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DFS TEST REPORT

REPORT NO.: RF140606E01-3

MODEL NO.: T77H526

FCC ID: MCLT77H526

RECEIVED: June 06, 2014

TESTED: June 30, 2014

ISSUED: July 09, 2014

APPLICANT: Hon Hai PRECISION IND.CO.,LTD.

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ISSUED BY: Bureau Veritas Consumer Products Services
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Table of Contents

RELEASE CONTROL RECORD	3
1. CERTIFICATION	4
2. EUT INFORMATION	5
2.1 OPERATING FREQUENCY BANDS AND MODE OF EUT	5
2.2 EUT SOFTWARE AND FIRMWARE VERSION	5
2.3 DESCRIPTION OF AVAILABLE ANTENNAS TO THE EUT	5
2.4 EUT MAXIMUM CONDUCTED POWER	6
2.5 EUT MAXIMUM EIRP POWER	7
2.6 TRANSMIT POWER CONTROL (TPC)	8
2.7 STATEMENT OF MAUNFACTURER	8
3. U-NII DFS RULE REQUIREMENTS	9
3.1 WORKING MODES AND REQUIRED TEST ITEMS	9
3.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS	11
4. TEST & SUPPORT EQUIPMENT LIST	15
4.1 TEST INSTRUMENTS	15
4.2 DESCRIPTION OF SUPPORT UNITS	15
5. TEST PROCEDURE	16
5.1 BVADT DFS MEASUREMENT SYSTEM:	16
5.2 CALIBRATION OF DFS DETECTION THRESHOLD LEVEL:	17
5.3 DEVIATION FROM TEST STANDARD	18
5.4 CONDUCTED TEST SETUP CONFIGURATION	18
5.4.1 CLIENT WITHOUT RADAR DETECTION MODE	18
6. TEST RESULTS	19
6.1 SUMMARY OF TEST RESULTS	19
6.2 DETAILED TEST RESULTS	20
6.2.1 TEST MODE: DEVICE OPERATING IN CLIENT WITHOUT RADAR DETECTION MODE	20
6.2.1.1 DFS DETECTION THRESHOLD	20
6.2.1.2 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME	21
6.2.1.3 NON- OCCUPANCY PERIOD	22
6.2.1.4 NON-ASSOCIATED TEST	24
6.2.1.5 NON- CO-CHANNEL TEST	24
7. INFORMATION ON THE TESTING LABORATORIES	25
8. APPENDIX-A	26
9. APPENDIX B - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB	29



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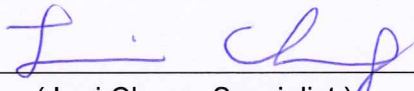
RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF140606E01-3	Original release	July 09, 2014

1. CERTIFICATION

PRODUCT: 802.11ac+802.11abgn + BT4.0+BT3.0+BT2.1/EDR
Module
BRAND NAME : FOXCONN
MODEL NO.: T77H526
TEST SAMPLE: ENGINEERING SAMPLE
APPLICANT: Hon Hai PRECISION IND.CO.,LTD.
TESTED: June 30, 2014
STANDARDS: FCC Part 15, Subpart E (Section 15.407)
FCC KDB 905462 D02

The above equipment (Model: T77H526) has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and was in compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

PREPARED BY :  , **DATE:** July 09, 2014
(Lori Chung, Specialist)

APPROVED BY :  , **DATE:** July 09, 2014
(May Chen, Manager)

2. EUT INFORMATION

2.1 OPERATING FREQUENCY BANDS AND MODE OF EUT

TABLE 1: OPERATING FREQUENCY BANDS AND MODE OF EUT

OPERATIONAL MODE	OPERATING FREQUENCY RANGE	
	5250~5350MHz	5470~5725MHz
Client without radar detection and ad hoc function	✓	✓

2.2 EUT SOFTWARE AND FIRMWARE VERSION

TABLE 2: THE EUT SOFTWARE/FIRMWARE VERSION

PLATFORM	NO.	PRODUCT	MODEL NO.	SOFTWARE/FIRMWARE VERSION
Fedora OS	1	802.11ac+802.11abgn + BT4.0+BT3.0+BT2.1/EDR Module	T77H526	SD8897-15.68.4.p41-C3X15C020-GPL-(FP68)

2.3 DESCRIPTION OF AVAILABLE ANTENNAS TO THE EUT

TABLE 3: ANTENNA LIST

Antenna No.	Transmitter Circuit	Brand	Model	Antenna Gain(dBi) <include cable loss>	Cable Loss (dB)	Frequency range (MHz to MHz)	Antenna Type	Connector Type	Cable Length (mm)
1	Chain (0)	Wistron Neweb Corporation	DC33001KT00 (Main port)	1.54	1.38	2400~2500	PIFA	I-PEX	363
				1.26	1.98	5150~5350			
				0.57	2.04	5470~5725			
				1.23	2.08	5725~5850			
2	Chain (1)	Wistron Neweb Corporation	DC33001KT10 (Aux port)	0.63	2.13	2400~2500	PIFA	I-PEX	593
				0.16	3.11	5150~5350			
				0.35	3.21	5470~5725			
				1.84	3.27	5725~5850			

2.4 EUT MAXIMUM CONDUCTED POWER

TABLE 4: THE MEASURED CONDUCTED OUTPUT POWER

IEEE 802.11a

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	17.17	52.126
1	5470~5725	17.07	50.94

IEEE 802.11ac (VHT20)

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	17.10	51.231
1	5470~5725	17.06	50.763

IEEE 802.11ac (VHT40)

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	16.6	45.66
1	5470~5725	16.85	48.381

IEEE 802.11ac (VHT80)

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	12.34	17.125
1	5470~5725	17.06	50.873

2.5 EUT MAXIMUM EIRP POWER

TABLE 5: THE EIRP OUTPUT POWER LIST

IEEE 802.11a

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	18.43	69.671
1	5470~5725	17.64	58.084

IEEE 802.11ac (VHT20)

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	18.36	68.475
1	5470~5725	17.63	57.882

IEEE 802.11ac (VHT40)

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	17.86	61.029
1	5470~5725	17.42	55.126

IEEE 802.11ac (VHT80)

Ant. Set No.	FREQUENCY BAND (MHz)	MAX. POWER	
		OUTPUT POWER(dBm)	OUTPUT POWER(mW)
1	5250~5350	13.6	22.889
1	5470~5725	17.63	58.008



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2.6 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 EIRP of less than 500 mW.

Maximum EIRP of this device is 69.671mW which less than 500mW, therefore it's not require TPC function.

2.7 STATEMENT OF MAUNFACTURER

This device (Client) is without radar detection, then the manufacturer statement confirming that information regarding the parameters of the detected Radar Waveforms is not available to the end user. **And the device doesn't have Ad Hoc mode on DFS frequency band.**

3. U-NII DFS RULE REQUIREMENTS

3.1 WORKING MODES AND REQUIRED TEST ITEMS

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 6 and 7 for the applicability of DFS requirements for each of the operational modes.

TABLE 6: APPLICABILITY OF DFS REQUIREMENTS PRIOR TO USE A CHANNEL

Requirement	Operational Mode		
	Master	Client without radar detection	Client with radar detection
Non-Occupancy Period	✓	Not required	✓
DFS Detection Threshold	✓	Not required	✓
Channel Availability Check Time	✓	Not required	Not required
U-NII Detection Bandwidth	✓	Not required	✓

TABLE 7: APPLICABILITY OF DFS REQUIREMENTS DURING NORMAL OPERATION

Requirement	Operational Mode	
	Master or Client with radar detection	Client without radar detection
DFS Detection Threshold	✓	Not required
Channel Closing Transmission Time	✓	✓
Channel Move Time	✓	✓
U-NII Detection Bandwidth	✓	Not required

Additional requirements for devices with multiple bandwidth modes	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 all 20 MHz channel blocks and a null frequencies between the bonded 20 MHz channel blocks.



3.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

DETECTION THRESHOLD VALUES

TABLE 8: 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>	

**A D T****TABLE 9: 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
<p>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.</p> <p>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.</p> <p>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.</p>	



PARAMETERS OF DFS TEST SIGNALS

Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

TABLE 10: 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	<p>Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a</p> <p>-----</p> <p>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</p>	$\text{Roundup} \left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\}$	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.					



TABLE 11: 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 NUMBER OF TRIALS
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

TABLE 12: 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

4. TEST & SUPPORT EQUIPMENT LIST

4.1 TEST INSTRUMENTS

TABLE 13: TEST INSTRUMENTS LIST.

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer R&S	FSW8	101497	Aug.07.2013	Aug 06, 2014
Vector Signal Generator R&S	SMJ100A	101878	Aug 13, 2013	Aug 12, 2014

4.2 DESCRIPTION OF SUPPORT UNITS

TABLE 14: SUPPORT UNIT INFORMATION.

NO.	PRODUCT	BRAND	MODEL NO.	ID	SPEC.
1	WIRELESS AC MODULE	D-Link	WMC-AC01	RRK2012060056-1	The maximum EIRP is 27.64 dBm, Antenna Gain is 3.428dBi

NOTE: This device was functioned as a ☒ Master ☐ Slave device during the DFS test.

TABLE 15: SOFTWARE/FIRMWARE INFORMATION.

NO.	PRODUCT	MODEL NO.	SOFTWARE/FIRMWARE VERSION
1.	WIRELESS AC MODULE	WMC-AC01	1.00 Wed 06 Mar 2013

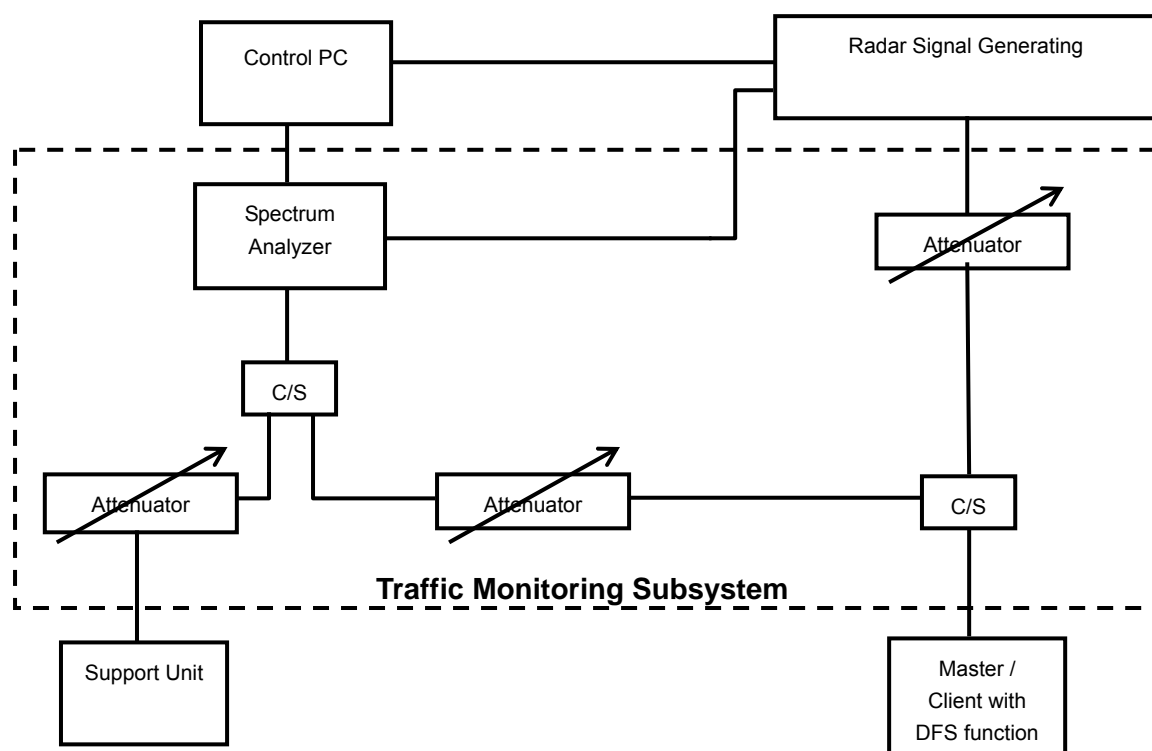
Note: This module WMC-AC01 was installed in the DIR-868L AP.

5. TEST PROCEDURE

5.1 BVADT DFS MEASUREMENT SYSTEM:

A complete BVADT DFS Measurement System consists of two subsystems: (1) the Radar Signal Generating Subsystem and (2) the Traffic Monitoring Subsystem. The control PC is necessary for generating the Radar waveforms in Table 10, 11 and 12. The traffic monitoring subsystem is specified to the type of unit under test (UUT).

CONDUCTED SETUP CONFIGURATION OF ADT DFS MEASUREMENT SYSTEM



The test transmission will always be from the Master Device to the Client Device. While the Client device is set up to associate with the Master device and play the MPEG file (6 $\frac{1}{2}$ Magic Hours) from Master device, the designated MPEG test file and instructions are located at:

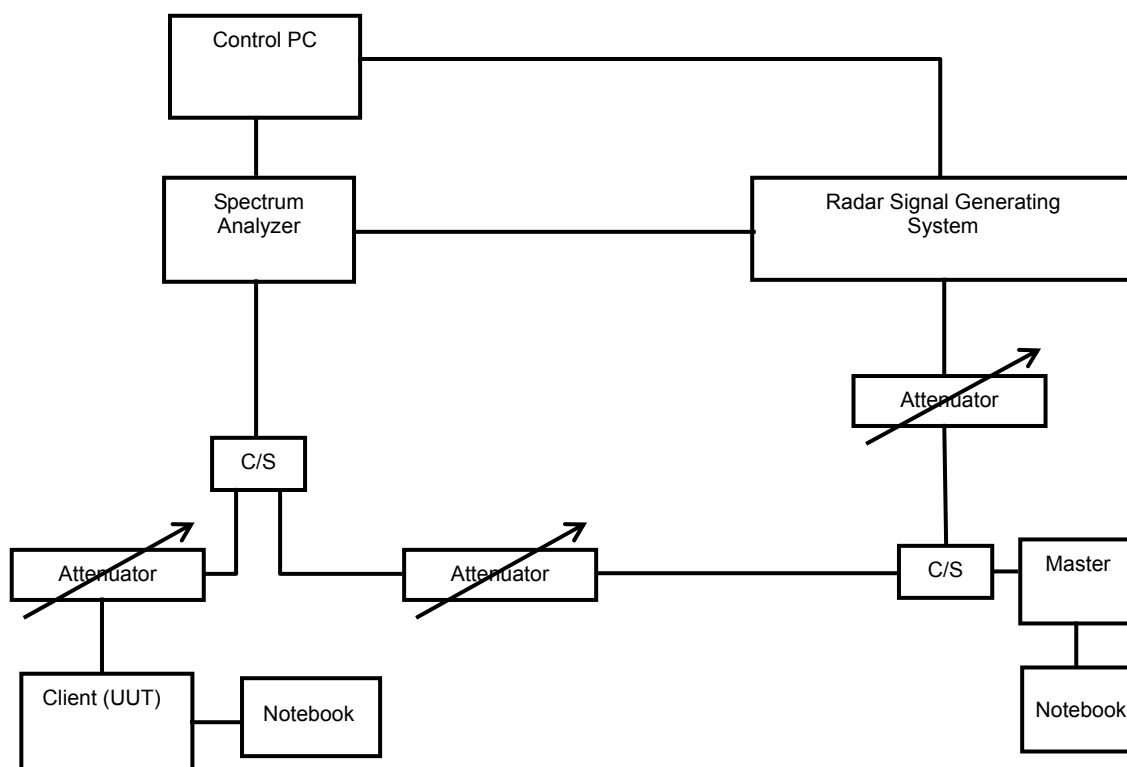
<http://ntiacsd.ntia.doc.gov/dfs/>.

5.3 DEVIATION FROM TEST STANDARD

No deviation.

5.4 CONDUCTED TEST SETUP CONFIGURATION

5.4.1 CLIENT WITHOUT RADAR DETECTION MODE



The UUT is a U-NII Device operating in Client mode without radar detection. The radar test signals are injected into the Master Device.

6. TEST RESULTS

6.1 SUMMARY OF TEST RESULTS

CLAUSE	TEST PARAMETER	REMARKS	PASS/FAIL
15.407	DFS Detection Threshold	Not Applicable	NA
15.407	Channel Availability Check Time	Not Applicable	NA
15.407	Channel Move Time	Applicable	Pass
15.407	Channel Closing Transmission Time	Applicable	Pass
15.407	Non- Occupancy Period	Applicable	Pass
15.407	U-NII Detection Bandwidth	Not Applicable	NA
15.407	Non-associated test	Applicable	Pass
15.407	Non-Co-Channel test	Applicable	Pass

6.2 DETAILED TEST RESULTS

6.2.1 TEST MODE: DEVICE OPERATING IN CLIENT WITHOUT RADAR DETECTION MODE.

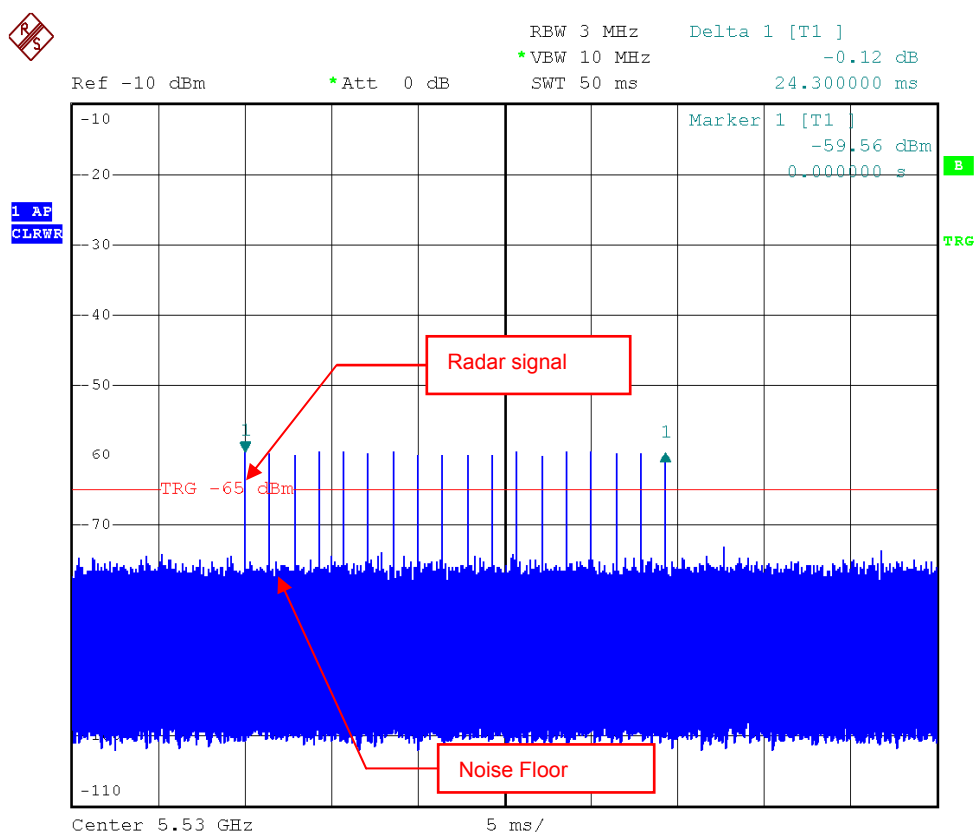
The radar test signals are injected into the Master Device.

This test was investigated for different bandwidth (20MHz 、 40MHz and 80MHz).

The following plots was done on 80MHz as a representative

6.2.1.1 DFS DETECTION THRESHOLD

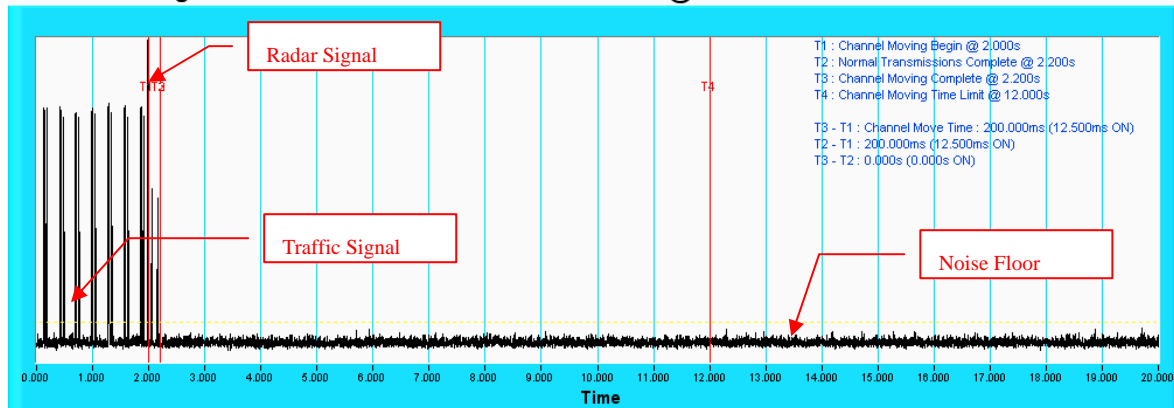
The required detection threshold is -59.572dBm ($= -64 + 3.428 + 1$). The conducted radar burst level is set to -59.572dBm .



Radar Signal 0

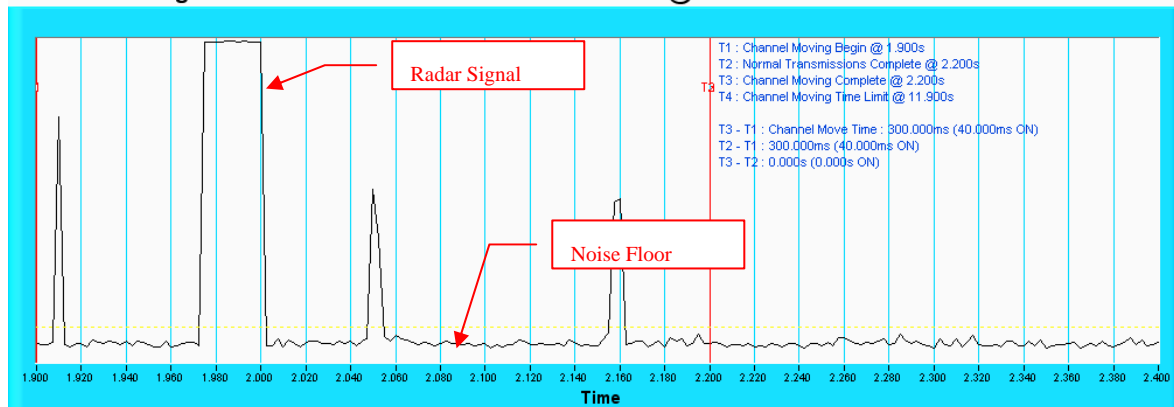
6.2.1.2 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME

Channel Closing Transmission Time & Channel Move Time @ CH106 - 5530MHz



NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

Channel Closing Transmission Time & Channel Move Time @ CH106 - 5530MHz

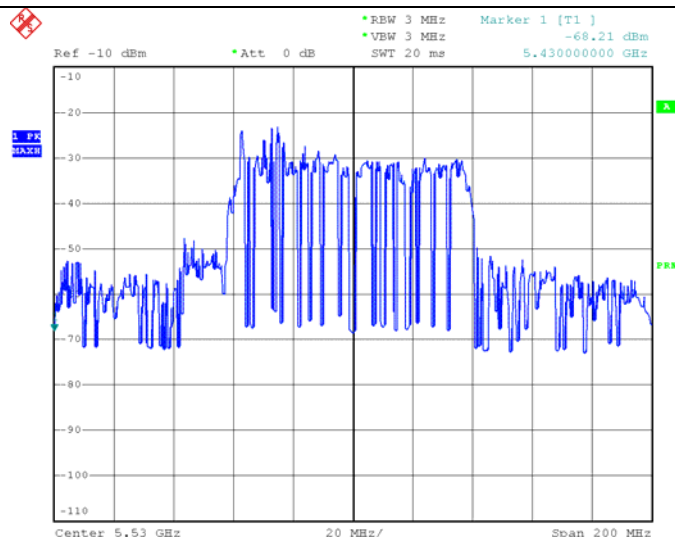


NOTE: An expanded plot for the device vacates the channel in the required 500ms.

6.2.1.3 NON- OCCUPANCY PERIOD

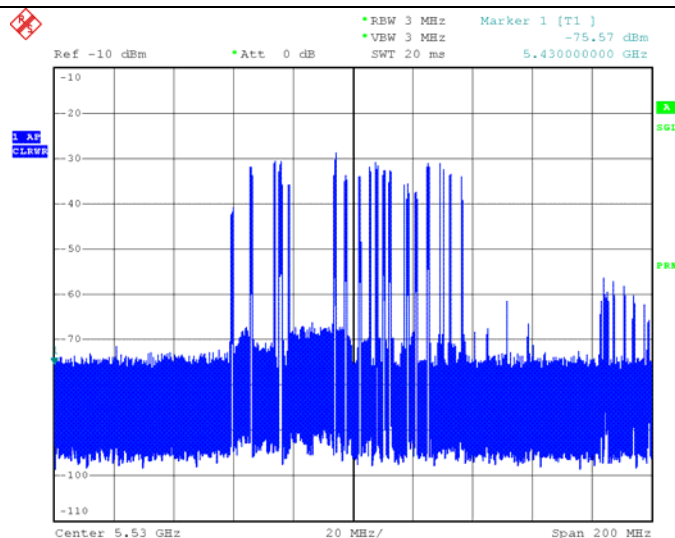
ASSOCIATED TEST

1) Test results demonstrating an associated client link is established with the master on a test frequency.



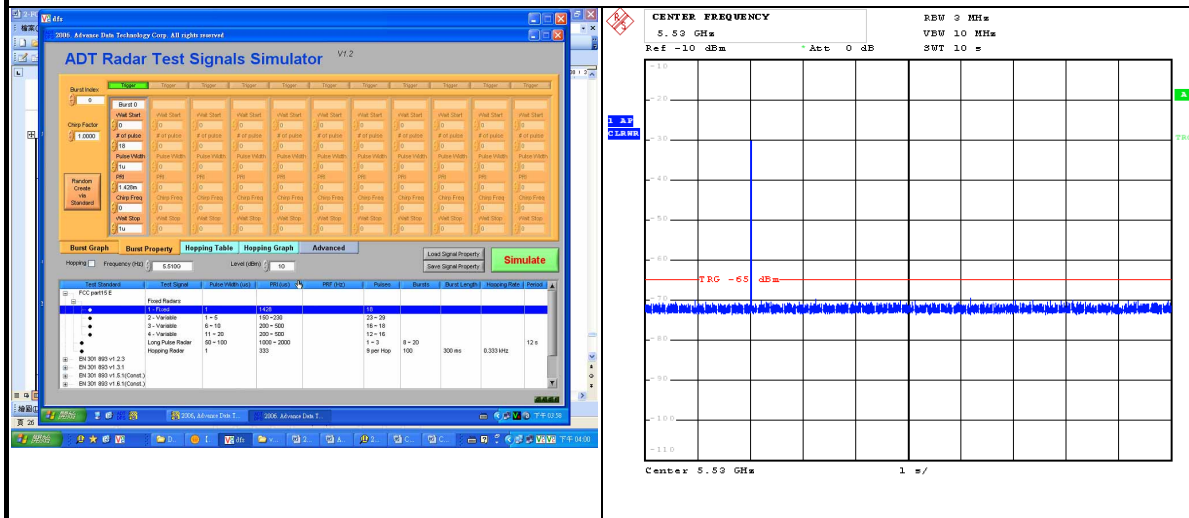
EUT (Client) links with master on 5530MHz

2) The client and DFS-certified master device are associated, and the movie can be streamed as specified in the DFS Order for a non-occupancy period test.



Client plays a specified files via master.

3). The device transmits one type of radar as specified in the DFS Order.

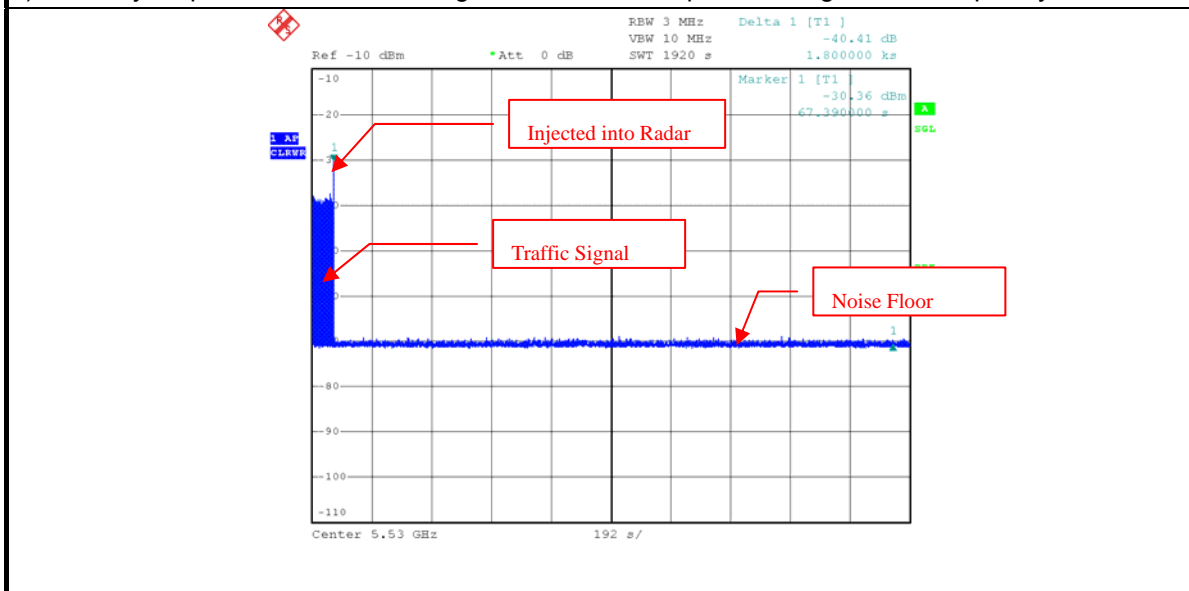


Radar 0 is used to test during DFS testing.

4) The test frequency has been 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;

5) An analyzer plot that contains a single 30-minute sweep on the original test frequency.

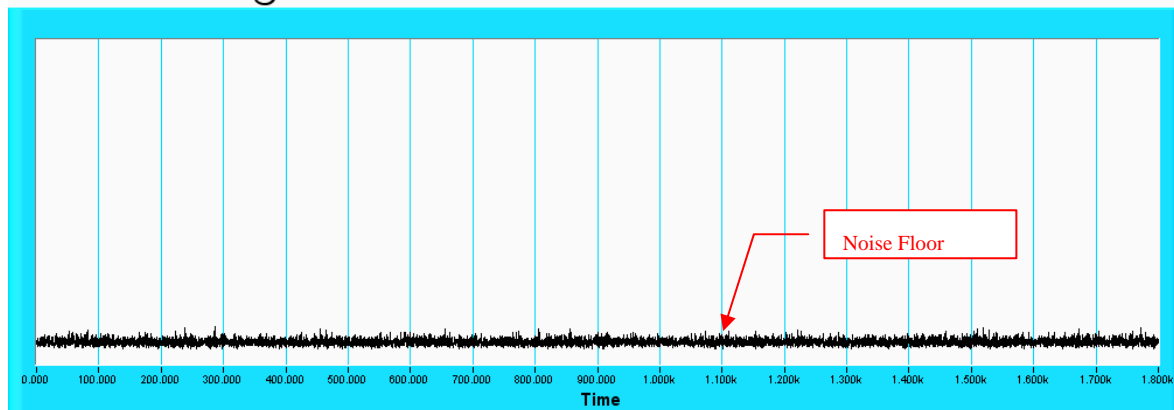


6.2.1.4 NON-ASSOCIATED TEST

Master was off.

During the 30 minutes observation time, The UUT did not make any transmissions in the DFS band after UUT power up.

Non Associated Test @ CH106 - 5530MHz



6.2.1.5 NON- CO-CHANNEL TEST

The UUT was investigated after radar was detected the channel and made sure no co-channel operation with radars.



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7. INFORMATION ON THE TESTING LABORATORIES

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab:

Tel: 886-2-26052180

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Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

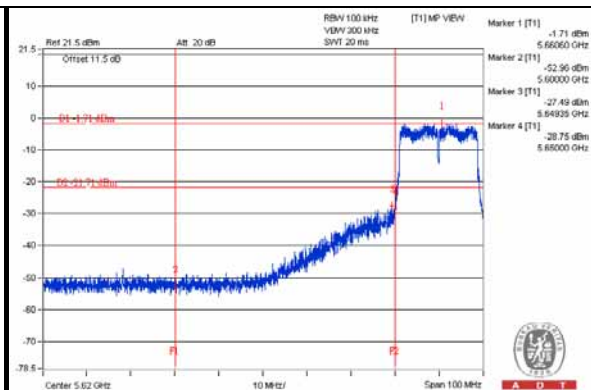
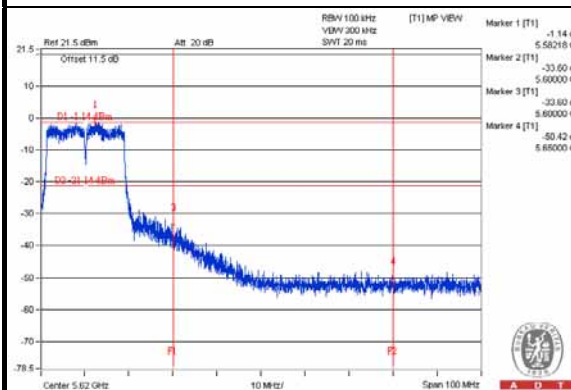
The address and road map of all our labs can be found in our web site also.

8. APPENDIX-A

Notch band in 5600-5650MHz

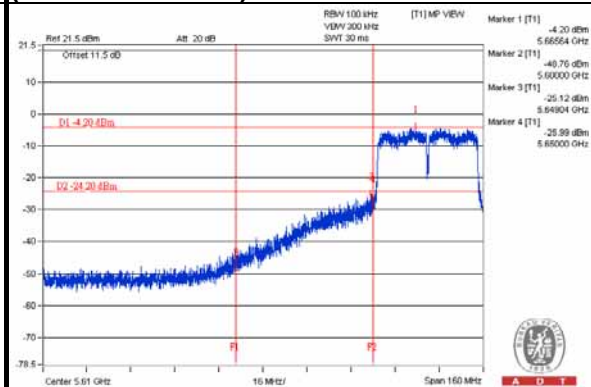
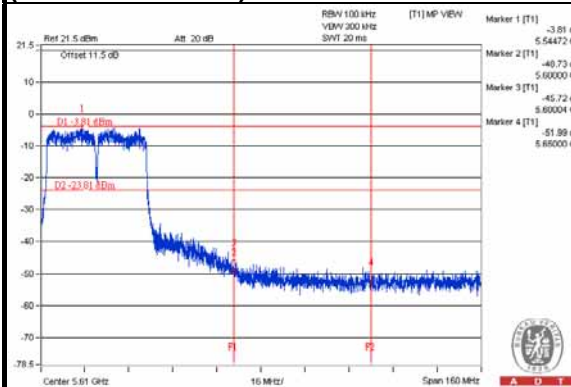
Verify that the 5600 – 5650 MHz band is notched.

Test results demonstrating last channel shall not exceed the band edge on 5600~5650MHz.



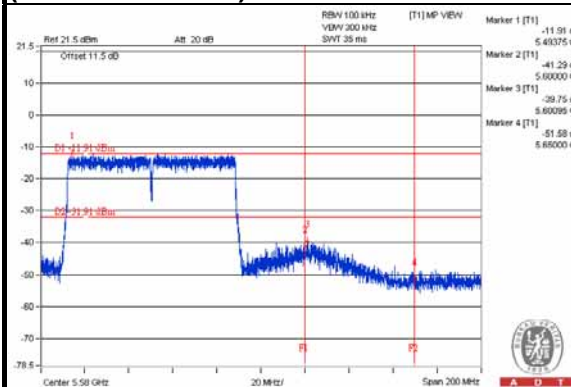
**802.11ac (VHT20) MODULATION
(CH 116: 5580MHz)**

**802.11ac (VHT20) MODULATION
(CH 132: 5660MHz)**



**802.11ac (VHT40) MODULATION
(CH 110: 5550MHz)**

**802.11ac (VHT40) OFDM MODULATION
(CH 134: 5670MHz)**



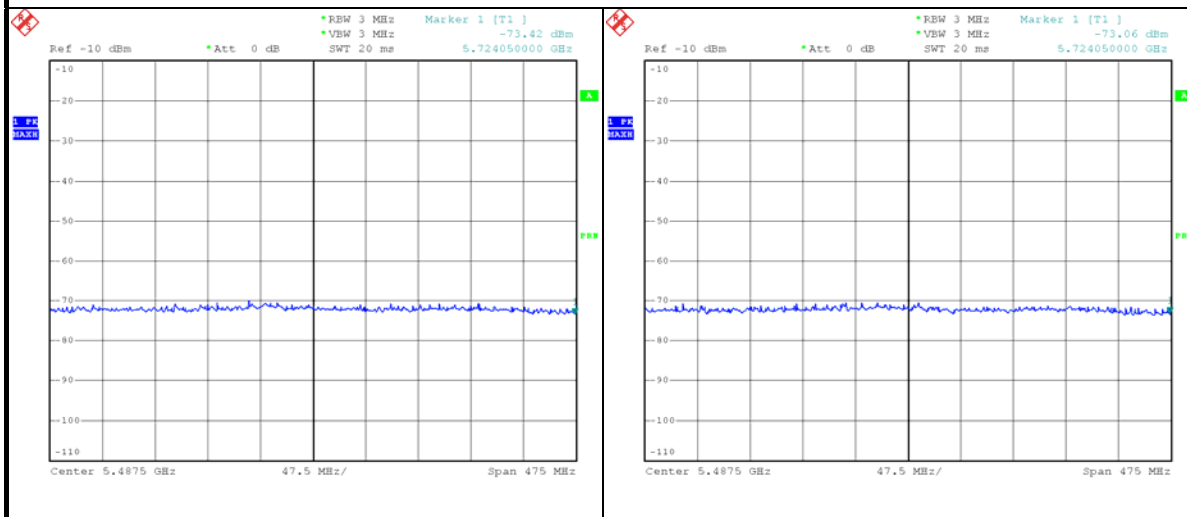
**802.11ac (VHT80) MODULATION
(CH 106: 5530MHz)**



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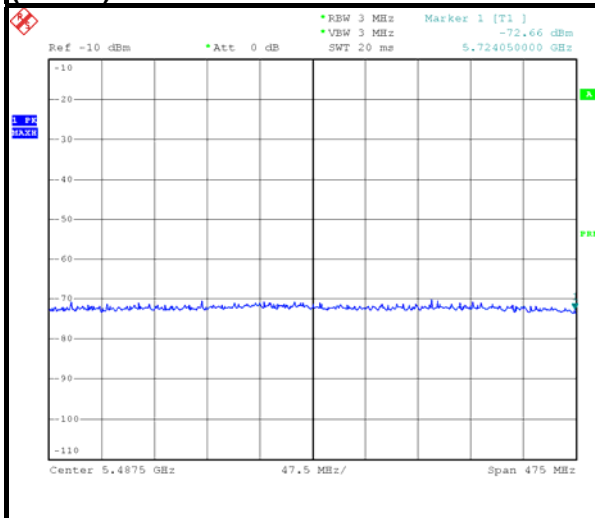
NON BEACON ON DFS BAND

- 1) Test results demonstrating no any beacon on DFS band after power up.
- 2) Observation time is 10min after power up.



EUT (Client) links with master on 11ac
(VHT20) mode

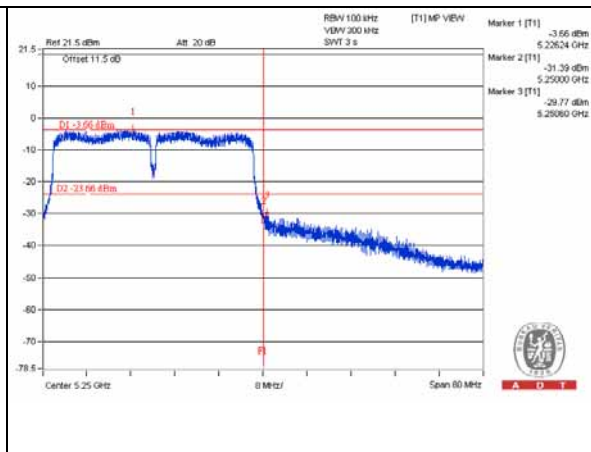
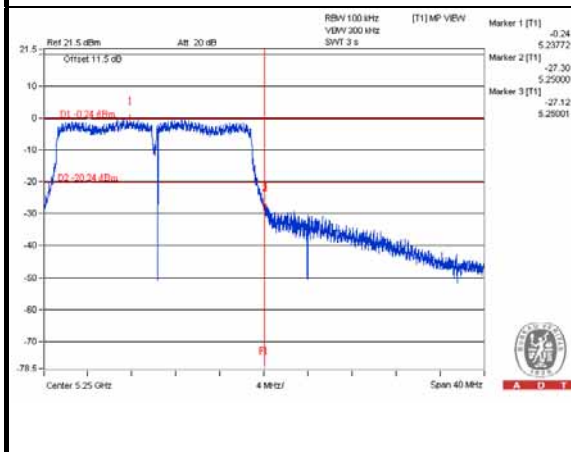
EUT (Client) links with master on 11ac
(VHT40) mode



EUT (Client) links with master on 11ac
(VHT80) mode

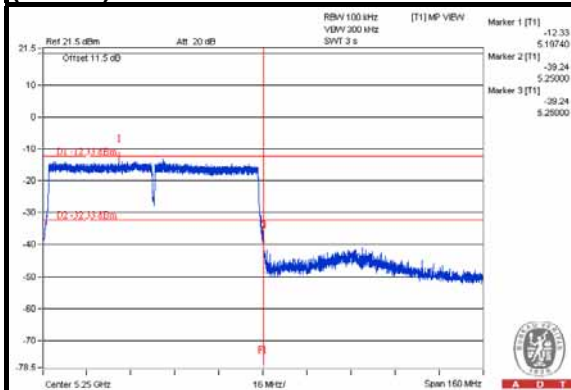
BAND EDGE AT NEARBY DFS BAND

1) Test results demonstrating last channel (20dB BW) shall not exceed the band edge on 5150~5250MHz.



EUT (Client) links with master on 11ac
(VHT20) mode

EUT (Client) links with master on 11ac
(VHT40) mode



EUT (Client) links with master on 11ac
(VHT80) mode



A D T

9. APPENDIX B - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No modifications were made to the EUT by the lab during the test.

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