radar Injection)
T1: 2.498 Sec(Eut Move Time)
T2: 2.22428 Sec(200ms Interval)

Channel Move Time: 0.474 Sec

Channel Closing Transmission Time: 0.006 Sec

Radar Type 1 Channel Move and Closing Transmission Time - 2



T0: 2.02428 Sec(Radar Injection)
T1: 2.498 Sec(Eut Move Time)
T2: 2.22428 Sec(200ms Interval)

Channel Move Time: 0.474 Sec

Channel Closing Transmission Time: 0.006 Sec

Verdict: *Note: narrowing the sweep time as the good engineering process for the verification of transmission closing in 200ms*

Non-occupancy Period (without radar detection)

Verdict: *To verify whether channel is unavailable to be operated in 30 minutes.*

1.8ks = 1800s = 1800 s/min /60 = 30minute

~ End of Report ~