



中认信通
CHINA CERTIFICATION ICT CO., LTD. (DONGGUAN)



DFS TEST REPORT

Applicant: Shape Labs Inc.

Address: 179 11th St, CA 94103, San Francisco, USA

FCC ID: 2A9XISHAPESCALE-001

Product Name: Shapescape

Standard(s): 47 CFR Part 15, Subpart E (15.407)
FCC KDB 905462 D02 UNII DFS Compliance
Procedures New Rules v02

The above device has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: CR230101974-00F

Date Of Issue: 2023/11/30

Reviewed By: Calvin Chen

Title: RF Engineer

Approved By: Sun Zhong

Title: Manager

Test Laboratory: China Certification ICT Co., Ltd (Dongguan)

No. 113, Pingkang Road, Dalang Town, Dongguan,
Guangdong, China
Tel: +86-769-82016888

Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

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

This report cannot be reproduced except in full, without prior written approval of the Company.

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk “★”.

CONTENTS

DOCUMENT REVISION HISTORY	4
1. GENERAL INFORMATION	5
1.1 Product Description for Equipment under Test (EUT)	5
1.2 DESCRIPTION OF TEST CONFIGURATION.....	6
1.2.1 EUT Operation Condition:.....	6
1.2.2 Support Equipment List and Details	6
1.2.3 Support Cable List and Details	6
1.2.4 Block Diagram of Test Setup.....	6
2. SUMMARY OF TEST RESULTS	7
3. REQUIREMENTS AND TEST PROCEDURES	8
3.1 DFS REQUIREMENT.....	8
3.2 TEST PROCEDURE	12
4. Test DATA AND RESULTS	13
4.1 RADAR WAVEFORM CALIBRATION	14
4.2 CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME	15
4.2.1 Test Procedure	15
4.2.2 Test Results.....	15
4.3 NON-OCCUPANCY PERIOD.....	17
4.3.1 Test Procedure	17
4.3.2 Test Result	17
5. EUT PHOTOGRAPHS	18
6. TEST SETUP PHOTOGRAPHS	19

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR230101974-00F	Original Report	2023/11/30

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Shapescale
EUT Model:	Shapescale-001
Operation Frequency:	Band2: 5260-5320 MHz (802.11a/n ht20/ac vht20/ax hew20) 5270-5310 MHz (802.11n ht40/ac vht40/ax hew40) 5290 MHz (802.11ac vht80/ax hew80) Band4: 5745-5825 MHz (802.11a/n ht20/ac vht20/ax hew20) 5755-5795 MHz (802.11n ht40/ac vht40/ax hew40) 5775 MHz (802.11ac vht80/ax hew80)
Maximum Average Output Power (Conducted):	17.43 dBm(5250-5350 MHz) 17.75 dBm(5470-5725 MHz)
Modulation Type:	802.11a/n/ac: OFDM-BPSK, QPSK, 16QAM, 64QAM,256QAM 802.11ax: OFDMA- BPSK, QPSK, 16QAM, 64QAM,256QAM,1024QAM
Rated Input Voltage:	DC 19V from adapter
Serial Number:	1YK8-1
EUT Received Date:	2023/1/12
EUT Received Status:	Good

1.1.2 Antenna Information Detail▲:

Antenna	Antenna Type	input impedance (Ohm)	Frequency Range	Antenna Gain
Chain 0	Chip	50	5150~5250MHz	5.2 dBi
			5250-5350 MHz	
			5470-5725 MHz	
			5725~5850MHz	
Chain 1	Chip	50	5150~5250MHz	5.2 dBi
			5250-5350 MHz	
			5470-5725 MHz	
			5725~5850MHz	

The Method of §15.203 Compliance:

- ☒ Antenna was permanently attached to the unit.
☐ Antenna use a unique type of connector to attach to the EUT.
☐ Unit was professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

1.1.3 Accessory Information:

Accessory Description	Manufacturer	Model
Adapter	Dongguan Dongsong electronic Co., LTD	DYS865-190342W

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

EUT Operation Mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer.
Equipment Modifications:	No
EUT Exercise Software:	No
WLAN traffic is generated by software “Tfgen”, software is used by IP and Frame based systems for loading the test channel during the In-service compliance testing of the U-NII device. Data package streamed from the Access Point to the Client using the software “Tfgen”.	

1.2.2 Support Equipment List and Details

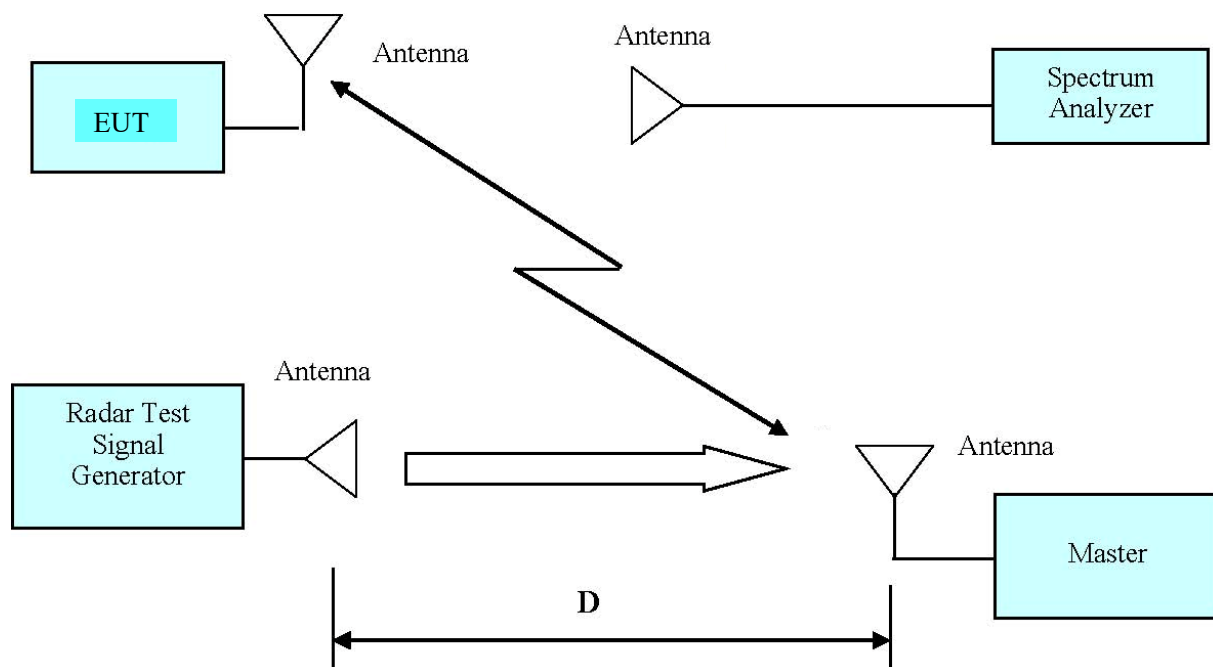
Manufacturer	Description	Model	Serial Number
Lenovo	Laptop	T430	AA887-03
Huawei	Wireless Router	HG8245Q2	HG8245-001

Note: The Wireless Router FCC ID: QISHG8245Q2.

1.2.3 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

1.2.4 Block Diagram of Test Setup



2. SUMMARY OF TEST RESULTS

The following result table represents the list of measurements required under the CFR §47 Part 15.407(h), KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v02

Items	Description of Test	Result
Detection Bandwidth	UNII Detection Bandwidth	Not applicable
Performance Requirements Check	Initial Channel Availability Check Time (CAC)	Not applicable
	Radar Burst at the Beginning of the CAC	Not applicable
	Radar Burst at the End of the CAC	Not applicable
In-Service Monitoring	Channel Move Time	Compliance
	Channel Closing Transmission Time	Compliance
	Non-Occupancy Period	Compliance
Radar Detection	Statistical Performance Check	Not applicable

Note:

Not applicable: The EUT is a client unit without radar detection.

3. REQUIREMENTS AND TEST PROCEDURES

3.1 DFS Requirement

CFR §47 Part 15.407(h)

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

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

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
<i>Non-Occupancy Period</i>	Yes	Not required	Yes
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Availability Check Time</i>	Yes	Not required	Not required
<i>U-NII Detection Bandwidth</i>	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
<i>DFS Detection Threshold</i>	Yes	Not required
<i>Channel Closing Transmission Time</i>	Yes	Yes
<i>Channel Move Time</i>	Yes	Yes
<i>U-NII Detection Bandwidth</i>	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
<i>U-NII Detection Bandwidth and Statistical Performance Check</i>	All BW modes must be tested	Not required
<i>Channel Move Time and Channel Closing Transmission Time</i>	Test using widest BW mode available	Test using the widest BW mode available for the link
<i>All other tests</i>	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: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP \geq 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
<p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p>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.</p> <p>Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p>	

Table 4: DFS Response Requirement Values

Parameter	Value
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds See Note 1.
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 100% of the U- NII 99% transmission power bandwidth. See Note 3.
<p>Note 1: <i>Channel Move Time</i> and the <i>Channel Closing Transmission Time</i> should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.</p> <p>Note 2: The <i>Channel Closing Transmission Time</i> is comprised of 200 milliseconds starting at the beginning of the <i>Channel Move Time</i> plus any additional intermittent control signals required to facilitate a <i>Channel</i> 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.</p> <p>Note 3: During the <i>U-NII Detection Bandwidth</i> 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.</p>	

Table 5 – 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 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	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 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.

For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 usec is selected, the number of pulses

would be $\text{Roundup} \left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{3066} \right) \right\} = \text{Roundup} \{17.2\} = 18$.

Table 5a - Pulse Repetition Intervals Values for Test A

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

The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 1-4. For example, the following table indicates how to compute the aggregate of percentage of successful detections.

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	35	29	82.9%
2	30	18	60%
3	30	27	90%
4	50	44	88%
Aggregate $(82.9\% + 60\% + 90\% + 88\%)/4 = 80.2\%$			

Table 6 – Long Pulse Radar Test Waveform

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

Table 7 – Frequency Hopping Radar Test Waveform

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

3.2 Test Procedure

A spectrum analyzer is used as a monitor verifies that the EUT status including Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the diction and Channel move.

4. Test DATA AND RESULTS

Serial Number:	1YK8-1	Test Date:	2023/3/23
Test Site:	RF	Test Mode:	Transmitting
Tester:	Ada Yan	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.1	Relative Humidity: (%)	61	ATM Pressure: (kPa)	100.7
----------------------	------	------------------------------	----	------------------------	-------

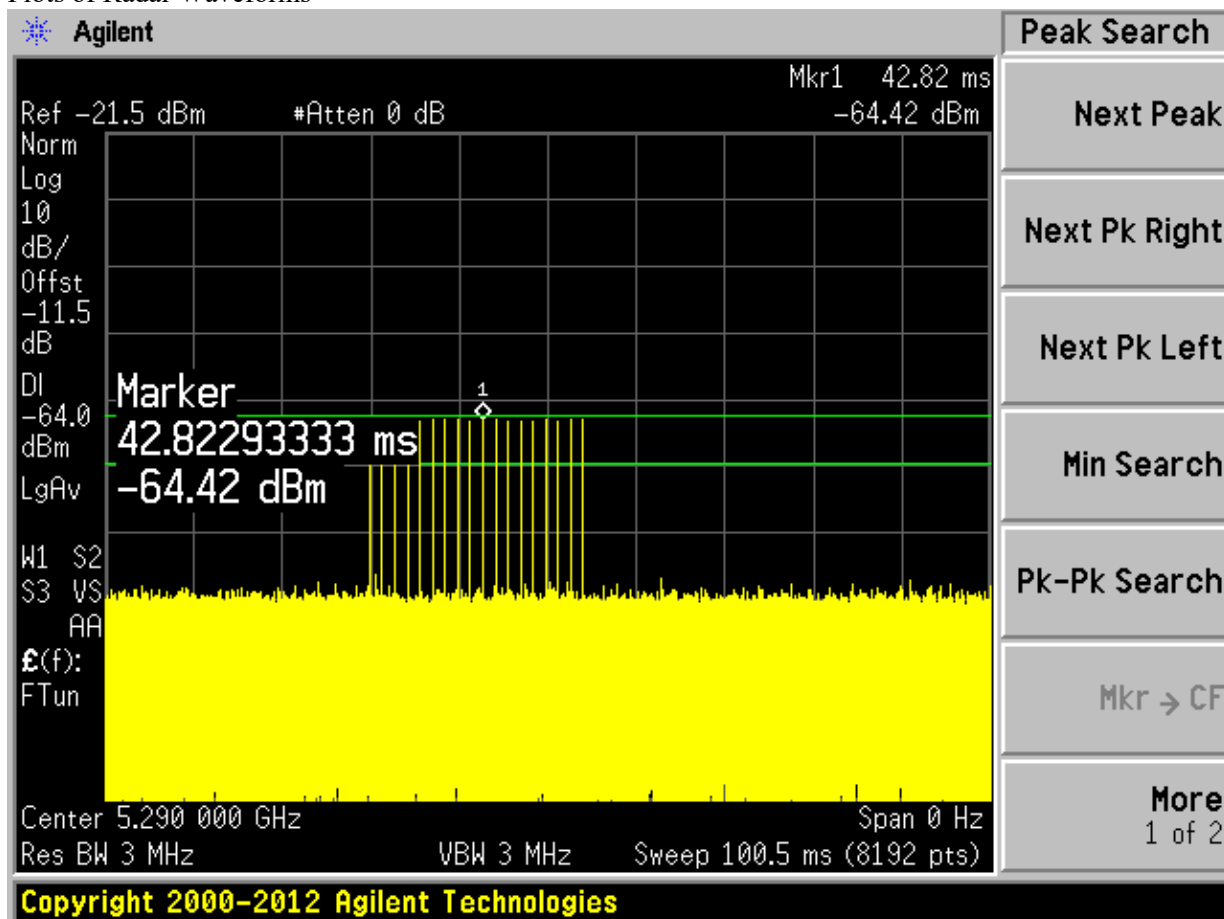
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
National Instruments	NI PXI-1042 8-Slot chassis	PXI-1042	VOBX40FBD	N/A	N/A
National Instruments	Arbitrary Waveform Generator	PXI-5421	N/A	N/A	N/A
National Instruments	RF Upconverter	PXI-5610	N/A	N/A	N/A
ASCOR	Upconverter	AS-7202	N/A	N/A	N/A
Agilent	Spectrum Analyzer	E4440A	SG43360054	2022/7/15	2023/7/14
Ditorn	Splitter/Combiner	D3C4080	SN2244	N/A	N/A
TDK RF	horn antenna	HRN-0118	130 084	2021/10/12	2024/10/12
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020/10/13	2023/10/12

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

4.1 Radar Waveform Calibration

Plots of Radar Waveforms



4.2 Channel Move Time and Channel Closing Transmission Time

4.2.1 Test Procedure

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.

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.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = $N \times \text{Dwell Time}$

N is the number of spectrum analyzer bins showing a device transmission Dwell Time is the dwell time per bin (i.e. $\text{Dwell Time} = S/B$, S is the sweep time and B is the number of bin, i.e. 8192)

4.2.2 Test Results

Frequency (MHz)	Bandwidth (MHz)	Radar Type	Results
5290	80	Type 0	Compliant

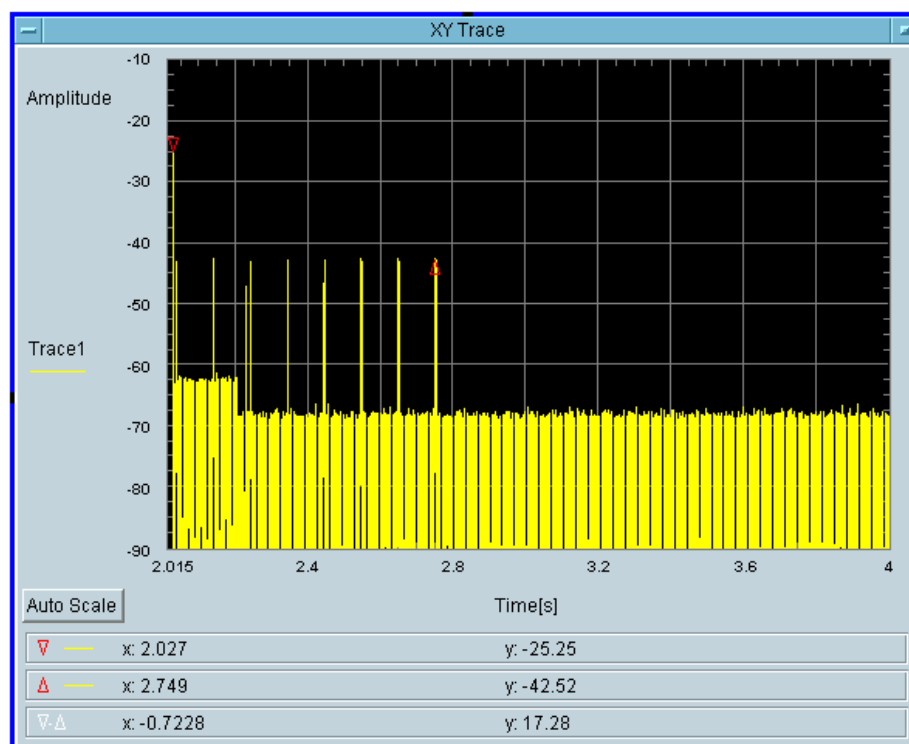
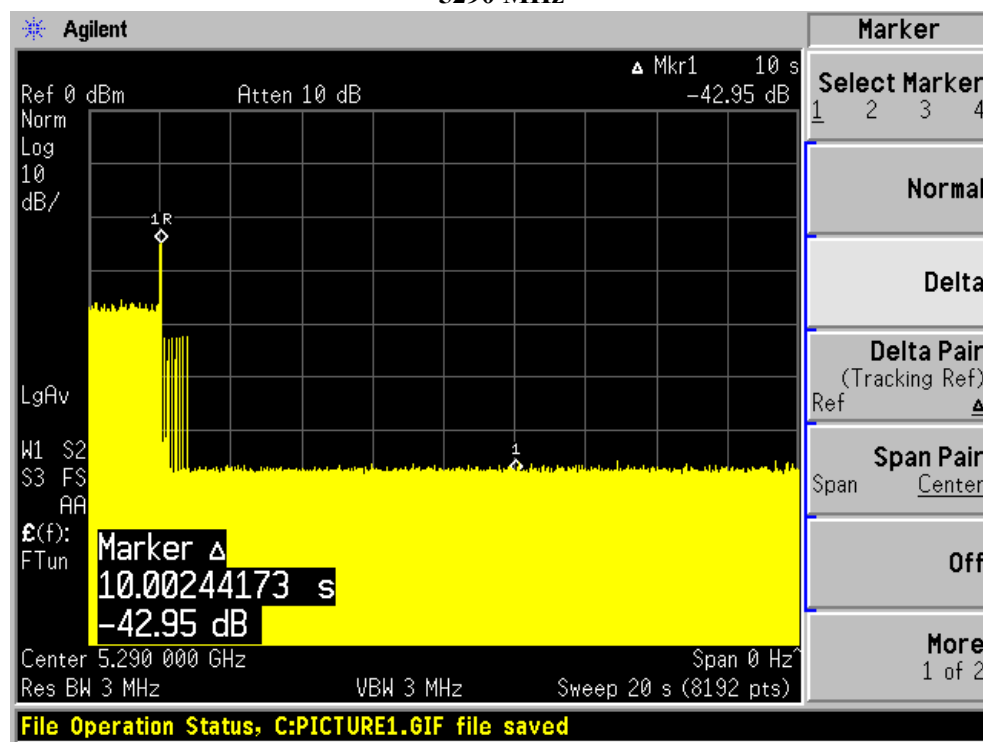
Please refer to the following tables and plots.

5290 MHz

Transmission After 200ms	Aggregate Transmission Time After 200ms Delay (ms)	Limit for Aggregate Transmission Time After 200ms Delay (ms)	Result
Yes	39.06	60	Pass

Channel Closing Time (s)	Limit (s)	Result
0.72	10	Pass

5290 MHz



Total On Time [s]
0.1294

Total On Time After Delay [s]
39.06m

4.3 Non-occupancy Period

4.3.1 Test Procedure

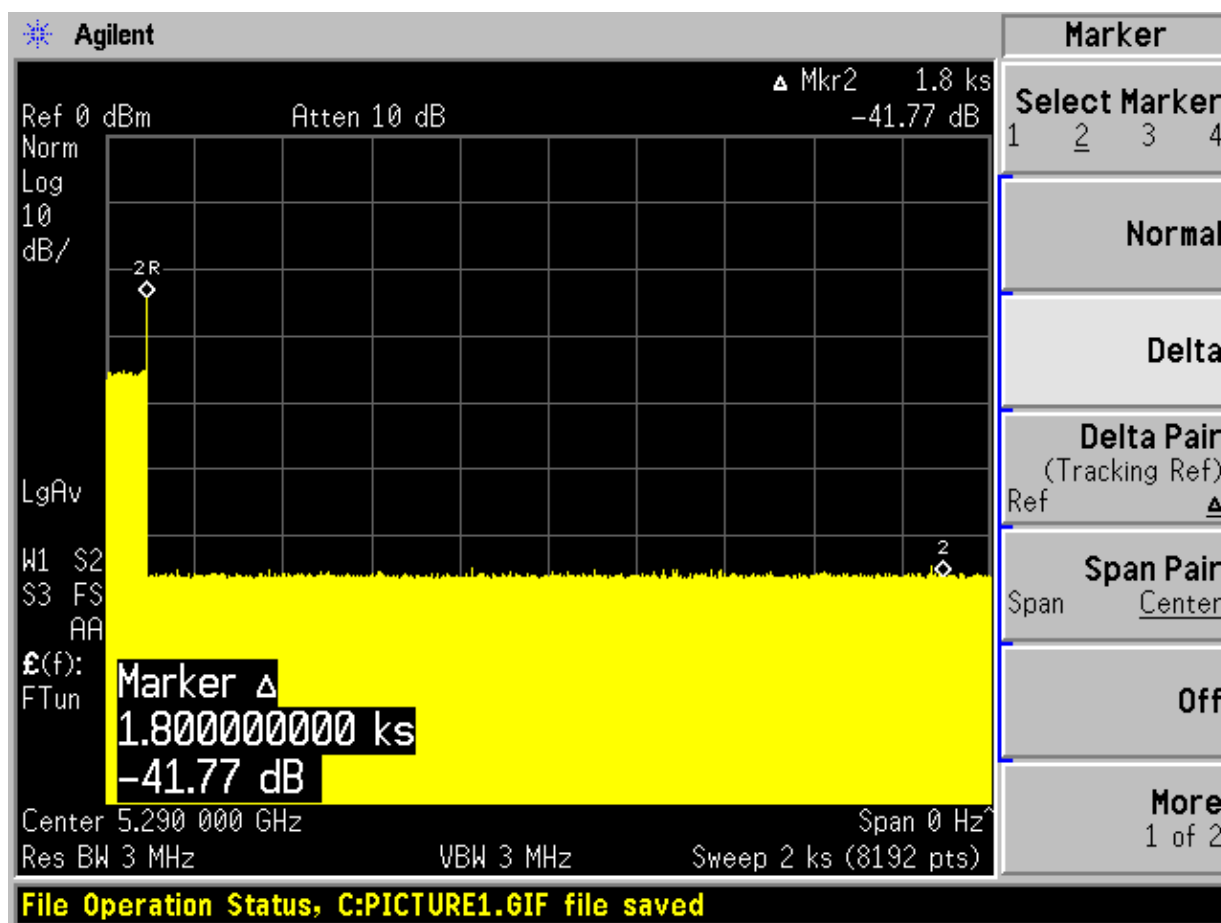
Measure the EUT for more than 30 minutes following the channel close/move time to verify that the EUT does not resume any transmissions on this channel. Provide one plot to demonstrate no transmission on the channel for the non-occupancy period (30 minutes observation time)

4.3.2 Test Result

Frequency (MHz)	Bandwidth (MHz)	Spectrum Analyzer Display
5290	80	No transmission within 30 minutes

Please refer to the following plots.

5290 MHz



5. EUT PHOTOGRAPHS

Please refer to the attachment CR230101974-EXP EUT EXTERNAL PHOTOGRAPHS and
CR230101974-INP EUT INTERNAL PHOTOGRAPHS

6. TEST SETUP PHOTOGRAPHS

Please refer to the attachment CR230101974-00F-TSP TEST SETUP PHOTOGRAPHS.

******* END OF REPORT *******