FCC TEST REPORT

Product	:	Mobile Phone
Trade mark	:	MI
Model/Type reference	:	2016102
Report Number	:	1610280464RFC-5
Date of Issue	:	Jan. 04, 2017
FCC ID	:	2AFZZ-RT6102
Test Standards	:	FCC 47 CFR Part 15 Subpart E
Test result	:	PASS

Prepared for:

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The Rainbow City of China Resources, NO.68, Qinghe Middle Street, Haidian District, Beijing, China

Prepared by:

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Date: Jan. 04, 2017

Version

Version No.	Date	Description
V1.0	Jan. 04, 2017	Original

Content

Page

1 GENERAL INFORMATION 4

1.1 CLIENT INFORMATION 4
1.2 GENERAL DESCRIPTION OF EUT 4
1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD 4
1.4 DESCRIPTION OF SUPPORT UNITS 5
1.5 TEST LOCATION 5
1.6 TEST FACILITY 5
1.7 DEVIATION FROM STANDARDS 5
1.8 ABNORMALITIES FROM STANDARD CONDITIONS 5
1.9 OTHER INFORMATION REQUESTED BY THE CUSTOMER 5

2 TEST SUMMARY 6

3 EQUIPMENT LIST 7

4 TEST REQUIREMENT 8

4.1 EUT OPERATING MODE 8
4.1.1 Applicability 8
4.2 IN-SERVICE MONITORING: CHANNEL MOVE TIME, CHANNEL CLOSING TRANSMISSION TIME AND NON-OCCUPANCY PERIOD 12
4.2.1 Limit of In-Service Monitoring 12
4.2.2 Test Procedures 12
4.3 CONDUCTED TEST SETUP 13
4.3.1 Setup for Client with injection at the Master 13
4.4 DESCRIPTION OF EUT 13
4.5 RESULT OF CHANNEL MOVE TIME, CHANNEL CLOSING TRANSMISSION TIME 14
4.6 RESULT OF NON-OCCUPANCY PERIOD 23

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP 24

APPENDIX 2 PHOTOGRAPHS OF EUT 24

1 General Information

1.1 Client Information

Applicant:	Xiaomi Communications Co., Ltd.
Address of Applicant:	The Rainbow City of China Resources, NO.68, Qinghe Middle Street, Haidian District, Beijing, China
Manufacturer:	Xiaomi Communications Co., Ltd.
Address of Manufacturer:	The Rainbow City of China Resources, NO.68, Qinghe Middle Street, Haidian District, Beijing, China

1.2 General Description of EUT

Product Name:	Mobile Phone	
Model No.(EUT):	2016102	
Type of device:	Client device(No radar detection)	
Trade Mark:	MI	
EUT Supports Radios application:	GSM850/900/1800/1900 WCDMA Band I/Band II/Band V/Band VIII LTE FDD Band 1 /Band 3 /Band 4 /Band 5 /Band 7 /Band 8 /Band 20 LTE TDD Band 38 /Band 40 Wlan 2400MHz-2483.5MHz IEEE 802.11b/g/n(HT20&HT40) Wlan 5150MHz-5350MHz, 5470MHz-5725MHz, 5725MHz-5850MHz only support IEEE 802.11a Bluetooth V3.0+EDR&Bluetooth V4.0 BLE GPS, Glonass	
Power Supply:	AC adapter	Model: MDY-08-EF Input: 100-240V~50/60Hz 0.35A MAX Output: DC 5.0V ⎓ 2000mA
	Battery	Model: BN43 Brand: MI Rated Voltage: 3.85Vdc Battery Capacity: 4000mAh(Li-on Rechargeable)
USB Micro-B Plug cable:	117cm(Shielded without ferrite)	
Sample Received Date:	Sep. 12, 2016	
Sample tested Date:	Dec. 09, 2016 ~ Jan. 04, 2017	

1.3 Product Specification subjective to this standard

Operating Frequency / Channel Number:	5250MHz to 5350MHz: 4 for IEEE 802.11a 5470MHz to 5725MHz: 11 for IEEE 802.11a
Type of Modulation:	IEEE for 802.11a:OFDM(64QAM, 16QAM, QPSK, BPSK)
Channels Step:	Channels with 20MHz step
Transmit Data Rate:	IEEE 802.11a:6M/ 9M/ 12M/ 18M/ 24M/ 36M/ 48M/ 54M bps
Maximum Output Power:	5250MHz to 5350MHz: 15.08 dBm 5470MHz to 5725MHz: 15.14 dBm
Antenna Type:	LDS Antenna
Antenna Gain:	-1.7 dBi

Normal Test voltage:	3.85Vdc
Software Version:	MIUI8
Hardware Version:	P3

Remark:

1. For other wireless features of this EUT, test report will be issued separately.
2. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Manufacturer	Model No.	FCC ID	Serial Number
Notebook	Dwll	P51F	PD93160NGU	B3MY362
Wireless AP	Alcatel-Lucent	G-240W-B	2ADZRG240WB	NA

2) Cable

Cable No.	Description	Connector Type	Cable Type/Length	Supplied by
1	Antenna Cable	SMA	30cm	UnionTrust
2	Network Cable	RJ45	100cm(Unshielded without ferrite)	UnionTrust

1.5 Test Location

All tests were performed at:

Compliance Certification Services (Shenzhen) Inc.

No.10-1 Mingkeda Logistics Park, No.18 Huanguan South RD. Guan lan Town, Baoan Distr, Shenzhen, Guangdong, China.

Tel: 86 0755 28055000 Fax: 86 0755 29055221

1.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Compliance Certification Services (Shenzhen) Inc. has been accepted by the FCC, the FCC Registration Number is 441872.

1.7 Deviation from Standards

None.

1.8 Abnormalities from Standard Conditions

None.

1.9 Other Information Requested by the Customer

None.

2 Test Summary

Test Case	Result
Channel Availability Check Time	N/A[1]
U-NII Detection Bandwidth	N/A[1]
Channel Closing Transmission Time	PASS
Channel Move Time	PASS
DFS Detection Threshold	N/A[1]
Non- Occupancy Period	N/A[1]

Remark:

1. The EUT is slave, NA In this whole report not application.

3 Equipment List

RF test system						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm-dd-yyyy)**	**Due date (mm-dd-yyyy)**
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY52221469	10-25-2016	10 -24-2017
☒	Vector Signal Generator	KEYSIGHT	N5182B	MY51351596	04-12-2016	04-11-2017

4 Test Requirement

Reference documents for testing:

No.	Identity	Document Title
1	FCC 47 CFR Part 15	Radio Frequency Devices
2	905462 D02 UNII DFS Compliance Procedures New Rules v02	Compliance measurement procedures for Unlicensed –National Information Infrastructure devices operates in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz bands incorporating dynamic frequency selection
3	905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability
4	905462 D07 Overview UNII Rules v02	Overview of revised rules for U-NII devices

4.1 EUT Operating Mode

Operational Mode	Operating Frequency Range	
	5250~5350MHz	5470~5725MHz
Slave without radar detection	✓	✓

4.1.1 Applicability

The following table from KDB905462 and the lists of the applicable requirements for the DFS testing.

4.1.1.1 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	✓	Not required	Yes
DFS Detection Threshold	✓	Not required	Yes
Channel Availability Check Time	✓	Not required	Not required
U-NII Detection Bandwidth	✓	Not required	Yes

4.1.1.2 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
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	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.		

4.1.1.3 DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

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	-64dBm
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.	

4.1.1.4 DFS Radar Signal Parameter 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.	

4.1.1.5 DFS Radar Signal Parameter

Radar Type 0 was used in the evaluation of the Client device for the purpose of measuring the Channel Move Time and the Channel Closing Transmission Time

Table 1-Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
0	1	1428	18	See Note 1.	See Note 1.
1	1	Test A Test B	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	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 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.					

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

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.

The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4

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

Table 2-Long Pulse Radar Test Waveform

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

Table 3-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 Trials
6	1	333	9	0.333	300	70%	30

4.2 In-Service Monitoring: Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

4.2.1 Limit of In-Service Monitoring

Reference to section 4.1.1.4 form

4.2.2 Test Procedures

a) One frequency will be chosen from the Operating Channels of the EUT within the 5250-5350 MHz or 5470-5725 MHz bands. For 802.11 devices, the test frequency must contain control signals. This can be verified by disabling channel loading and monitoring the spectrum analyzer. If no control signals are detected, another frequency must be selected within the emission bandwidth where control signals are detected.

b) In case the EUT is a Master Device, a U-NII device operating as a Client Device will be used and it is assumed that the Client will associate with the EUT (Master). For radiated tests, the emissions of the Radar Waveform generator will be directed towards the Master Device. If the Master Device has antenna gain, the main beam of the antenna will be directed toward the radar emitter. Vertical polarization is used for testing.

c) The TCP protocol unicast data stream was generated by the iperf software command line with at least 17% activity ratio over any 100ms period.

d) Timing plots are reported with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyzer for zero span and approximate the Time On/ (Time On + Off Time).

e) At time T0 the Radar Waveform generator sends a Burst of pulses for one of the Short Pulse Radar Types 1-4 at DFS Detection Threshold levels on the Operating Channel. 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.

f) Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the EUT during the observation time (Channel Move Time). Measure and record the Channel Move Time and Channel Closing Transmission Time if radar detection occurs.

g) When operating as a Master Device, monitor the EUT for more than 30 minutes following instant T2 to verify that the EUT does not resume any transmissions on this Channel. Perform this test once and record the measurement result.

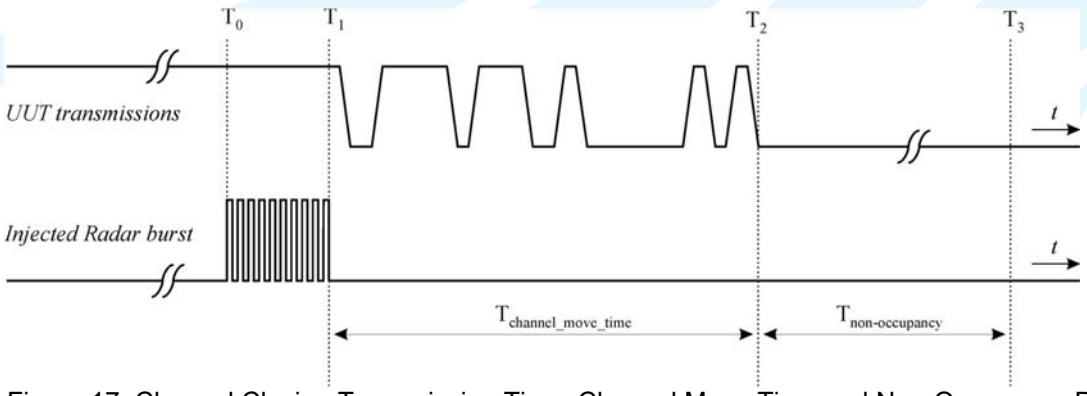
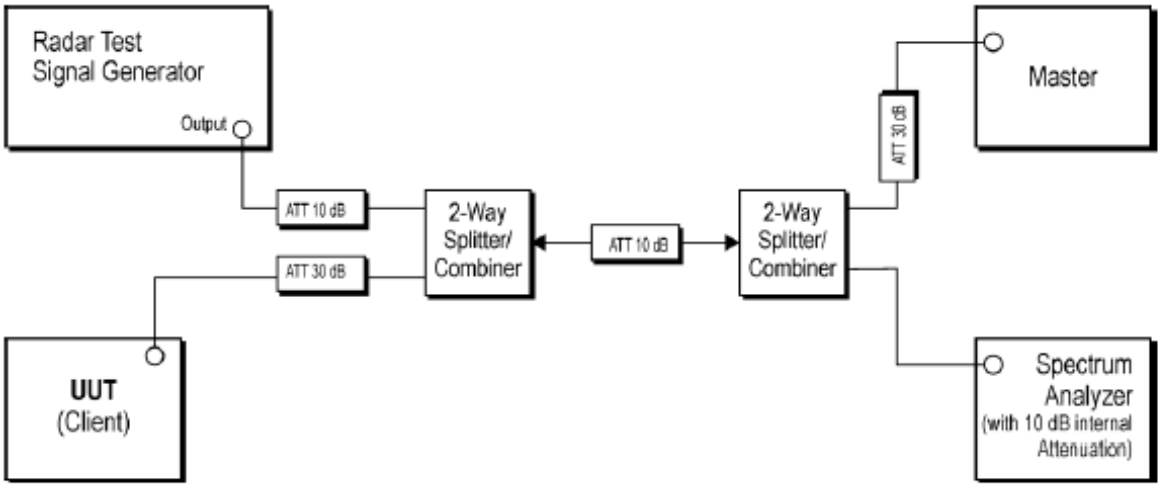


Figure 17: Channel Closing Transmission Time, Channel Move Time and Non-Occupancy Period

4.3 Conducted test setup

4.3.1 Setup for Client with injection at the Master



4.4 DESCRIPTION OF EUT

For FCC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges.

The EUT is a Slave Device without Radar Detection.

The highest power level within these bands is 15.08 dBm EIRP in the 5250-5350 MHz band and 15.14 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT has a gain of -1.7 dBi in the 5250-5350 MHz band 5470-5725 MHz band.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is –64 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is –64 + 1 = -63 dBm.

The calibrated radiated DFS Detection Threshold level is set to –64 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

TPC is not required since the maximum EIRP is less than 500 mW (27 dBm).

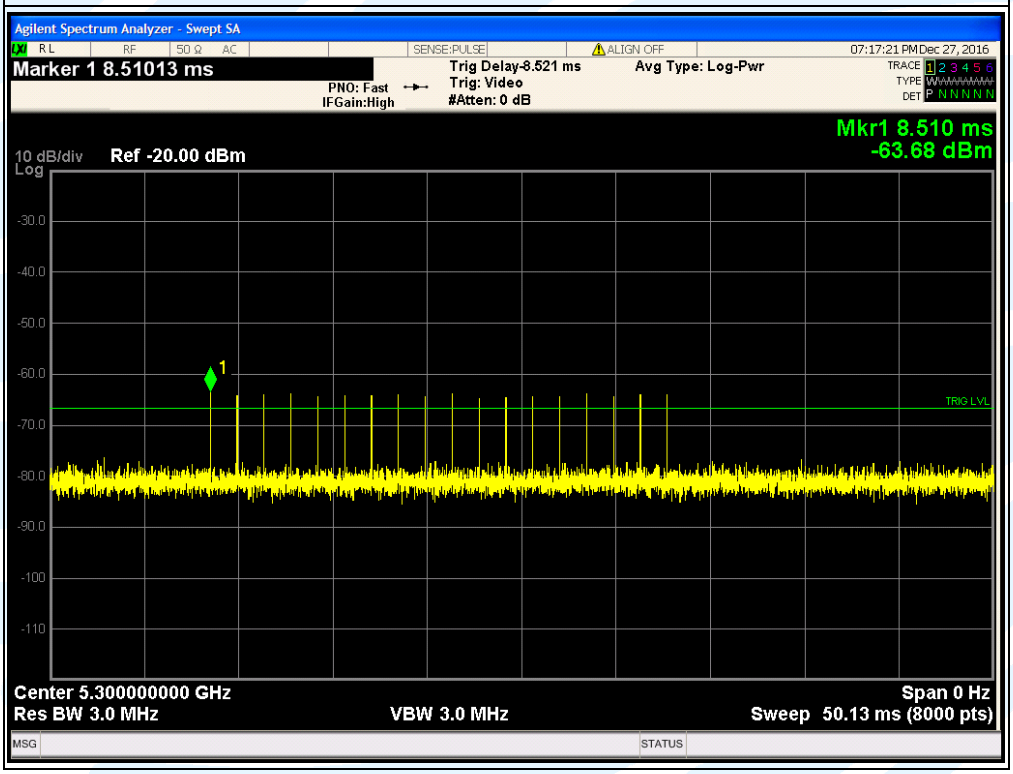
The EUT only support the 802.11a architecture, nominal channel bandwidths is implemented: 20 MHz

4.5 Result of Channel Move Time, Channel Closing Transmission Time

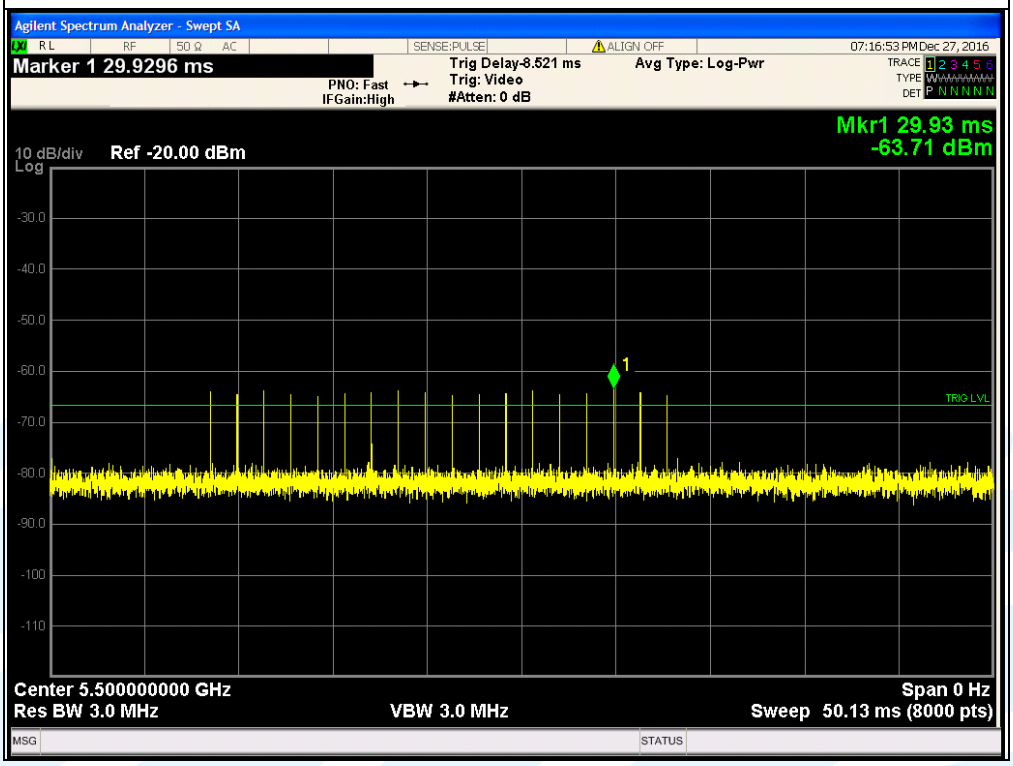
BW / Channel	Test Item	Test Result	Limit	Pass/Fail
20MHz / 5300 MHz	Channel Move Time	1.341 s	< 10s	Pass
	Channel Closing Transmission Time	6.50 ms	< 200+60ms	Pass
	Non-Occupancy Period	No transmission	30 minutes	Pass
20MHz / 5500 MHz	Channel Move Time	1.333 s	< 10s	Pass
	Channel Closing Transmission Time	14.50 ms	< 200+60ms	Pass
	Non-Occupancy Period	No transmission	30 minutes	Pass

Radar Waveform

Reference DFS test signal_802.11a 5300MHz

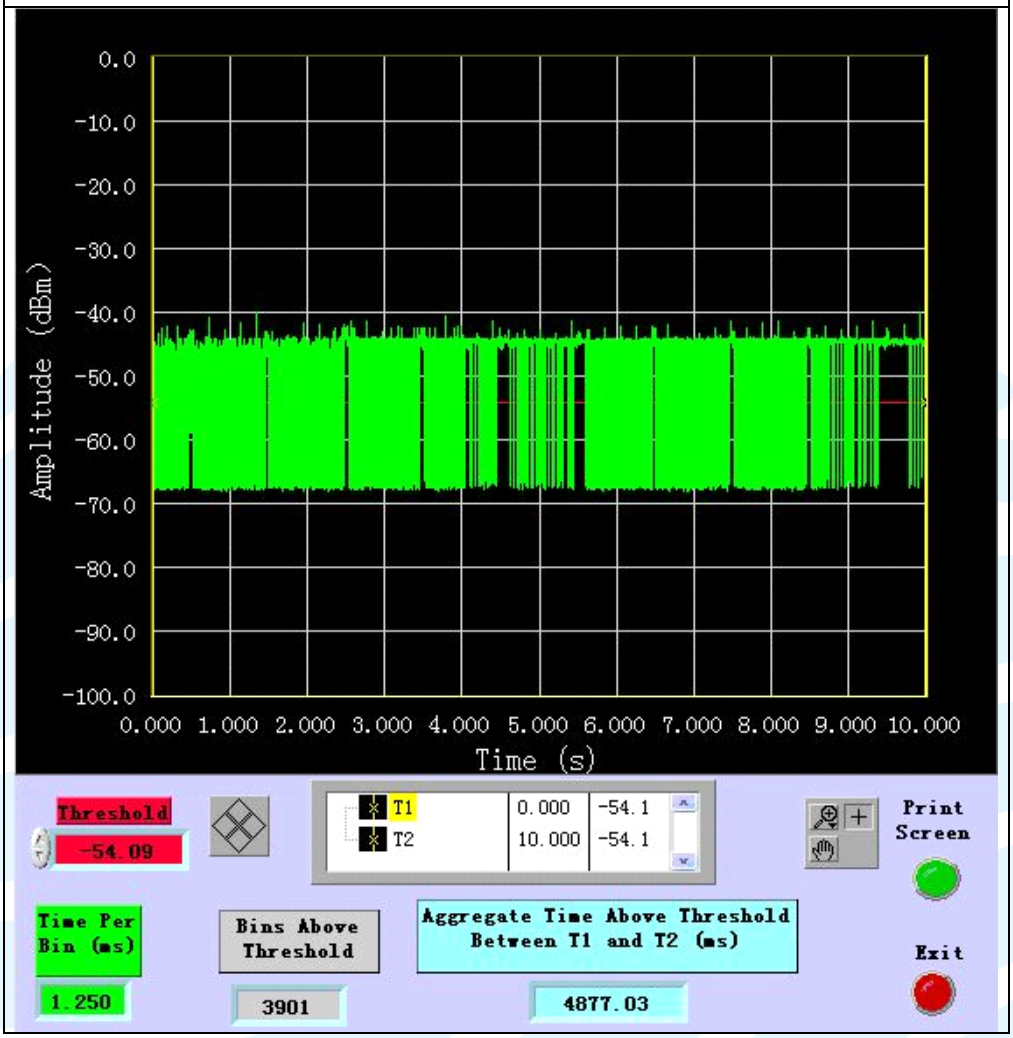


Reference DFS test signal_802.11a 5500MHz

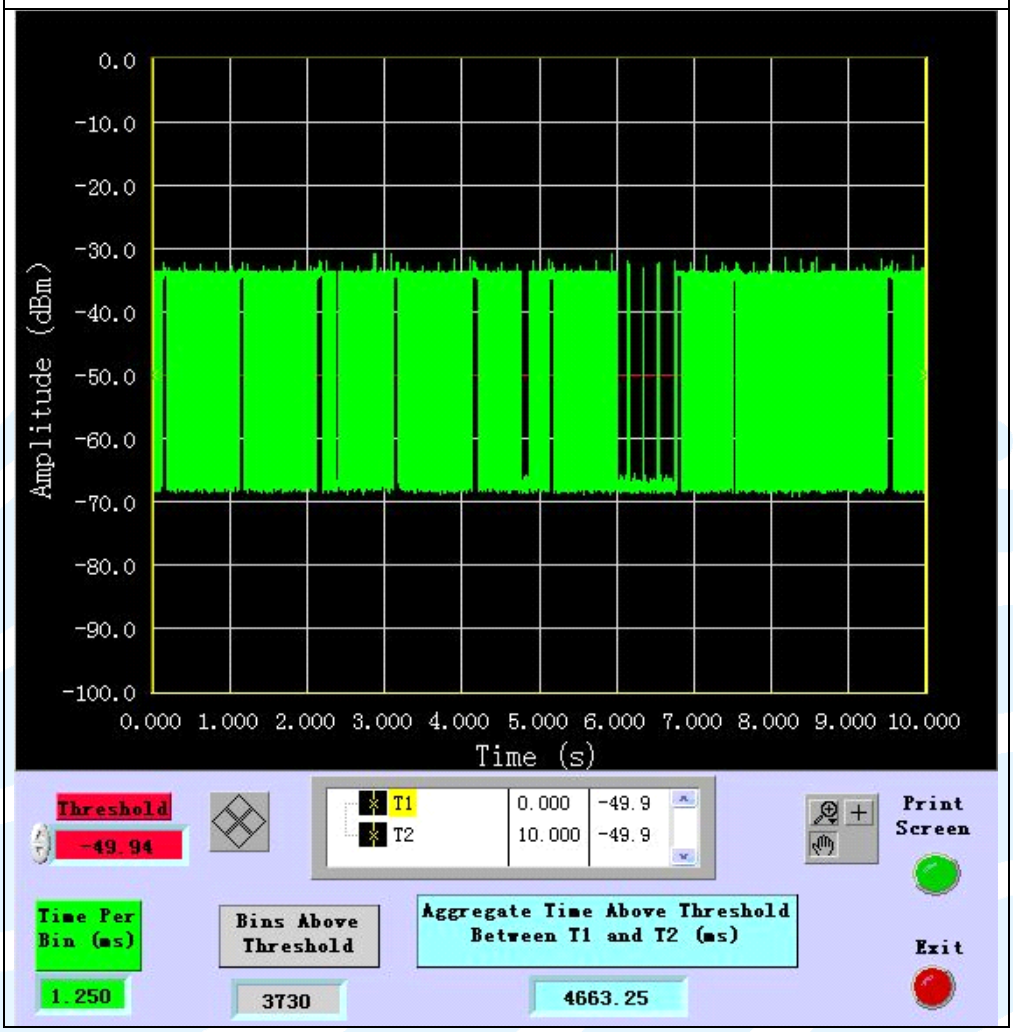


TRAFFIC

Slave Traffic_802.11a 5300MHz

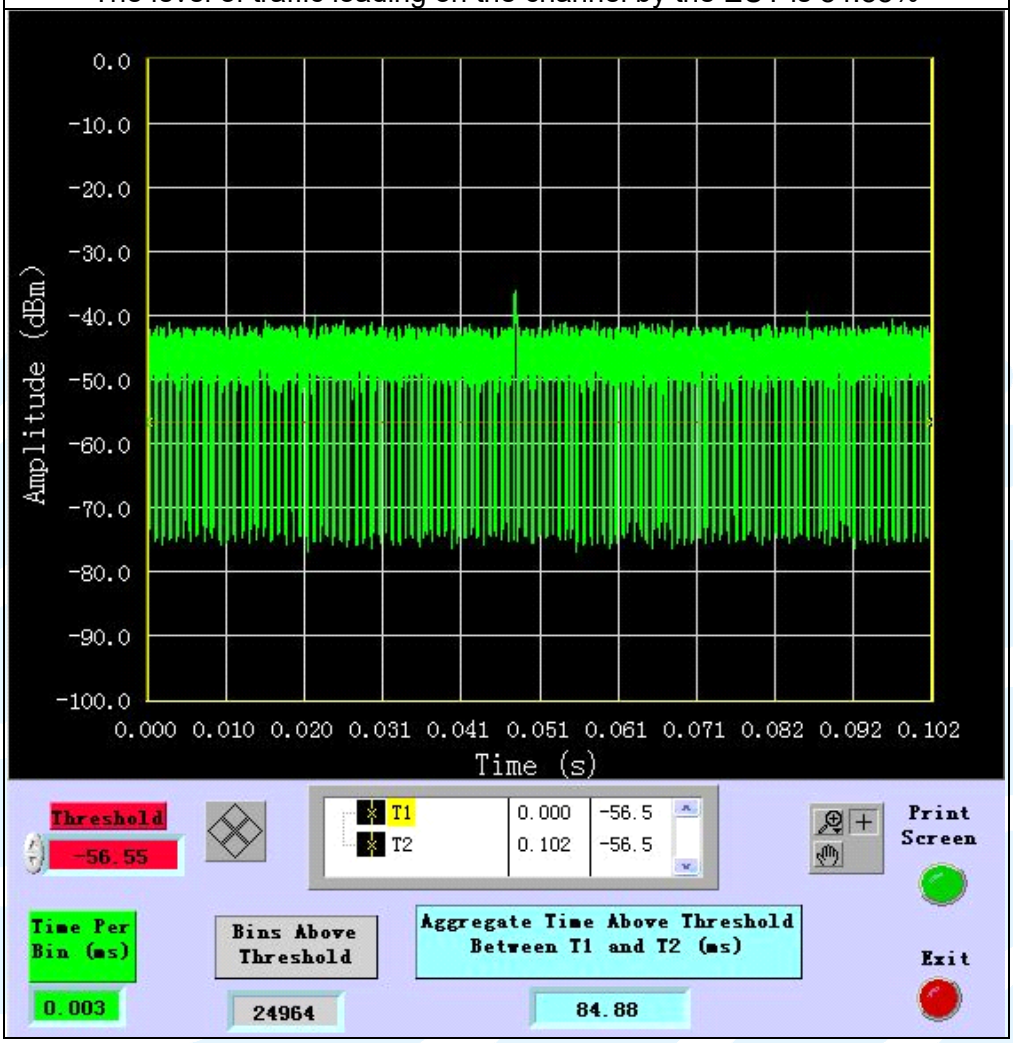


Slave Traffic_802.11a 5500MHz

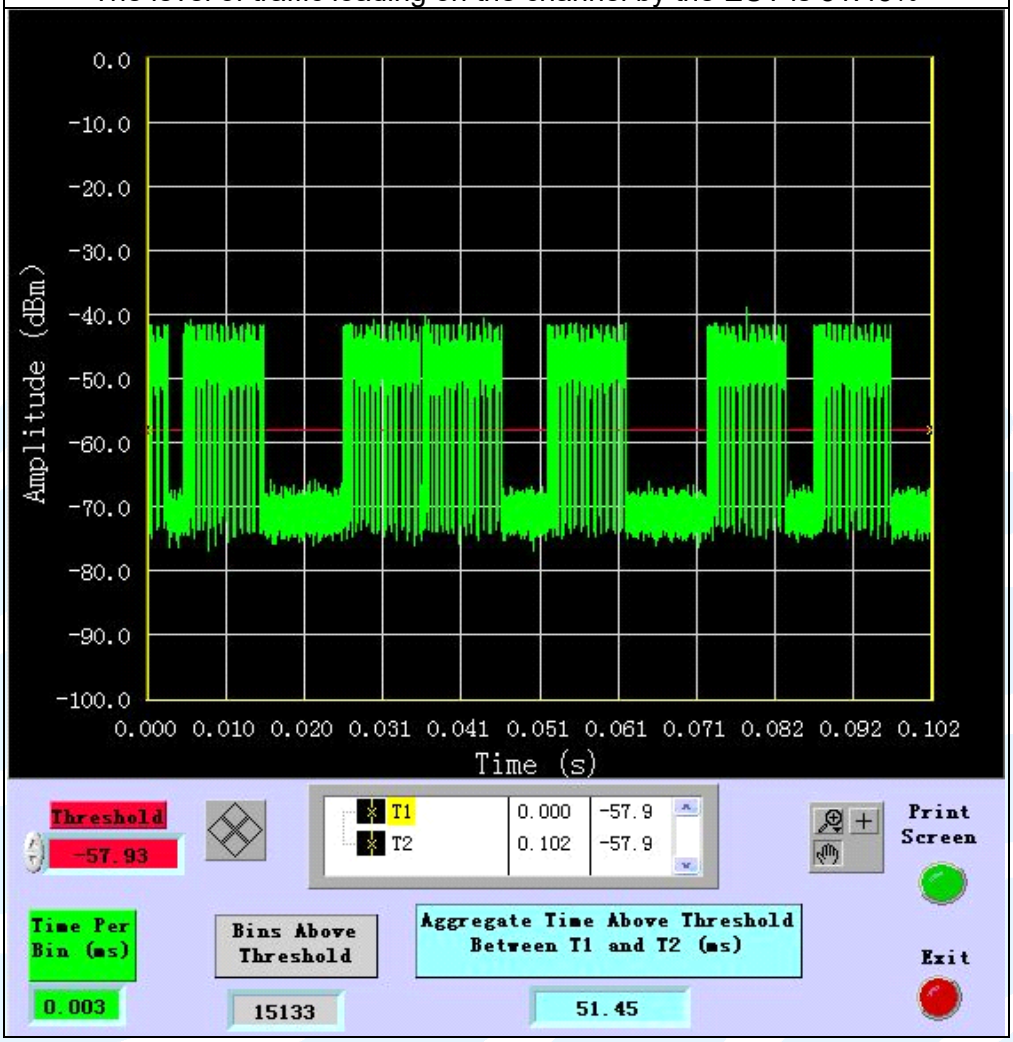


CHANNEL LOADING

Channel Loading_802.11a 5300MHz
The level of traffic loading on the channel by the EUT is 84.88%



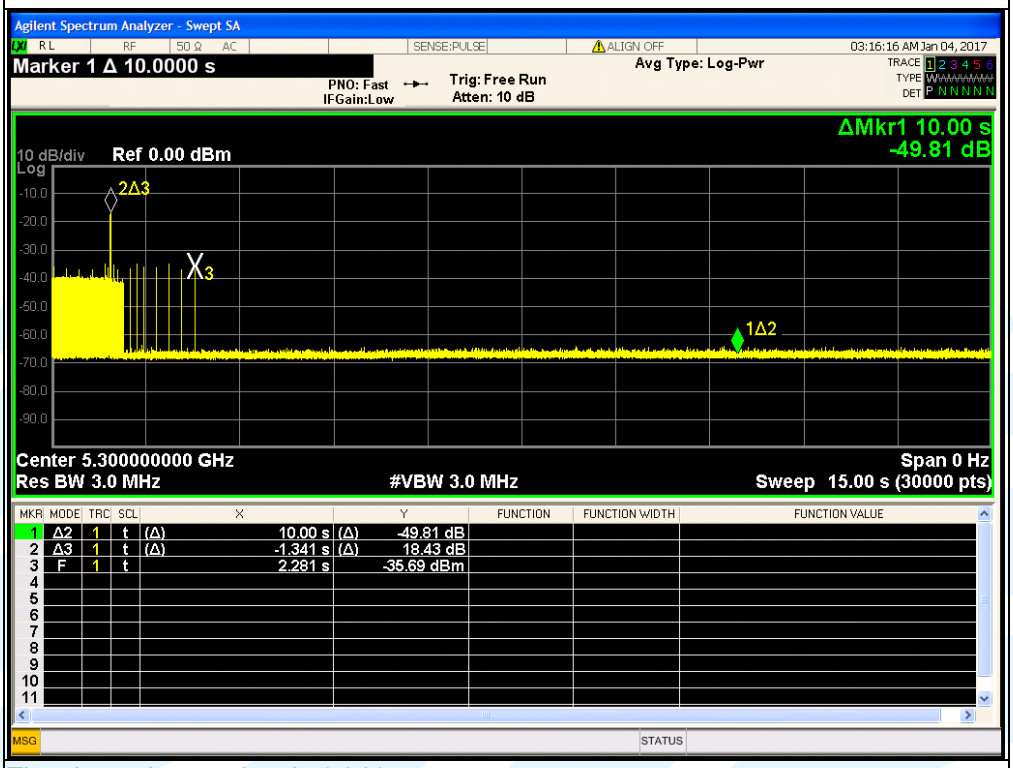
Channel Loading_802.11a 5500MHz
The level of traffic loading on the channel by the EUT is 51.45%



CHANNEL MOVE TIME

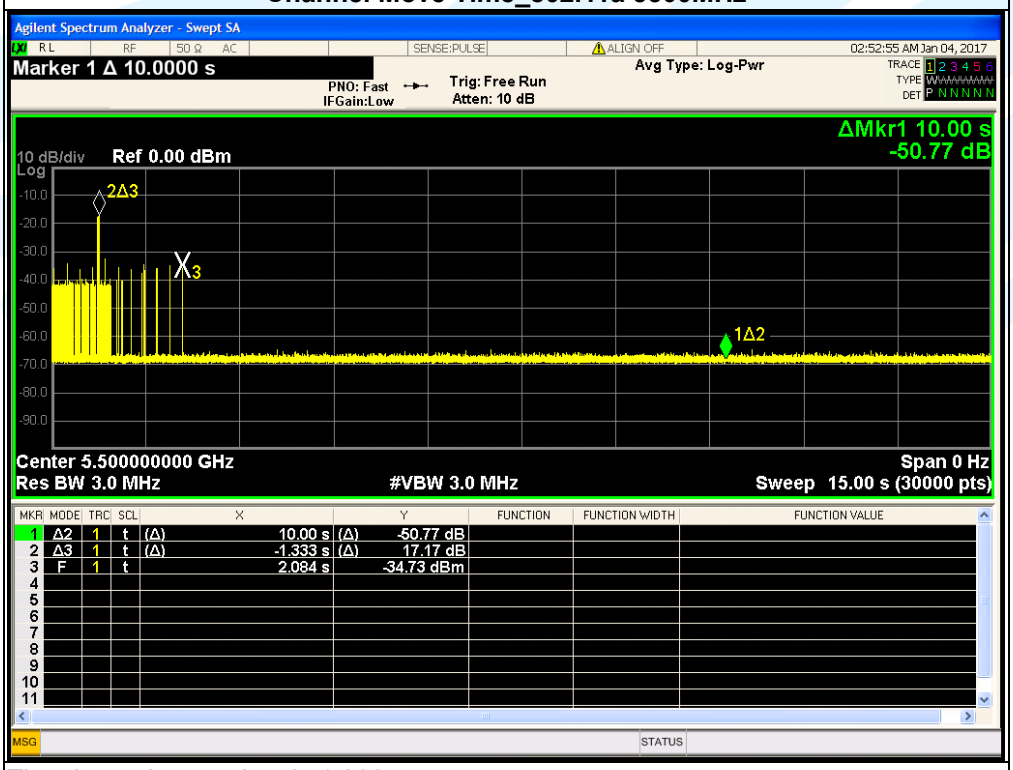
The reference marker is set at the end of last radar pulse.
The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

Channel Move Time_802.11a 5300MHz



The channel move time is 1.341s

Channel Move Time_802.11a 5500MHz

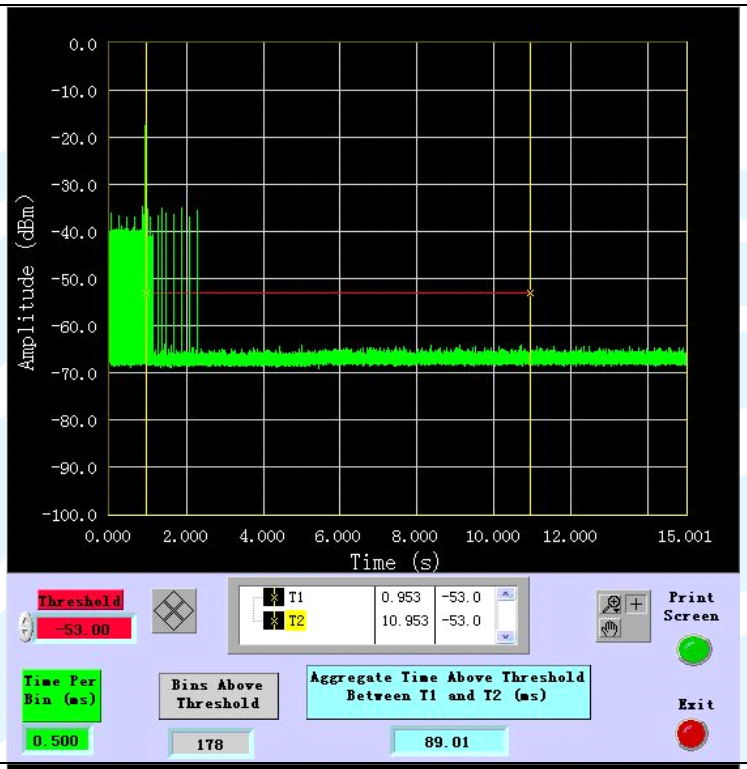


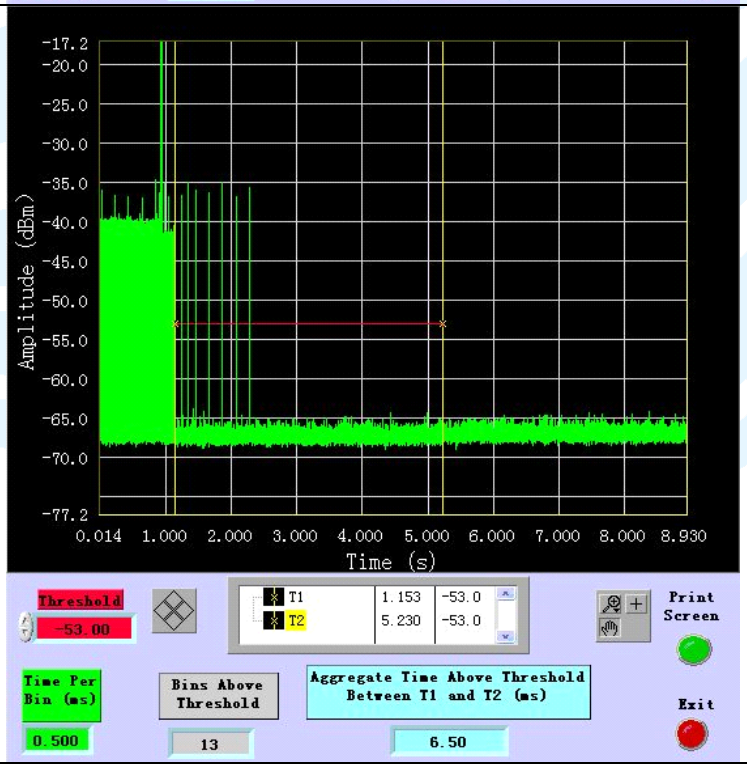
The channel move time is 1.333s

CHANNEL CLOSING TRANSMISSION TIME

The aggregate channel closing transmission time is calculated as follows:
Aggregate Transmission Time = (Number of analyzer bins showing transmission) * (dwell time per bin)
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200msec) and ends no earlier than (Reference Marker + 10 sec).

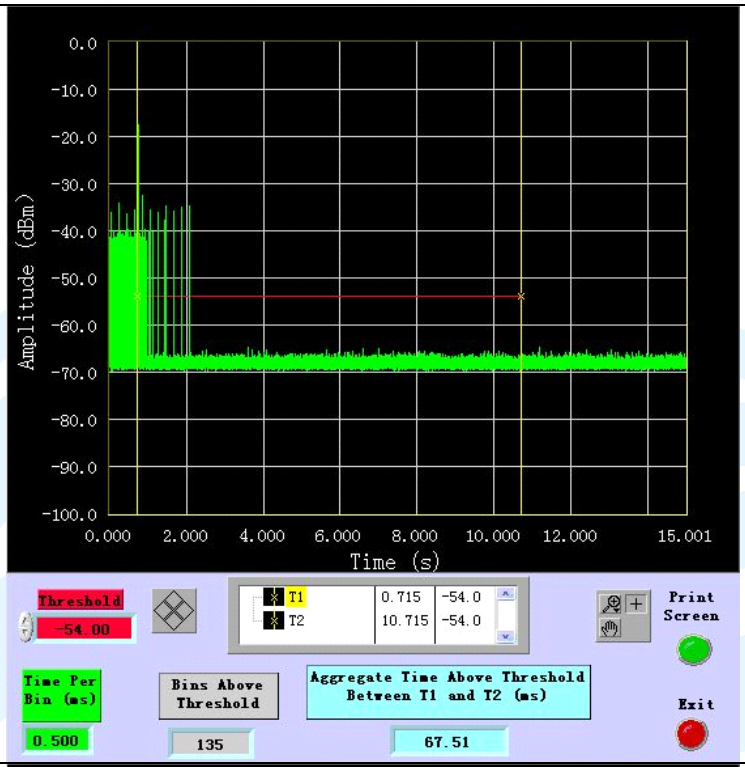
Channel Closing Transmission Time_802.11a 5300MHz

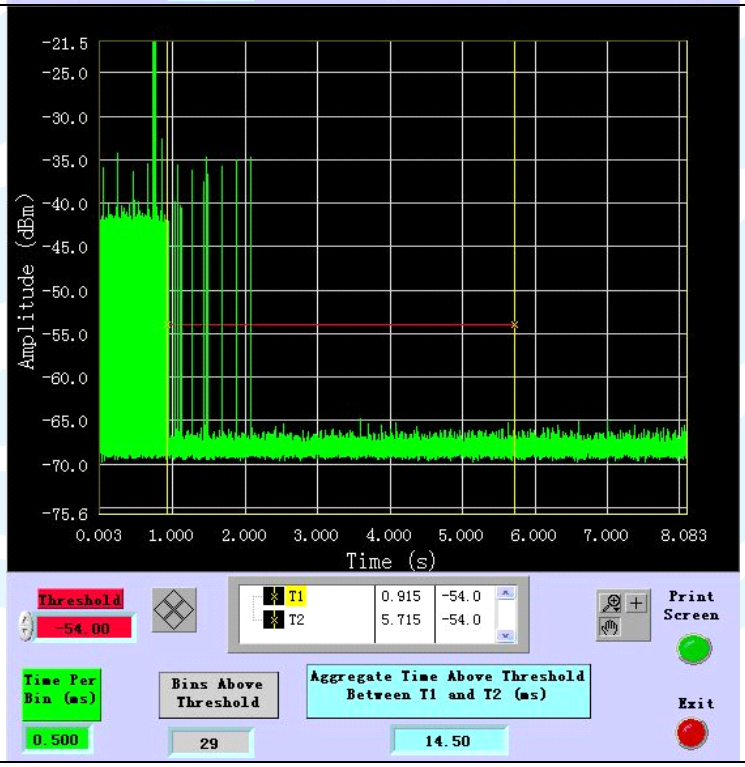




No data signal after reference marker + 200msec
Aggregate closing time is 6.50ms

Channel Closing Transmission Time_802.11a 5500MHz



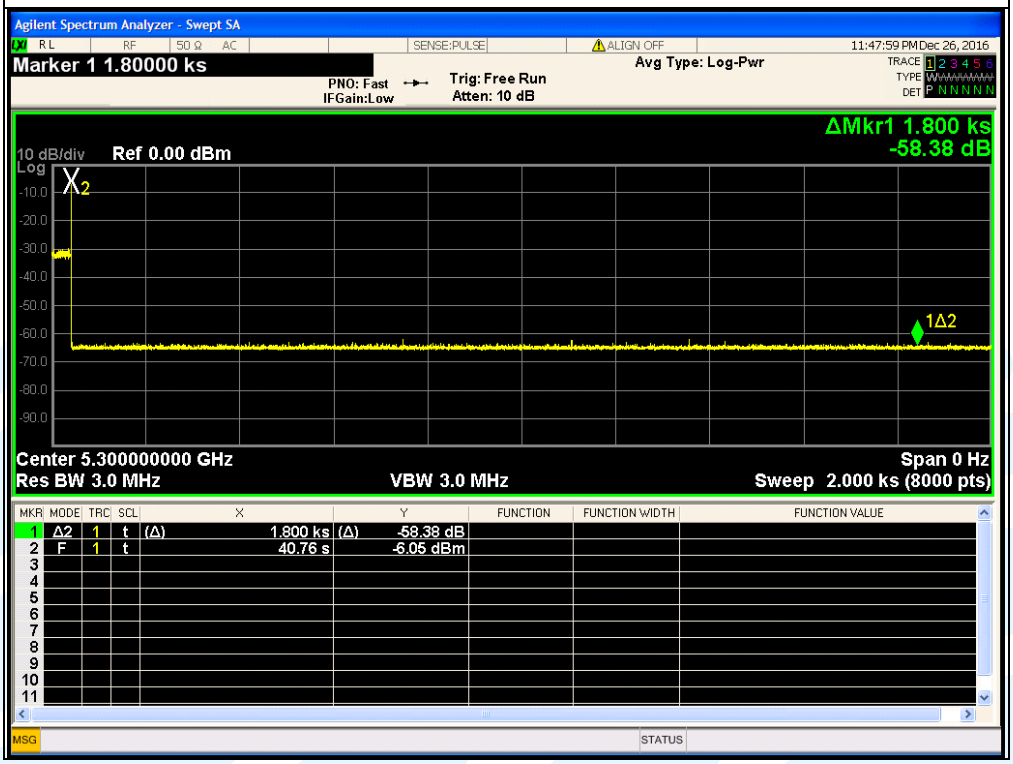


No data signal after reference marker + 200msec
Aggregate closing time is 14.50ms

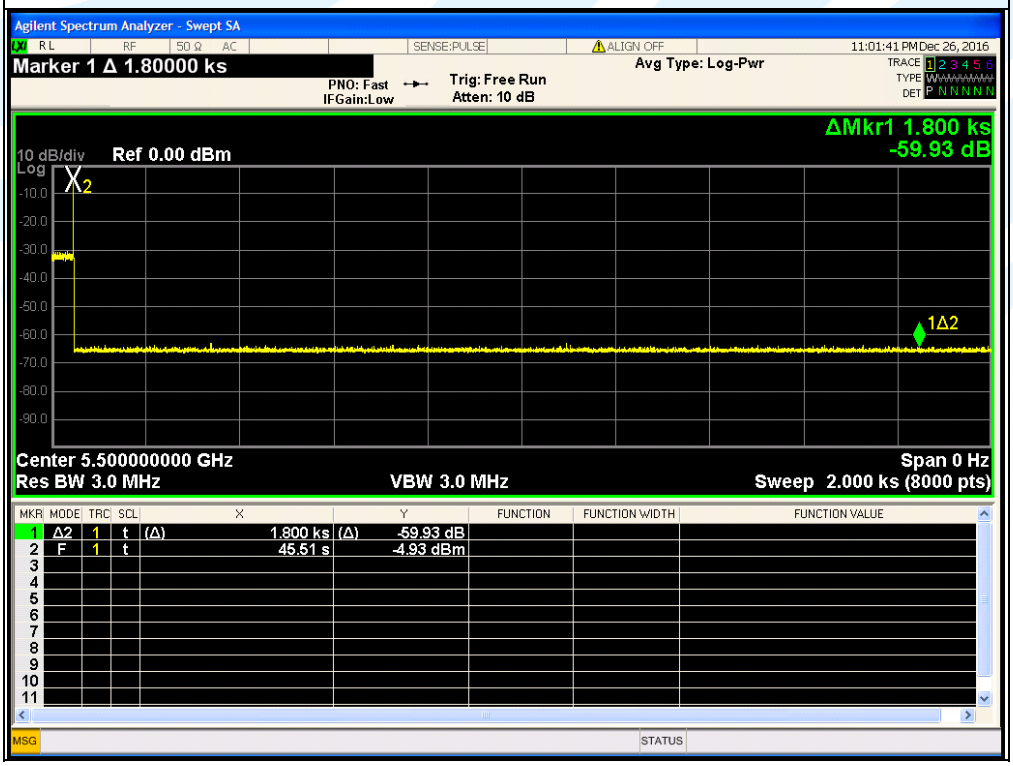
4.6 Result of Non-Occupancy Period

No EUT transmissions were observed on the test channel during the 30-minute observation time.

Non-Occupancy Period_802.11a 5300MHz



Non-Occupancy Period_802.11a 5500MHz



APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

Refer to 2AFZZ-RT6102_APPENDIX 1_TEST SETUP

APPENDIX 2 PHOTOGRAPHS OF EUT

Refer to Report No. 1610280462EMC-1 for EUT external and internal photos.

*** End of Report ***

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