FCC Test Report (WLAN)

Report No.:	RF150226E05E
FCC ID:	PPD-QCA9008-TBD1
Test Model:	QCA9008-TBD1
Received Date:	May 23, 2017
Test Date:	June 02, 2017
Issued Date:	June 07, 2017
Applicant:	Qualcomm Atheros, Inc.
Address:	1700 Technology Drive, San Jose, CA 95110
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
Test Location (1):	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, 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.

Testing Laboratory
2022

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Release Control Record

Issue No.	Description	Date Issued
RF150226E05E	Original release.	June 07, 2017

1 Certificate of Conformity

Product:	802.11abgn/ac/ad+BT module
Brand:	Qualcomm Atheros
Test Model:	QCA9008-TBD1
Sample Status:	ENGINEERING SAMPLE
Applicant:	Qualcomm Atheros, Inc.
Test Date:	June 02, 2017
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10: 2013

The above equipment 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:** June 07, 2017

Claire Kuan / Specialist

Approved by : _____ , **Date:** June 07, 2017

May Chen / Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.247(b)	Conducted power	PASS	Meet the requirement of limit.

NOTE:

1. This report is prepared for FCC Class II change. Only Peak Transmit Power Measurement was presented in this test report.

2.1 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	802.11abgn/ac/ad+BT module
Brand	Qualcomm Atheros
Test Model	QCA9008-TBD1
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	DC 3.3V from host equipment
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 11ac mode and VHT (20/40) mode in 2.4GHz
Modulation Technology	DSSS,OFDM
Transfer Rate	802.11b: up to 11Mbps 802.11a/g: up to 54Mbps 802.11n : up to 300Mbps 802.11ac: up to 866.7Mbps
Operating Frequency	For 15.407 5.18 ~ 5.24GHz, 5.26 ~ 5.32GHz, 5.50 ~ 5.72GHz, 5.745 ~ 5.825GHz For 15.247 2.412 ~ 2.472GHz
Number of Channel	For 15.407 25 for 802.11a, 802.11n (HT20), 802.11ac (VHT20) 12 for 802.11n (HT40), 802.11ac (VHT40) 6 for 802.11ac (VHT80) For 15.247 13 for 802.11b/g, 802.11n (HT20), VHT20 9 for 802.11n (HT40), VHT40
Output Power	For 15.407 802.11a: 69.281mW 802.11ac (VHT20): 72.767mW 802.11ac (VHT40): 56.034mW 802.11ac (VHT80): 35.575mW For 15.247 802.11b: 279.918mW 802.11g: 422.415mW VHT20: 424.648mW VHT40: 401.871mW
Antenna Type	See item 3.2
Antenna Connector	See item 3.2
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. This report is prepared for FCC Class II change. The difference compared with the Report No.: RF150226E05 design is as the following information:

   ◆ Add one new antenna as following table:

Original									
Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	2.4GHz Cable Loss (dBi)	5GHz Cable Loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)	WNC	81-EBJ15.005	PIFA	3.00	5.15~5.35GHz: 2.56 5.47~5.725GHz: 4.76 5.725~5.85GHz: 4.76	1.15	5.15~5.35GHz: 1.70 5.47~5.725GHz: 1.74 5.725~5.85GHz: 1.79	IPEX	300
Chain (1)	WNC	81-EBJ15.005	PIFA	3.62	5.15~5.35GHz: 3.08 5.47~5.725GHz: 3.31 5.725~5.85GHz: 2.42	1.15	5.15~5.35GHz: 1.70 5.47~5.725GHz: 1.74 5.725~5.85GHz: 1.79	IPEX	300

Newly							
Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)	INPAQ	DAM-J7-H-DL-065-10-34	Dipole	1.94	1.37	SMA RP Plug	625
Chain (1)	INPAQ	DAM-J7-H-DL-065-10-34	Dipole	1.94	1.37	SMA RP Plug	625

Note: 1. Above antenna gains of antenna are Total (H+V).

2. According to above condition, only Peak Transmit Power test items need to be performed. And all data were verified to meet the requirements.
3. There are Bluetooth technology and WLAN (2.4GHz, 5GHz & 60GHz) technology used for the EUT.

4. The EUT incorporates a 2T2R function.

2.4GHz Band			
MODULATION MODE	**DATA RATE (MCS)**	**TX & RX CONFIGURATION**	
802.11b	1 ~ 11Mbps	2TX	2RX
802.11g	6 ~ 54Mbps	2TX	2RX
802.11n (HT20)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
VHT20	MCS 0~8, Nss=1	2TX	2RX
	MCS 0~8, Nss=2	2TX	2RX
VHT40	MCS 0~9, Nss=1	2TX	2RX
	MCS 0~9, Nss=2	2TX	2RX
5GHz Band			
MODULATION MODE	**DATA RATE (MCS)**	**TX & RX CONFIGURATION**	
802.11a	6 ~ 54Mbps	2TX	2RX
802.11n (HT20)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11ac (VHT20)	MCS 0~8, Nss=1	2TX	2RX
	MCS 0~8, Nss=2	2TX	2RX
802.11ac (VHT40)	MCS 0~9, Nss=1	2TX	2RX
	MCS 0~9, Nss=2	2TX	2RX
802.11ac (VHT80)	MCS 0~9, Nss=1	2TX	2RX
	MCS 0~9, Nss=2	2TX	2RX

Note: The modulation and bandwidth are similar for 802.11n mode for 20MHz (40MHz) and 802.11ac mode for 20MHz (40MHz), therefore investigated worst case to representative mode in test report. (Final test mode refer section 3.3.1)

5. The EUT was pre-tested under the following modes:

Test Mode	**Data rate**
Mode A	400ns GI
Mode B	**800ns GI**

From the above modes, the worst case was found in **Mode B**. Therefore only the test data of the mode was recorded in this report.

6. WLAN/BT coexistence mode:

- 2x2 WLAN + BT:
  - 5GHz 802.11a/an (or 11ac) transmit concurrent with BT.
  - 2.4GHz: timely shared coexistence. (2.4GHz & BT technology can't transmit at same time.)
  - 2.4GHz & 5GHz technology can't transmit at same time.

7. The emission (conducted & radiated emission) of the simultaneous operation (WiFi <5GHz> & Bluetooth) have been evaluated and no non-compliance found. The detail combinations of transmitters / frequencies / modes as below table

Mode	Available Channel	Tested Channel	Modulation Technology
5 GHz (802.11a) + Bluetooth (GFSK)	36 to 165	157	OFDM
	0 to 78	0	FHSS

8. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Antenna

The antenna gain was declared by client; please refer to the following table:

Original									
Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	2.4GHz Cable Loss (dBi)	5GHz Cable Loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)	WNC	81-EBJ15.005	PIFA	3.00	5.15~5.35GHz: 2.56 5.47~5.725GHz: 4.76 5.725~5.85GHz: 4.76	1.15	5.15~5.35GHz: 1.70 5.47~5.725GHz: 1.74 5.725~5.85GHz: 1.79	IPEX	300
Chain (1)	WNC	81-EBJ15.005	PIFA	3.62	5.15~5.35GHz: 3.08 5.47~5.725GHz: 3.31 5.725~5.85GHz: 2.42	1.15	5.15~5.35GHz: 1.70 5.47~5.725GHz: 1.74 5.725~5.85GHz: 1.79	IPEX	300

Newly							
Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)	INPAQ	DAM-J7-H-DL-065-10-34	Dipole	1.94	1.37	SMA RP Plug	625
Chain (1)	INPAQ	DAM-J7-H-DL-065-10-34	Dipole	1.94	1.37	SMA RP Plug	625

Note: 1. Above antenna gains of antenna are Total (H+V).

For testing, we select the highest gain on each frequency band for calculation and testing
The detail information as below:

Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	2.4GHz Cable Loss (dBi)	5GHz Cable Loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)+(1)	WNC	81-EBJ15.005	PIFA	3.62	5.15~5.35GHz: 3.08 5.47~5.725GHz: 4.76 5.725~5.85GHz: 4.76	1.15	5.15~5.35GHz: 1.70 5.47~5.725GHz: 1.74 5.725~5.85GHz: 1.79	IPEX	300

3.3 Description of Test Modes

13 channels are provided for 802.11b, 802.11g and 802.11n (HT20), VHT20:

Channel	Frequency	Channel	Frequency
1	2412MHz	8	2447MHz
2	2417MHz	9	2452MHz
3	2422MHz	10	2457MHz
4	2427MHz	11	2462MHz
5	2432MHz	12	2467MHz
6	2437MHz	13	2472MHz
7	2442MHz		

9 channels are provided for 802.11n (HT40), VHT40:

Channel	Frequency	Channel	Frequency
3	2422MHz	8	2447MHz
4	2427MHz	9	2452MHz
5	2432MHz	10	2457MHz
6	2437MHz	11	2462MHz
7	2442MHz		

3.3.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO	DESCRIPTION
	APCM	
-	√	-

Where **APCM:** Antenna Port Conducted Measurement **RE<1G:** Radiated Emission below 1GHz

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	DATA RATE (Mbps)
802.11b	1 to 13	1, 6, 11, 12, 13	DSSS	1
802.11g	1 to 13	1, 6, 11, 12, 13	OFDM	6
VHT20	1 to 13	1, 6, 11, 12, 13	OFDM	6.5
VHT40	3 to 11	3, 6, 9, 10, 11	OFDM	13.5

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (System)	TESTED BY
APCM	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen

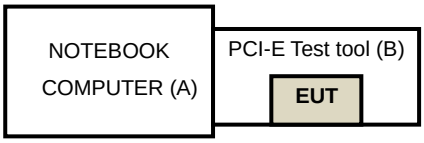
3.4 Description of Support Units

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	Remark
A	NOTEBOOK COMPUTER	Lenovo	0769	NA	NA	Supplied by Client
B	PCI-E Test tool	Qualcomm Atheros	NA	NA	NA	Supplied by Client

NOTE: All power cords of the above support units are non-shielded (1.8 m).

3.4.1 Configuration of System under Test



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 C (15.247)
KDB 558074 D01 DTS Meas Guidance v03r05
KDB 662911 D01 Multiple Transmitter Output v02r01
ANSI C63.10-2013

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

4 Test Types and Results

4.1 Conducted Output Power Measurement

4.1.1 Limits of Conducted Output Power Measurement

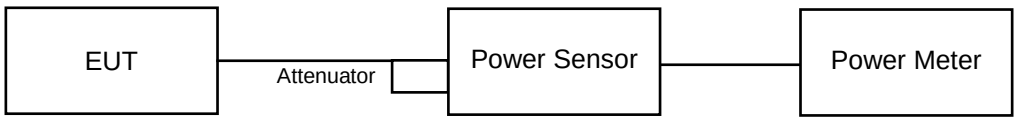
For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = 10 log(N_{ANT}/N_{SS}) dB.

4.1.2 Test Setup



4.1.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Power meter Anritsu	ML2495A	1014008	May 11, 2017	May 10, 2018
Power sensor Anritsu	MA2411B	0917122	May 11, 2017	May 10, 2018

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 : June 02, 2017

4.1.4 Test Procedures

A peak / average power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak / average power sensor. Record the power level.

4.1.5 Deviation from Test Standard

No deviation.

4.1.6 EUT Operating Conditions

The software (QCRT-CONN30033.exe) provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.1.7 Test Results

FOR PEAK POWER

802.11b

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.86	20.74	240.476	23.81	29.37	Pass
6	2437	21.47	21.45	279.918	24.47	29.37	Pass
11	2462	21.22	21.11	261.556	24.18	29.37	Pass
12	2467	17.95	17.02	112.723	20.52	29.37	Pass
13	2472	13.28	12.48	38.982	15.91	29.37	Pass

NOTE: Directional gain = 3.62dBi + 10log(2) = 6.63dBi > 6dBi , so the power limit shall be reduced to 30-(6.63-6) = 29.37dBm.

802.11g

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	21.01	20.18	230.415	23.63	29.37	Pass
6	2437	23.38	23.11	422.415	26.26	29.37	Pass
11	2462	19.92	19.93	196.576	22.94	29.37	Pass
12	2467	16.94	16.53	94.409	19.75	29.37	Pass
13	2472	8.11	7.34	11.891	10.75	29.37	Pass

NOTE: Directional gain = 3.62dBi + 10log(2) = 6.63dBi > 6dBi , so the power limit shall be reduced to 30-(6.63-6) = 29.37dBm.

VHT20

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.28	19.26	190.993	22.81	29.37	Pass
6	2437	23.27	23.27	424.648	26.28	29.37	Pass
11	2462	19.11	18.98	160.538	22.06	29.37	Pass
12	2467	17.00	16.43	94.073	19.73	29.37	Pass
13	2472	6.38	6.28	8.591	9.34	29.37	Pass

NOTE: Directional gain = 3.62dBi + 10log(2) = 6.63dBi > 6dBi , so the power limit shall be reduced to 30-(6.63-6) = 29.37dBm.

VHT40

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	18.46	18.02	133.533	21.26	29.37	Pass
6	2437	23.10	22.96	401.871	26.04	29.37	Pass
9	2452	17.19	17.32	106.311	20.27	29.37	Pass
10	2457	15.32	15.09	66.326	18.22	29.37	Pass
11	2462	7.44	7.31	10.929	10.39	29.37	Pass

NOTE: Directional gain = 3.62dBi + 10log(2) = 6.63dBi > 6dBi , so the power limit shall be reduced to 30-(6.63-6) = 29.37dBm.

FOR AVERAGE POWER

802.11b

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	18.64	18.38	141.979	21.52
6	2437	19.22	19.66	176.03	22.46
11	2462	19.19	19.14	165.02	22.18
12	2467	15.47	14.78	65.298	18.15
13	2472	10.95	10.14	22.773	13.57

802.11g

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	15.42	14.76	64.757	18.11
6	2437	18.57	18.43	141.608	21.51
11	2462	14.03	13.82	49.392	16.94
12	2467	11.01	10.63	24.179	13.83
13	2472	1.74	1.19	2.808	4.48

VHT20

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	14.20	13.60	49.212	16.92
6	2437	18.06	18.98	143.041	21.55
11	2462	13.10	13.04	40.554	16.08
12	2467	11.02	10.43	23.688	13.75
13	2472	0.31	0.23	2.128	3.28

VHT40

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	12.42	12.00	33.307	15.23
6	2437	16.28	16.34	85.515	19.32
9	2452	11.00	11.02	25.236	14.02
10	2457	9.15	8.46	15.237	11.83
11	2462	1.15	0.82	2.511	4.00

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – 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:

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

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