RF TEST REPORT

FCC / ISED

DFS

APPLICANT

Owl Labs Inc.

MODEL NAME

MTW405

FCC ID

2ALXJ-MTW405

ISED ID

22676-MTW405

REPORT NUMBER

HA240429-OWL-001-R16

TEST REPORT

Date of Issue
June 7, 2022

Test Site
Hyundai C-Tech, Inc. dba HCT America, Inc.
1726 Ringwood Ave, San Jose, CA 95131, USA

Applicant	Owl Labs Inc.
Applicant Address	33-1/2 Union Square Somerville, MA 02143 U.S.A.
FCC ID	2ALXJ-MTW405
ISED ID	22676-MTW405
Model Name	MTW405
EUT Type	360-Degree Video Conferencing Platform
Modulation Type	OFDM / OFDM-A
FCC Classification	Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s)	Part 15.407
ISED Rule Part(s)	RSS-247 Issue 3 (August 2023) RSS-Gen Issue 5 Amd 2 (February 2021)
Test Procedure	KDB 905462 D02 v02

The device bearing the trade name and model specified above, has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures required. The results of testing in this report apply only to the product which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Hyundai C-Tech, Inc. dba HCT America, Inc. certifies that no party to application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C 862

Tested By

John Park

Test Engineer

Reviewed By

Yongsoo Park

Technical Manager

REVISION HISTORY

The revision history for this document is shown in table.

TEST REPORT NO.	DATE	DESCRIPTION
HA240429-OWL-001-R16	June 7, 2024	Initial Issue

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Hyundai C-Tech, Inc. dba HCT America, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA. TEL: +1-510-933-8848 FAX: +1-510-933-8849

1. GENERAL INFORMATION

EUT DESCRIPTION

Model	MTW405
EUT Type	Meeting Owl 4+
Serial Number	M4FV13240031
Power Supply	20 V d.c. (USB type C - External adaptor)
RF Specification	WIFI 2.4 GHz : 802.11b/g/ n(HT20, HT40)/ ac(VHT20, VHT40)/ ax(HE20, HE40) WIFI 5 GHz : 802.11a/n(HT20/40)/ ac(VHT20/40/80)/ ax(HE20, HE40, HE80) Bluetooth 5.0 LE (1M / BR / EDR)
Transmitter Chain	WIFI 2.4 GHz / 5 GHz : 2x2 MIMO Bluetooth LE / Bluetooth BR/EDR : SISO
Operating Environment	Indoor
Operating Temperature	5 °C ~ +30 °C

RF SPECIFICATION SUBJECT TO THE REPORT

RF Specification	802.11a / 802.11n HT20 / 802.11ac VHT20 / 802.11ax HE20 802.11n HT40 / 802.11ac VHT40 / 802.11ax HE40 802.11ac VHT80 / 802.11ax HE80	
Frequency Range [1)]	U-NII 2a	20 MHz BW : 5260 MHz – 5320 MHz 40 MHz BW : 5270 MHz – 5310 MHz 80 MHz BW : 5290 MHz
	U-NII 2c	20 MHz BW : 5500 MHz – 5720 MHz (Straddle at 5720 MHz) 40 MHz BW : 5510 MHz – 5710 MHz (Straddle at 5710 MHz) 80 MHz BW : 5530 MHz – 5690 MHz (Straddle at 5690 MHz)
Modulation Type	OFDM / OFDM-A	
Operating Modes	☐ Master	
	☐ Mesh	
	☐ Slave with radar detection	
	☒ Slave without radar detection	
TPC Feature [2)]	☒ TPC function	☐ No TPC function
Antenna Specification [3)]	ANT1	Antenna Type : PCB Antenna Antenna Model : CU23001-1 Antenna Brand: antenova Peak Gain : 3.8 dBi
	ANT2	Antenna Type : PCB Antenna Antenna Model : CU23002-1 Antenna Brand: antenova Peak Gain : 3.2 dBi
Firmware Version [4)]	6.4.21.22	
Hardware Version [4)]	OWL-900-00027 Rev 5	
Date(s) of Tests	June 2, 2024	

Note :

1. The device cannot operate in the frequency range 5600 – 5650 MHz in Canada
2. The EUT employs the TPC mechanism having the capability to operate at least 6 dB below the highest RF output.
3. Antenna information is based on the document provided.
4. Firmware and Hardware Version are as received by the client.

ANTENNA CONFIGURATION

The device employs 2x2 MIMO technologies with possible configurations below.

Frequency	Configuration	SDM	Beamforming	CDD
		ANT1 + ANT2	ANT1 + ANT2	ANT1 + ANT2
2.4 GHz	802.11b	-	-	O
	802.11g	-	-	O
	802.11n	O	-	O
	802.11ac	O	O	O
	802.11ax	O	O	O
5 GHz	802.11a	-	-	O
	802.11n	O	-	O
	802.11ac	O	O	O
	802.11ax	O	O	O

The equipment under test supports Cyclic Diversity mode.
CDD mode was picked as worst case for testing even though the device support both CDD and SDM, Beamforming.

ANTENNA DIRECTIONAL GAIN

Antenna Type	Type	RF Technology	Frequency	Gain (Ant 1)	Gain (Ant 2)
PCB	Dipole	802.11b/g/n	2.4 GHz	2.90 dBi	2.90 dBi
PCB	Dipole	802.11a/n/ac	5 GHz	3.80 dBi	3.20 dBi

Directional Gain (2.4 GHz : Uncorrelated) = 10 log[($10^{(2.90/10)}$+$10^{(2.90/10)}$) / 2] = 2.90 dBi
Directional Gain (5 GHz : Uncorrelated) = 10 log[($10^{(3.80/10)}$+$10^{(3.20/10)}$) / 2] = 3.51 dBi

Directional Gain (2.4 GHz : Correlated) = 10 log[($10^{(2.90/20)}$+$10^{(2.90/20)}$)^2 / 2] = 5.91 dBi
Directional Gain (5 GHz : Correlated) = 10 log[($10^{(3.80/20)}$+$10^{(3.20/20)}$)^2 / 2] = 6.52 dBi

Beamforming Directional Gain (2.4 GHz) = 2.90 dBi + 10 log(2) = 5.91 dBi
Beamforming Directional Gain (5 GHz) = 3.51 dBi + 10 log(2) = 6.52 dBi

2. METHODOLOGY

The measurement procedure described in FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 dated April 8, 2016 entitled “Compliance Measurement Procedure for Unlicensed-National Information Infrastructure Devices Operating in the 5250 – 5350 MHz and 5470 – 5725 MHz Bands incorporating Dynamic Frequency Selection” was used in the measurement.

DESCRIPTION OF TEST MODES

For all testing, normal mode was used to verify compliance

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.407 under the FCC Rules Part 15 Subpart E. / RSS-247 issue 2.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment’s, which is traceable to recognized national standards. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, California 95131, USA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Accredited Laboratory

A2LA has accredited

HYUNDAI C-TECH, INC.
DBA HCT AMERICA, INC.
San Jose, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 17th day of July 2023.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4201.01
Valid to July 31, 2025

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5. TECHNICAL REQUIREMENT AND PARAMETERS FOR DFS TEST

5.1. Applicability of DFS Requirements

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

Requirement	Operational mode		
	Master	Client without Radar Detection	Client with Radar Detection
Non-Occupancy Period	O	Not required	O
DFS Detection Threshold	O	Not required	O
Channel Availability Check Time	O	Not required	Not required
U-NII Detection Bandwidth	O	Not required	O

Table 2 : Applicability of DFS Requirement during Normal Operation

Requirement	Operational mode	
	Master Device or Client with Radar Detection	Client without Radar Detection
Non-Occupancy Period	O	Not required
DFS Detection Threshold	O	Not required
Channel Availability Check Time	O	Not required
U-NII Detection Bandwidth	O	Not required

Additional Requirement for Devices with Multiple Bandwidth Modes	Master Device or Client with Radar Detection	Client without Radar Detection
U-NII Detection Bandwidth	All BW modes must be tested	Not required
Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time / Channel Closing Transmission Time	Widest BW mode available	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.

5.2. DFS Detection Thresholds

Table 3 : DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

Maximum Transmit Power	Value (See. Note 1,2, and 3)
EIRP ≥ 200 mW	-64 dBm
EIRP < 200 mW and Power Spectral Density < 10 dBm/MHz	-62 dBm
EIRP < 200 mW and Power Spectral Density > 10 dBm/MHz	-64 dBm

Note 1 : This is the level at the input of the receiver assuming a 0 dBi receive antenna.

Note 2 : Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.

Note 3 : EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01

5.3. Response Requirement

Table 4 : DFS Response Requirement Values

Parameter	Value
Non-Occupancy Period	> 30 min
Channel Availability Check Time	> 60 sec
Channel Move Time	< 10 sec (See Note 1)
Channel Closing Transmission Time	< 200 ms + aggregate of 60 ms over remaining 10 s period (See Note 1 and 2)
U-NII Detection Bandwidth	> 100 % of U-NII 99 % Tx Power Bandwidth

Note 1 : Channel Move Time and the Channel Closing Transmission Time should be performed with the 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.

6. RADAR TEST WAVEFORMS

6.1. Short Pulse Radar Test Waveforms

Table 5 : Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (us)	PRI (us)	No of Pulses	Minimum % of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	TEST A (See Note 2) TEST B (See Note 3)	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	60 %	30
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 Type 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.
Note 2 : TEST A : 15 unique PRI values randomly selected from the list of 23 PRI in Table 5a
Note 3 : TEST B : 15 unique PRI values randomly selected with the range of 519 – 3066 us with a minimum increment of 1 us, excluding PRI values selected in TEST A

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.

Table 5a : Pulse Repetition Interval Values for TEST A

PRF Number	PRF (Pulse/Sec)	PRI (us)	PRF Number	PRF (Pulse/Sec)	PRI (us)
1	1930.5	518	13	1319.3	758
2	1858.7	538	14	1285.3	778
3	1792.1	558	15	1253.1	798
4	1730.1	578	16	1222.5	818
5	1672.2	598	17	1193.3	838
6	1618.1	618	18	1165.6	858
7	1567.4	638	19	1139	878
8	1519.8	658	20	1113.6	898
9	1474.9	678	21	1089.3	918
10	1432.7	698	22	1066.1	938
11	1392.8	718	23	326.2	3066
12	1355	738			

6.2. Long Pulse Radar Test Waveforms

Table 6 : Long Pulse Radar Test Waveform

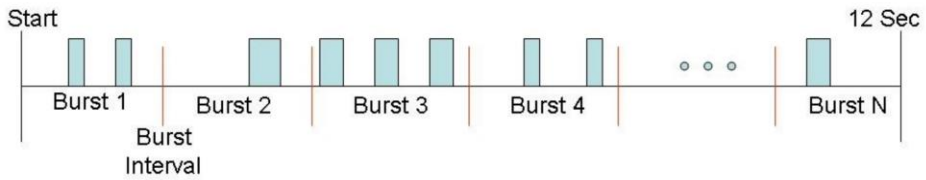
Radar Type	Pulse Width (us)	Chirp Width (MHz)	PRI (us)	Number of Pulses	Number of Bursts	Minimum % of Successful Detection	Minimum Number of Trials
5	50 – 100	5 – 20	1000 – 2000	1 – 3	8 – 20	80 %	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used for the Long Pulse Radar Type waveforms, 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 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 random time interval between the first and second pulses is chosen independently of the random time interval 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 randomly.

Representative Example of Radar Waveform :



Total test signal length	12 sec
Number of Bursts	Randomly generated between 8 – 20 for the Burst Count (ex. 8 random bursts are generated. Burst 1 above has 2 randomly generated pulses)
Pulse Width	Randomly selected from the range 50 – 200 (ex. 75 us)
PRI	Randomly selected from the range 1000 – 2000 (ex. 1213 us)
Burst Interval	Total Test Signal Length / No of Burst = 12 sec / 8 = 1 500 000 us / burst segment

6.3. Frequency Hopping Radar Test Waveform

Table 7 : Frequency Radar Test Waveform

Radar Type	Pulse Width (us)	PRI (us)	Pulses Per Hop	Hopping Rate (kHz)	Hopping Sequence Length (ms)	Minimum % of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	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 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.

7. SUMMARY OF TEST RESULTS

DFS Summary

Response Requirement	Limit	Result
Channel Move Time	< 10 sec	Compliant
Channel Closing Transmission Time	< 200 ms + aggregate of 60 ms over remaining 10 s period	Compliant
Client Beacon Test	> 30 mins	Compliant

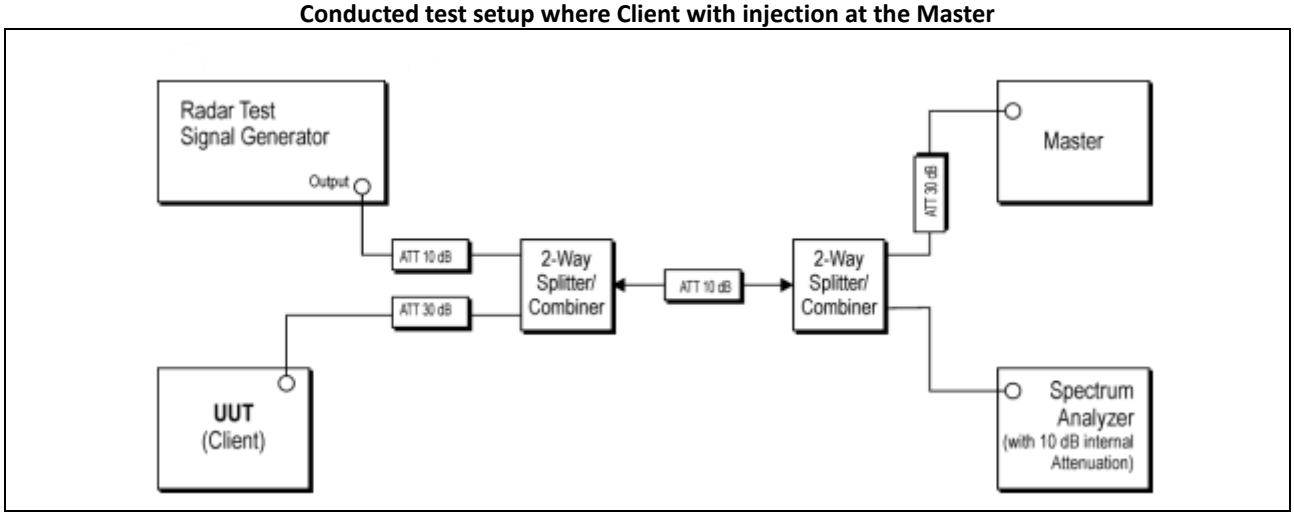
LIST OF SUPPORT EQUIPMENT

Equipment Type	Model No.	Serial No.	Manufacturer	Qty	Note
Power Supply	PA-1650-58	165058LT33803287PEA01	LITEON	1	Input : 100-240 V a.c., 50-60 Hz, 1.6 A Output : 20 V d.c., 3.25 A
WIFI Router	RT-BE96U	R9IG6G201614BB5	ASUS	1	Master Device

8. DYNAMIC FREQUENCY SELECTION

8.1 Procedure

Conducted test setup where Client with injection at the Master

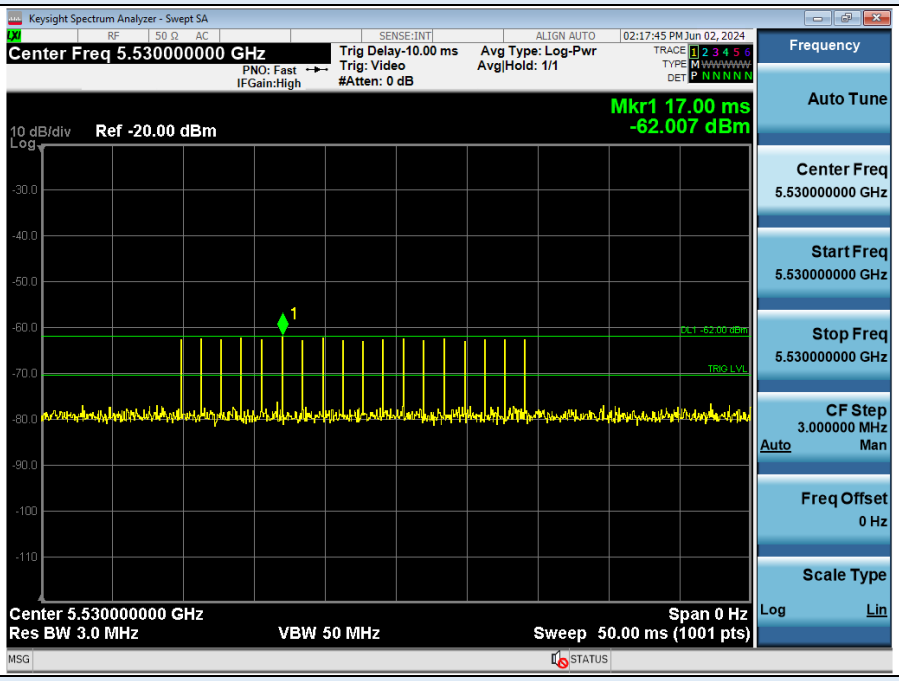


One of the frequencies (widest BW) between UNII-2A and UNII-2C was tested.

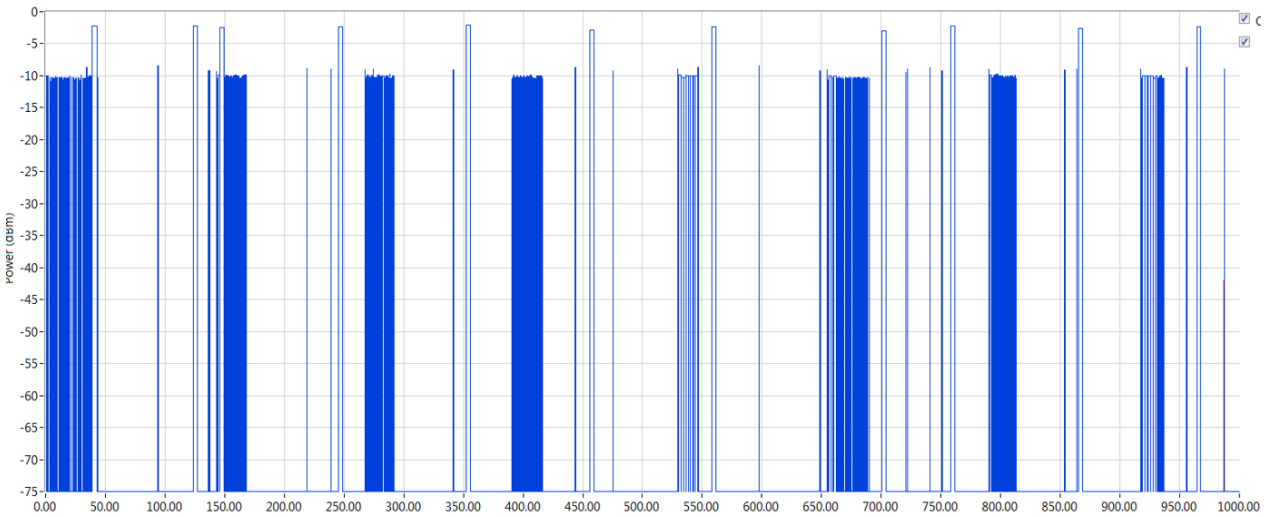
1. The radar pulse generator is setup to provide a pulse at the frequency that the Master and Client are operating. A type 0 radar pulse with a 1 µs pulse with and a 1428 µs PRI is used for the testing.
2. The vector signal generator is adjusted to provide the radar burst (18 pulses) at a level of approximately -62 dBm at the antenna of the Master device.
3. The client device (EUT) is set up per the picture above and communications between the Master and the Client is established.
4. Per KDB 905462 d02 v02, minimum 17 % of channel loading is applied between the Master and the Client device.
5. The spectrum analyzer is set to record about 15 s window to any transmission occurring up to and after 10 s.
6. The system is again setup and the monitoring time is shortened in order to capture the Channel Closing Transmission Time. This time is measure to insure that the Client ceases transmission within 200 ms and the aggregate of emissions occurring after 200 ms up to 10 s do not exceed 60 ms.
   (Note : the channel may be different since the Master and the Client have changed channels due to the detection of the initial radar pulse.)
7. After the initial radar burst the channel is monitored for 30 min to insure no transmission or beacons occur. A second monitoring setup is used to verify that the Master and the Client have both moved to different channels.

▣ TEST PLOTS

Radar Waveforms Type 1 (CH 106 : 5530 MHz)



Channel Loading (CH 106 : 5530 MHz)



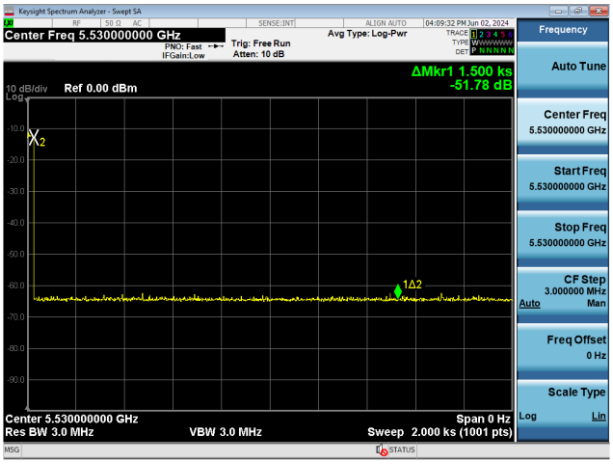
Duty Cycle	18.5652 %

8.2 Test Result

Test Frequency	5530 MHz (CH 106)
Mode	802.11ax HE80
Operation Mode	Slave without radar detection

Test Items	Measured Time	Limit	Result
Aggregate Channel Closing Transmission Time After 200 ms	0 ms	60 ms	Compliant
Channel Move Time	0.033 s	10 s	Compliant
Client Beacon Test	Monitored for 30 min with no client transmission	No client transmission occurred	Compliant

▣ TEST PLOTS

Channel Closing Time / Channel Move Time (CH 106)	Client Beacon Test (CH 106)
	

9. LIST OF TEST EQUIPMENT

No.	Instrument	Model No.	Calibration Due (mm/dd/yy)	Manufacture	Serial No.
☒	Signal Analyzer (10 Hz ~ 26.5 GHz)	N9020A	12/18/2024	Keysight	MY48011929
☒	Attenuator (20 dB, DC ~ 26.5 GHz)	8493C 20 dB	02/16/2025	Keysight	89401
☒	Attenuator (10 dB, DC ~ 26.5 GHz)	8493C 10 dB	09/05/2024	Keysight	89576
☒	Power Divider-2way (4 GHz ~ 8 GHz)	802-2-6.000	06/03/2025	Meca	#1
☒	Power Divider-2way (4 GHz ~ 8 GHz)	802-2-6.000	06/03/2025	Meca	#2
☒	DFS Radar Simulator (SA)	3035C	12/06/2024	AEROFLEX	302570/248
☒	DFS Radar simulator (VSG)	3025C	12/06/2024	AEROFLEX	303570/536
☒	DFS Test Software	-	N/A	AEROFLEX	-

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date

APPENDIX A. TEST SETUP PHOTOS

The setup photos are provided as a separate document.

APPENDIX B. PHOTOGRAPHS OF EUT

B.1. EXTERNAL PHOTOS

The external photos are provided as a separate document.

B.2. INTERNAL PHOTOS

The internal photos are provided as a separate document.

END OF TEST REPORT