FCC TEST REPORT (15.407) (Validation Test)

REPORT NO.:	RF121205E03A-1
MODEL NO.:	WMC-AC01
FCC ID:	RRK2012060056-1
RECEIVED:	Aug. 28, 2013
TESTED:	Aug. 30, 2013
ISSUED:	Sep. 02, 2013

APPLICANT:	Alpha Networks Inc.
ADDRESS:	No.8 Li-shing 7th Rd., Science-based Industrial Park, Hsinchu, Taiwan, R.O.C.

ISSUED BY:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
LAB ADDRESS :	No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.
TEST LOCATION (1):	No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.
TEST LOCATION (2):	No. 49, Ln. 206, Wende Rd., Shangshan Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.

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Table of Contents

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF121205E03A-1	Original release	Sep. 02, 2013

1. CERTIFICATION

PRODUCT:	Wireless AC Module
BRAND NAME:	Alpha
MODEL NO.:	WMC-AC01
TEST SAMPLE:	R&D SAMPLE
APPLICANT:	Alpha Networks Inc.
TESTED:	Aug. 30, 2013
STANDARDS:	FCC Part 15, Subpart E (Section 15.407) ANSI C63.10-2009

The above equipment (Model: WMC-AC01) has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found 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:** *Sep. 02, 2013*
(Lori Chung, Specialist)

APPROVED BY : _____ , **DATE:** *Sep. 02, 2013*
(May Chen, Manager)

2. TEST RESULT CONCLUSION

After Broadcom RD's investigation, they concluded that the power calibration in the submitted sample was not properly set and have reprogrammed a correct version for us to verify. The test result confirms that the finding is correct and now high channel-edge emission skirt has been significantly suppressed and demonstrates compliance with the rule. For detail, please refer to test comparison between both new and older versions attached below. The applicant confirms that the entire product will be shipped with new firmware and will not have the same issue found in the submitted version. Thanks.

3. EUT INFORMATION

3.1 EUT SOFTWARE AND FIRMWARE VERSION

No.	Product	Model No.	Software/Firmware Version
1	Wireless AC Module	WMC-AC01	1.00 Wed 06 Mar 2013

Note: This device DIR-868L AP Inside with WMC-AC01.

3.2 DESCRIPTION OF AVAILABLE ANTENNAS TO THE EUT

The antennas provided to the EUT, please refer to the following table:

Set 4								
Transmitter Circuit	Brand	Model name	Antenna Type	Gain (dBi) (Exclude cable loss)	Cable Loss (dB)	Net Gain (dBi)	Connecter Type	Cable Length(mm)
Chain (0)	WHA YU	C037-511226-A	PCB	4	0.416	3.584	I-PEX	80
Chain (1)	WHA YU	C037-511225-A	PCB	4	0.572	3.428	I-PEX	110
Chain (2)	WHA YU	C037-511225-A	PCB	4	0.572	3.428	I-PEX	110

3.3 DESCRIPTION OF TEST MODES

2 channels is provided for 802.11ac (VHT80):

CHANNEL	FREQUENCY
58	5290 MHz
106	5530 MHz

3.4 TEST MODE

3.4.1 TEST ITEM – RADIATED EMISSION AND BANDEDGE

(A) OLD VERSION FIRMFARE

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)	FIRMWARE VERSION
802.11n (VHT80)	58 to 106	58, 106	OFDM	BPSK	87.8	Old: DIR868LA1_FW100b08dfs04_d36i

(B) FINAL VERSION FIRMWARE

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)	FIRMWARE VERSION
802.11n (VHT80)	58 to 106	58, 106	OFDM	BPSK	87.8	New: DIR868LA1_FW101b05_d8la i

3.4.2 TEST ITEM – CHANNEL BANDWIDTH

(A) OLD VERSION FIRMWARE

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)	FIRMWARE VERSION
802.11n (VHT80)	58 to 106	58, 106	OFDM	BPSK	87.8	Old: DIR868LA1_FW100b08dfs04_d36i

(B) NEW VERSION FIRMWARE

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)	FIRMWARE VERSION
802.11n (VHT80)	58 to 106	58, 106	OFDM	BPSK	87.8	New: DIR868LA1_FW101b05_d8la i

3.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart E (15.407)

789033 D01 General UNII Test Procedures

662911 D01 Multiple Transmitter Output

ANSI C63.10-2009

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

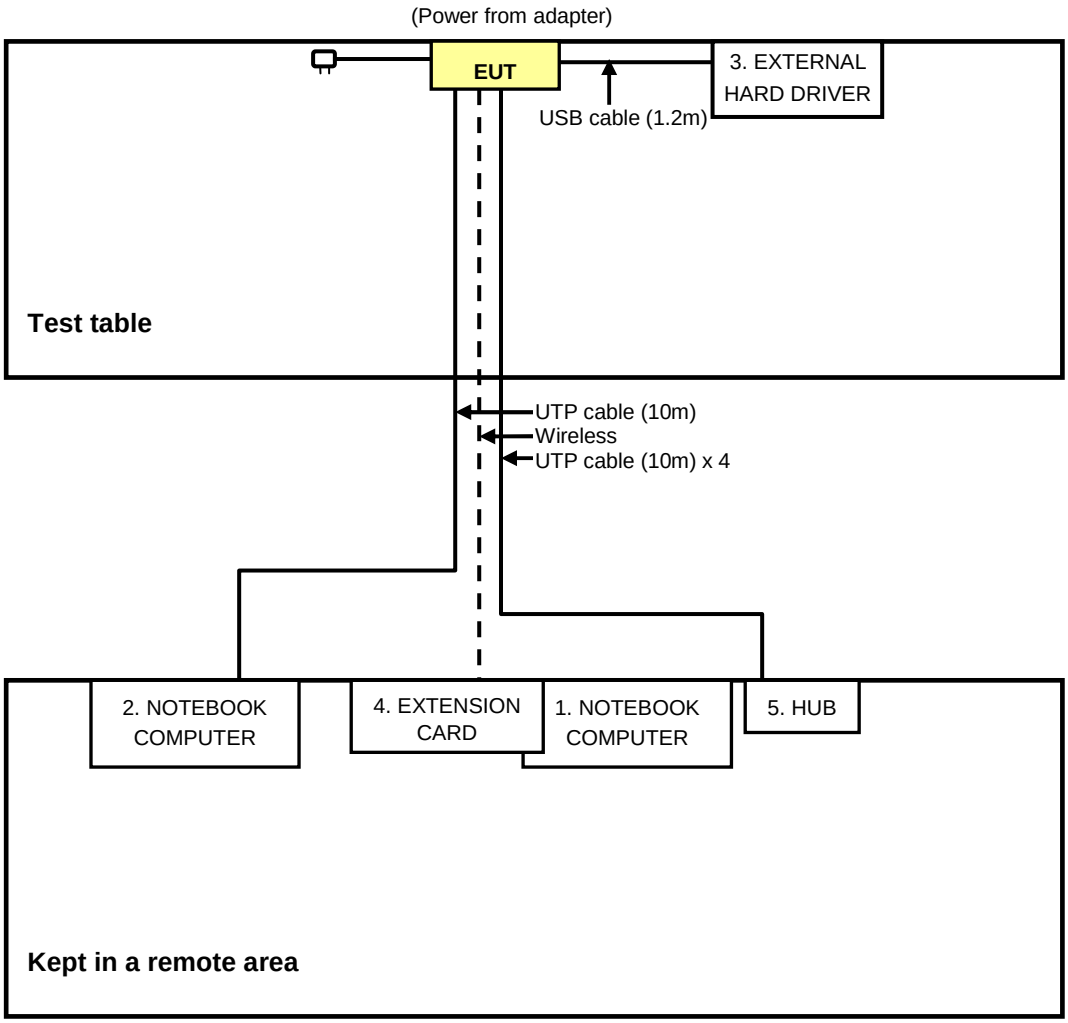
3.6 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	NOTEBOOK COMPUTER	DELL	PP19L	CN-OHC416-70166-5CA-0448	PIW632500516610
2	NOTEBOOK COMPUTER	DELL	E6420	H62T3R1	FCC DoC
3	EXTERNAL HARD DRIVER	WD	WDBACW0010HBK-SESN	WCAZAL625787	NA
4	Client Adapter 802.11 a/b/g/n/ac USB dongle	Cisco	AE6000	NA	Q87-AE6000
5	HUB	ZyXEL	ES-116P	S060H02000215	FCC DoC

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	UTP cable 10m x5
2	USB cable 1.2m x1
3	DC line, 1.5m x2

3.7 CONFIGURATION OF SYSTEM UNDER TEST



4. TEST TYPES AND RESULTS

4.1 RADIATED EMISSION AND BANDEDGE MEASUREMENT

4.1.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table:

Frequencies (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB.

4.1.2 LIMITS OF UNWANTED EMISSION OUT OF THE RESTRICTED BANDS

APPLICABLE TO	LIMIT	
	FIELD STRENGTH AT 3m (dBµV/m)	
	PK	AV
	74	54
	EIRP LIMIT (dBm)	EQUIVALENT FIELD STRENGTH AT 3m (dBµV/m)
√	PK	PK
	-27	68.3

NOTE:

1. The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3}$$ µV/m, where P is the eirp (Watts).

4.1.3 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer Agilent	E4446A	MY48250253	Sep. 03, 2012	Sep. 02, 2013
MXE EMI Receiver Agilent	N9038A	MY51210105	Jan. 29,2013	Jan. 28,2014
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-03	Nov. 14, 2012	Nov. 13, 2013
Pre-Amplifier Agilent	8449B	3008A02578	June 25, 2013	June 24, 2014
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Nov. 14, 2012	Nov. 13, 2013
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-360	Mar. 19, 2013	Mar. 18, 2014
Horn_Antenna AISI	AIH.8018	0000320091110	Nov. 19, 2012	Nov. 18, 2013
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Oct. 12, 2012	Oct. 11, 2013
RF Cable	NA	RF104-201 RF104-203 RF104-204	Dec. 25, 2012	Dec. 24, 2013
RF Cable	NA	CHGCAB_001	Oct. 06, 2012	Oct. 05, 2013
Software	ADT_Radiated _V8.7.05	NA	NA	NA
Antenna Tower & Turn Table CT	NA	NA	NA	NA

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
3 The test was performed in 966 Chamber No. G.
4. The FCC Site Registration No. is 966073.
5 The VCCI Site Registration No. is G-137.
6 The CANADA Site Registration No. is IC 7450H-2.
7 Tested Date: Aug. 30, 2013

4.1.4 TEST PROCEDURES

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

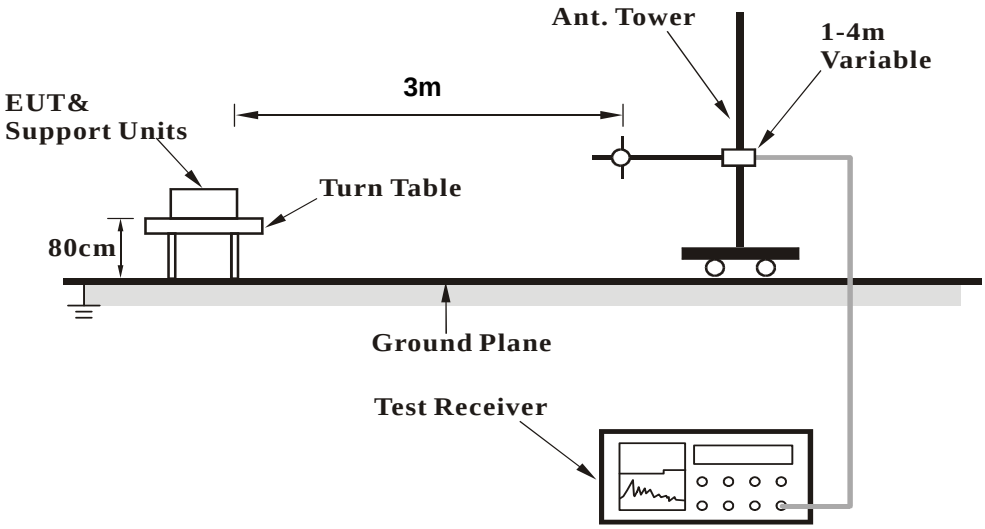
NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.5 DEVIATION FROM TEST STANDARD

No deviation

4.1.6 TEST SETUP



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

4.1.7 EUT OPERATING CONDITION

1. Connect the EUT with the support unit 1 (Notebook Computer) which is placed in remote area.
2. 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 to enable EUT under transmission/receiving condition continuously at specific channel frequency. The designated MPEG test file and instructions are located at: http://ntiacsd.ntia.doc.gov/dfs/.

4.1.8 TEST RESULTS

(A) OLD VERSION FIRMFARE

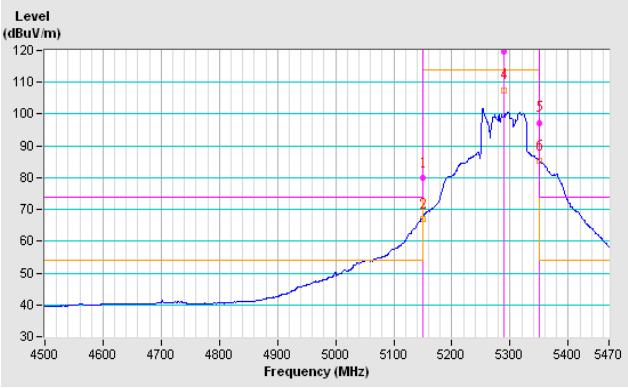
802.11n (VHT80)

CHANNEL	TX Channel 58	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 40GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	5150.00	80.1 PK	74.0	6.1	1.41 H	25	38.66	41.44
2	5150.00	67.1 AV	54.0	13.1	1.41 H	25	25.66	41.44
3	*5290.00	119.5 PK			1.41 H	25	77.77	41.73
4	*5290.00	107.6 AV			1.41 H	25	65.87	41.73
5	5350.00	97.3 PK	74.0	23.3	1.41 H	25	55.39	41.91
6	5350.00	85.2 AV	54.0	31.2	1.41 H	25	43.29	41.91

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

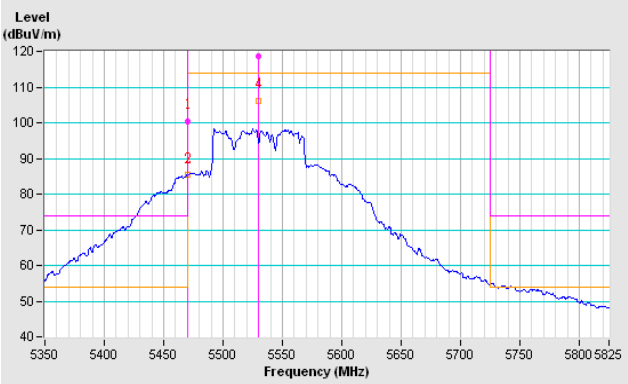


CHANNEL	TX Channel 106	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	#5470.00	100.3 PK	74.0	26.3	1.35 H	15	58.04	42.26
2	#5470.00	85.3 AV	54.0	31.3	1.35 H	15	43.04	42.26
3	*5530.00	118.7 PK			1.35 H	15	76.25	42.45
4	*5530.00	106.2 AV			1.35 H	15	63.75	42.45

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



(B) FINAL VERSION FIRMWARE

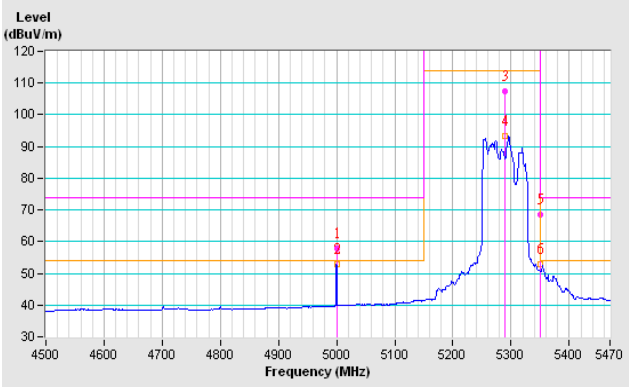
802.11n (VHT80)

CHANNEL	TX Channel 58	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 40GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	5000.00	57.9 PK	74.0	-16.1	1.17 H	92	17.11	40.79
2	5000.00	52.9 AV	54.0	-1.1	1.17 H	92	12.11	40.79
3	*5290.00	107.5 PK			1.41 H	25	65.77	41.73
4	*5290.00	93.4 AV			1.41 H	25	51.67	41.73
5	5350.00	68.6 PK	74.0	-5.4	1.41 H	25	26.69	41.91
6	5350.00	52.8 AV	54.0	-1.2	1.41 H	25	10.89	41.91

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

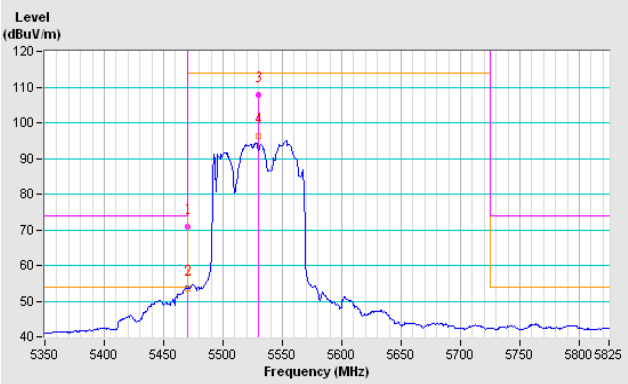


CHANNEL	TX Channel 106	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	#5470.00	70.8 PK	74.0	-3.2	1.33 H	9	28.54	42.26
2	#5470.00	53.7 AV	54.0	-0.3	1.33 H	9	11.44	42.26
3	*5530.00	107.9 PK			1.33 H	9	65.45	42.45
4	*5530.00	96.2 AV			1.33 H	9	53.75	42.45

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



4.2 CHANNEL BANDWIDTH

4.2.1 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
R&S Spectrum Analyzer	FSP40	100037	Nov. 01, 2012	Oct. 31, 2013

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested date : Aug. 30, 2013

4.2.2 TEST PROCEDURE

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 20 dB down from the peak of the emission..

4.2.3 DEVIATION FROM TEST STANDARD

No deviation

4.2.4 TEST SETUP

Follow section 3.1.6

4.2.5 EUT OPERATING CONDITIONS

Follow section 3.1.7

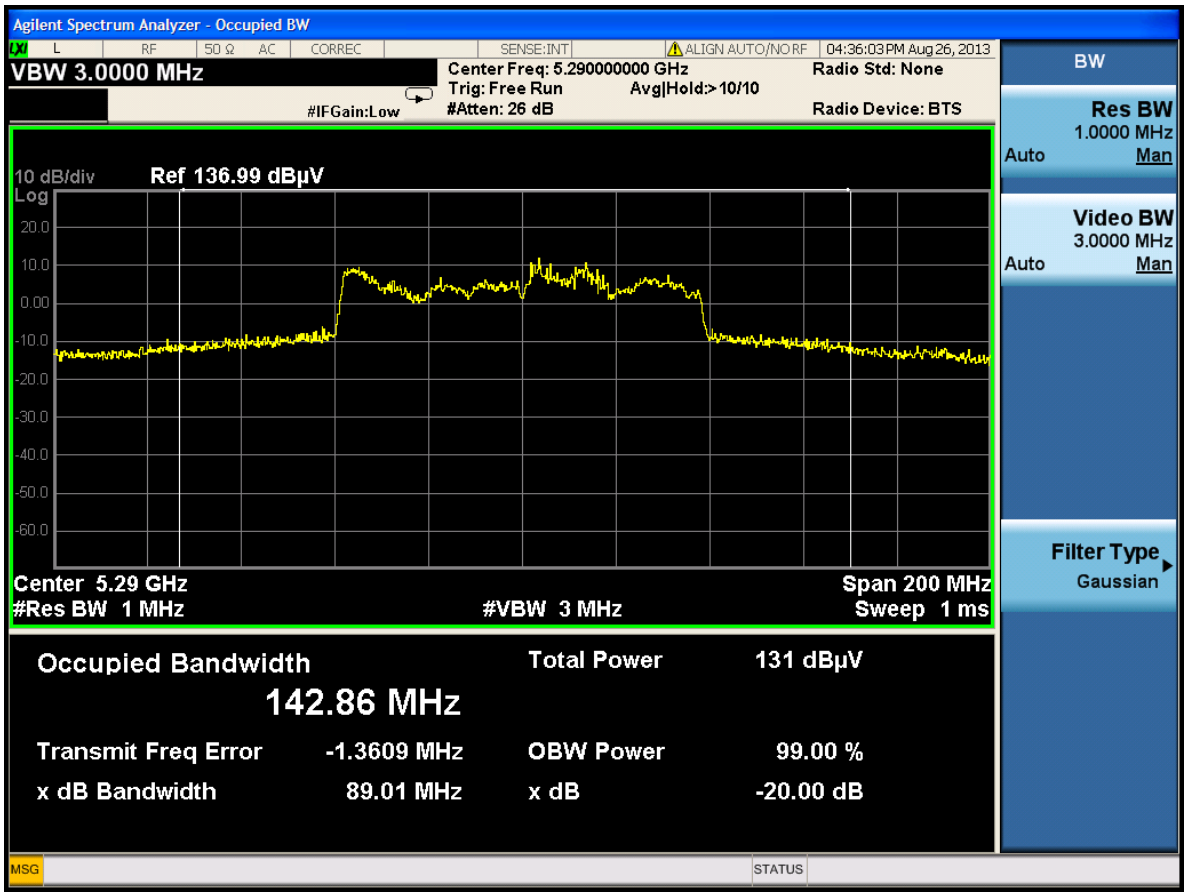
4.2.6 TEST RESULTS

(A) OLD VERSION FIRMFARE

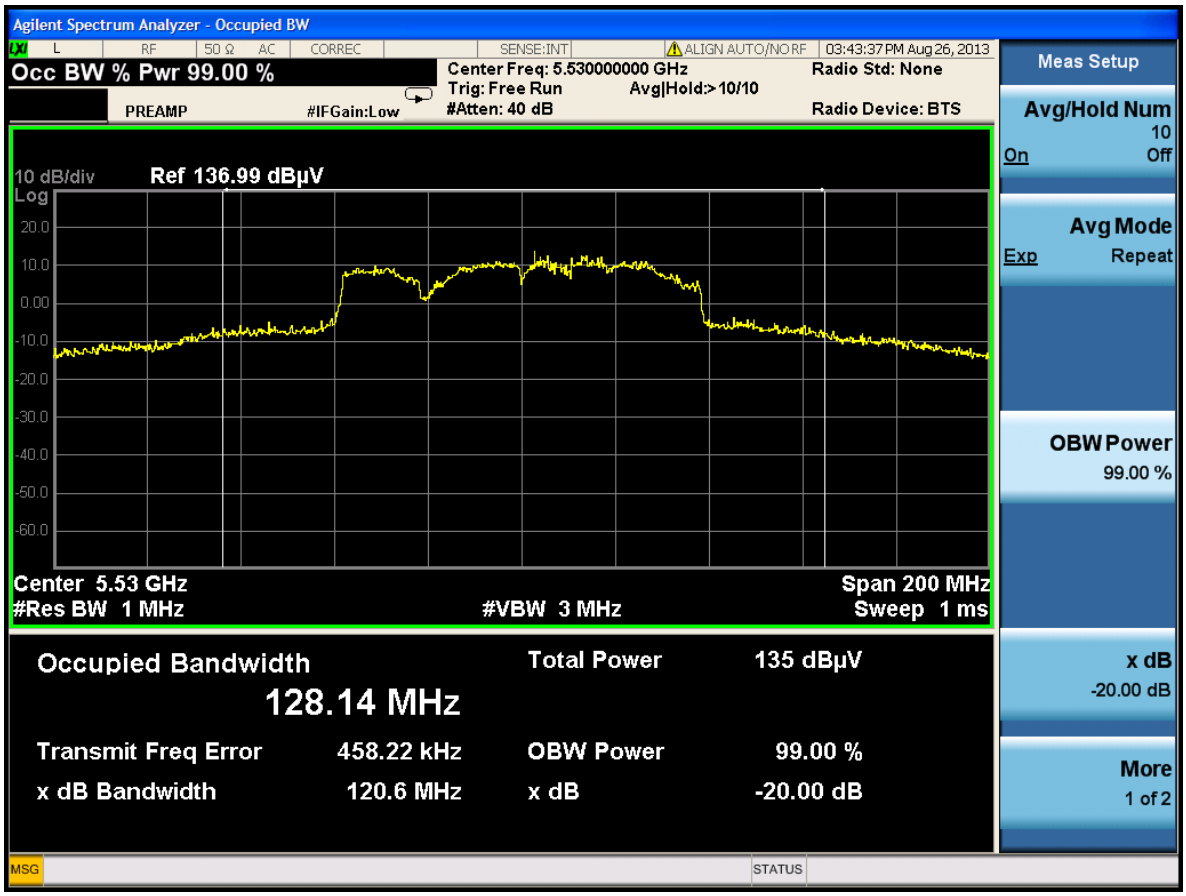
802.11ac (VHT80)

CHANNEL	FREQUENCY (MHz)	CHANNEL BANDWIDTH (MHz)
56	5290	142.86
108	5530	128.14

CH 56



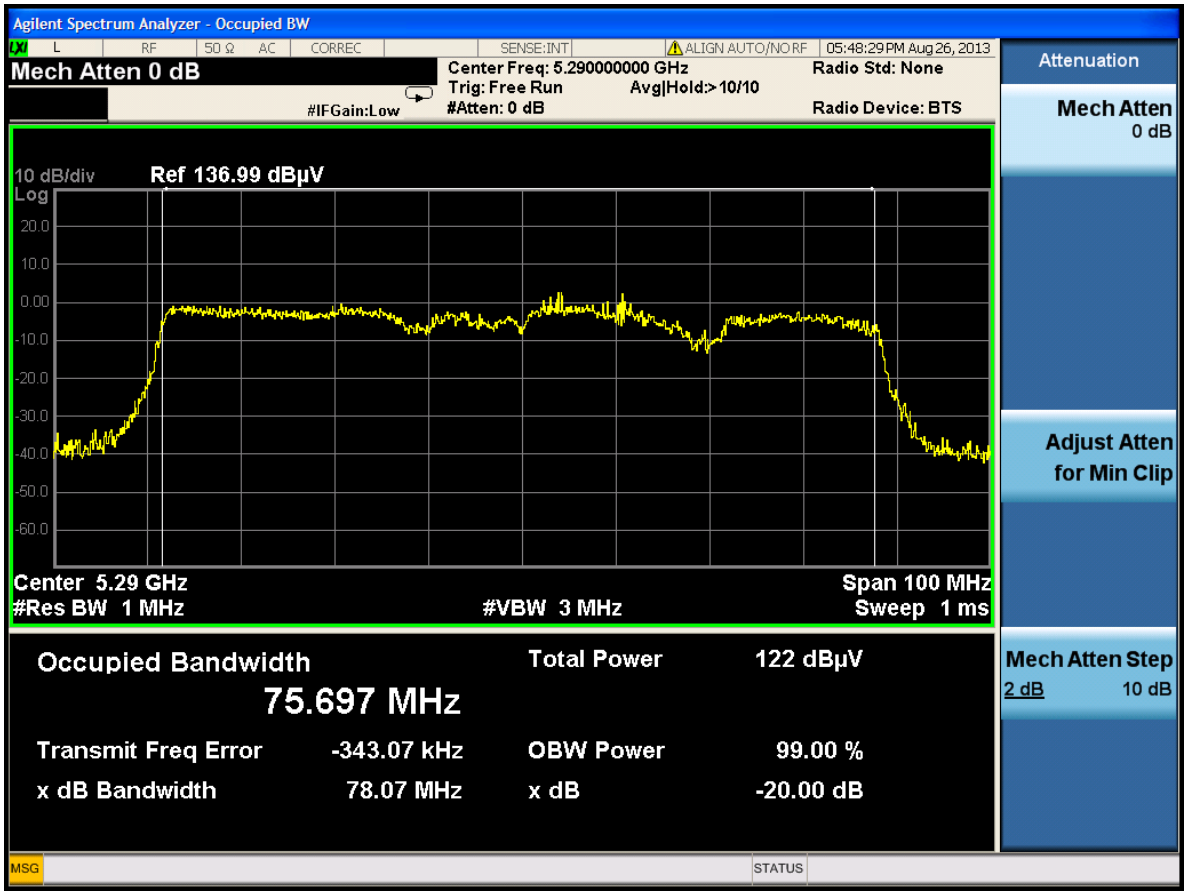
CH 108


Agilent Spectrum Analyzer - Occupied BW
RF
50 Ω
AC
CORREC
SENSE:INT
ALIGN AUTO/NO RF
03:43:37 PM Aug 26, 2013
Occ BW % Pwr 99.00 %
Center Freq: 5.530000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
PREAMP
#IFGain:Low
10 dB/div
Log
Ref 136.99 dBµV
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center 5.53 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 200 MHz
Sweep 1 ms
Occupied Bandwidth
128.14 MHz
Total Power
135 dBµV
Transmit Freq Error
458.22 kHz
OBW Power
99.00 %
x dB Bandwidth
120.6 MHz
x dB
-20.00 dB
MSG
STATUS
Meas Setup
Avg/Hold Num
10
On
Off
Avg Mode
Exp
Repeat
OBW Power
99.00 %
x dB
-20.00 dB
More
1 of 2

(B) FINAL VERSION FIRMWARE

CHANNEL	FREQUENCY (MHz)	CHANNEL BANDWIDTH (MHz)
56	5290	75.69
108	5530	75.23

CH 56



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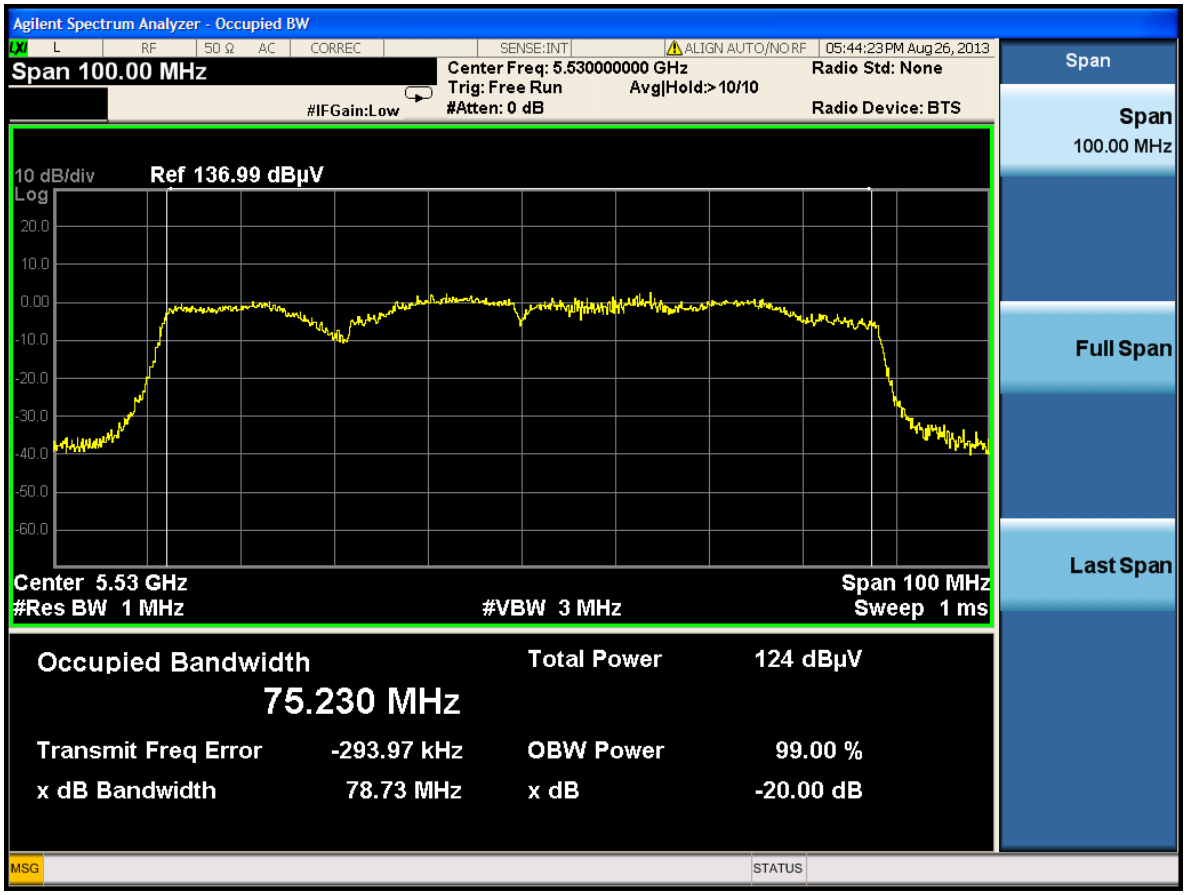
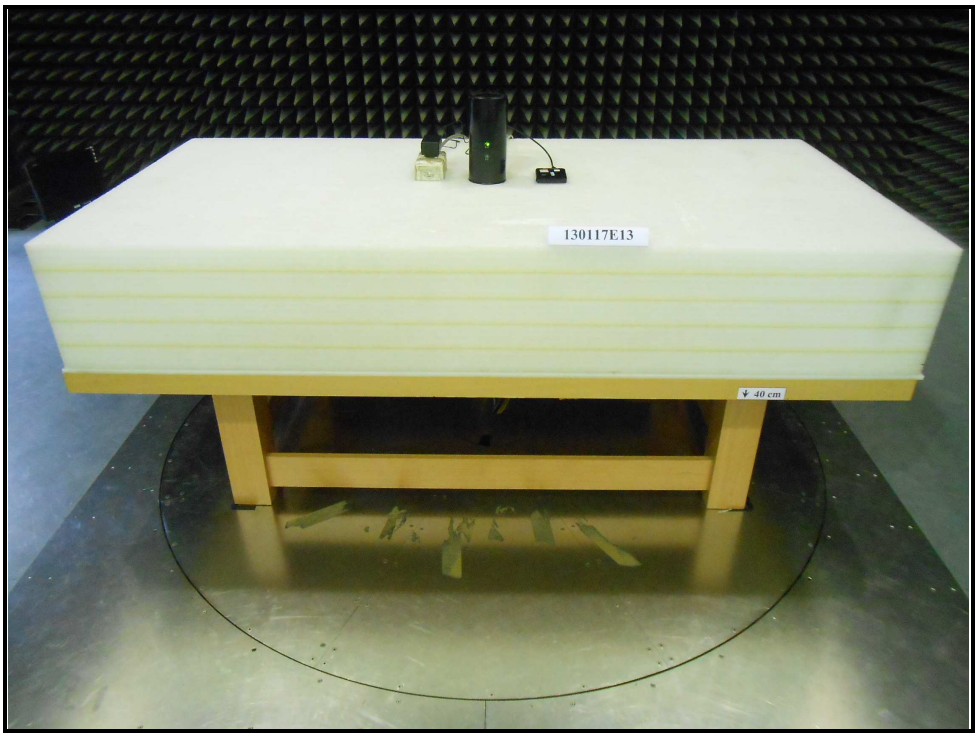
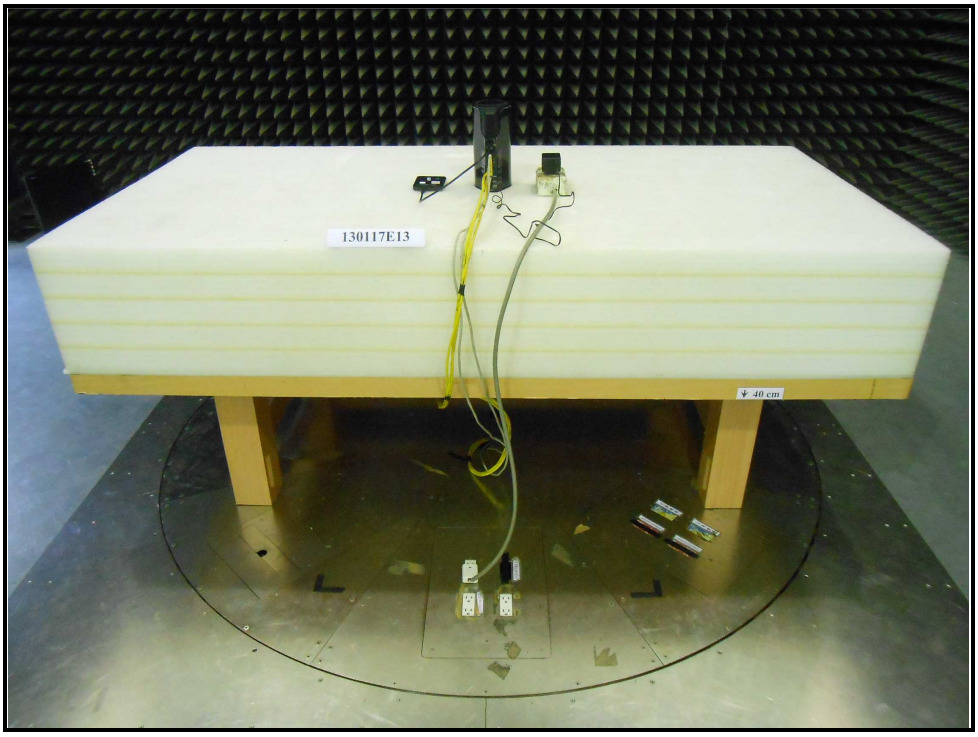

Agilent Spectrum Analyzer - Occupied BW
L
RF
50 Ω
AC
CORREC
SENSE:INT
ALIGN AUTO/NO RF
05:44:23 PM Aug 26, 2013
Span 100.00 MHz
Center Freq: 5.530000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 0 dB
Radio Std: None
Radio Device: BTS
10 dB/div
Log
Ref 136.99 dBµV
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center 5.53 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 100 MHz
Sweep 1 ms
Occupied Bandwidth
75.230 MHz
Total Power
124 dBµV
Transmit Freq Error
-293.97 kHz
OBW Power
99.00 %
x dB Bandwidth
78.73 MHz
x dB
-20.00 dB
MSG
STATUS
Span
Span
100.00 MHz
Full Span
Last Span

5. TEST SETUP PHOTO





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